

## GENETICAL SOCIETY OF GREAT BRITAIN

ABSTRACTS of Papers read at the HUNDRED AND FORTY-THIRD MEETING of the Society held on 15th and 16th NOVEMBER 1963, at the MIDDLESEX HOSPITAL MEDICAL SCHOOL, LONDON, W.1.

### RESISTANCE MUTANTS OF *ASPERGILLUS NIDULANS*

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Strains have been selected, each mutant for a different single gene, which are resistant to actidione (*Act.*), *para*-flouro-phenylalanine (*pf*), teoquil (*te*), iodo-acetate (*Iod*) or malachite green (*mg*). Some alleles have been firmly, others tentatively located. The *pf* mutants are probably allelic with those independently studied by Morpurgo. Attempts to find non-genic adaptation to malachite green or teoquil were unsuccessful.

Dominance, cross-resistance patterns and nutritional and genic interactions have been studied. *Act1* and *Iod1* are semi-dominant in diploids, the other mutant alleles are recessive. *mg1* determines resistance also to acriflavine to about the same degree as the non-allelic *acr2*. These alleles are not additive, however. *pf21* confers cross-resistance to iodo-acetate and suppresses requirement for nicotinic acid (*nicB*). *Iod1* strains, which are not resistant to fluoroacetate, are able to use acetate as sole carbon source. All the mutations provide good markers except *te*; resistance *versus* sensitivity is easily determined for conidia, but the mycelia of *te* and "sensitive" strains are relatively highly resistant.

Heterokaryons between *Act1* and sensitive strains show a gradual (and reversible) increase of the *Act* component on increasing actidione concentrations. Ultimately, a plateau is reached which presumably represents the nutritional limits of each particular combination of nutritional mutants.

### A TRANSLOCATION AFFECTING MORPHOLOGY IN *ASPERGILLUS NIDULANS*

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Crosses between certain morphologically normal strains of *Aspergillus nidulans* have given rise to a morphologically abnormal type. This type, designated "crinkled", comprised 1/3 of the total segregants. Examination of the pedigrees of the original strains showed that one parent in each cross was related to strains known to have translocation T III-VIII (Käfer 1962, *Genetica*, 33, 59-68). Backcrosses of crinkleds to translocated and untranslocated strains yielded 1:1 ratios.

It is suggested that the translocation is unequal and that reassortment of chromosomes results in a deficient class, which is inviable, and a crinkled class with the longer chromosome region in duplicate.

In a cross involving the segregation of a gene for sulphite requirement, *s1*, certain crinkled segregants have been shown to be heterozygous for this marker. Crinkled revertants, isolated independently from a single *s1/s1* + crinkled, differed in their response to sulphite; 3 were *s1* and 1 was *s1* +. Relevant crosses with these revertants have suggested that the reversion is due to a suppressor which is located on or near either member of the duplicated segment.

It is possible that the suppressor corrects the effects of the duplication by suppressing one of the chromosome segments involved in the translocation.

HETEROKARYOSIS IN *ASPERGILLUS NIDULANS*

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There are still unresolved problems concerned both with the maintenance of the heterokaryotic state under uniform conditions and with the adjustment of overall nuclear ratio in heterokaryotic adaptation to environmental change. The main difficulty in seeking definitive answers has been the inability to make microscopic characterisation and counts of the two nuclear types in a heterokaryon.

A direct approach to the first problem has now been made using fluorescence microscopy in an attempt to distinguish, by size, nuclei in heterokaryons formed between diploid and haploid strains. Homokaryotic controls showed that the average sizes of nuclei in haploids, diploids and triploids are approximately in a ratio of 1:2:3. It was also found that the volume of cytoplasm per nucleus varies similarly, although the size of cells is unaltered.

However, variation in nuclear size within a strain prevented unequivocal characterisation of individual nuclei in haploid-diploid heterokaryons. Nevertheless, extensive analyses of hyphae at the growing edge of a heterokaryon showed that certain heterokaryons had substantial variation of nuclear ratio from hypha to hypha.

These results suggest that, at least in *A. nidulans*, a heterokaryon comprises a group of micro-populations, with different and changing nuclear ratios, which compete for effective contribution to new growth.

## SOMATIC SEGREGATION IN POTATOES

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A tuber colour pattern called "spectacle" in the potatoes is known in both diploid and tetraploid cultivars. In the diploids it is determined genetically by the heterozygote  $Ii^{sp}$  in which colour is eliminated around the eyes, giving white patches on a coloured ground.  $II$  is self-coloured,  $i^{sp}i^{sp}$  white. Clones having a weak expression of spectacle sometimes produce some self-coloured tubers and the two phenotypes, self-coloured and spectacle, in vegetative progeny tend to reproduce their like. Thus somatic segregation may be said to occur and selection at the vegetative level is effective, even to the apparent extinction of the spectacle phenotype.

INSTABILITY AT THE *PAL* LOCUS OF  
*ANTIRRHINUM MAJUS*

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The unstable allele *pallida-recurrens* ( $pal^{rec}$ ) mutates with high frequency to the stable dominant allele *Pal*, giving red spots and flakes on otherwise acyanic flowers. The mutation frequency in the corolla is strongly dependent on environment; in plants grown at 25° with 8 hour days the spot frequency was of the order of a thousand times lower than in plants of the same clone grown at 15° with 16 hour days. By suitably timed environmental shifts mutation can be induced or inhibited at any stage of corolla development. Mutations also occur among the germ cells, and the germinal mutation is similarly dependent on environment.

The mutation frequency is also dependent on genotype, though the number of genetic loci involved in the control of mutability has not yet been determined. In a genetic background giving a relatively high mutation frequency, and in the

15° environment, somatic and germinal mutations occur with high frequency not only to *Pal* but also to a range of phenotypes resembling those given by other known alleles of the *pal* series. In other genetic backgrounds and in the 25° environment *pal<sup>r</sup>00* can be highly stable.

## IMMUNOLOGICAL STUDIES OF GLUTAMATE DEHYDROGENASE AND MUTANT FORMS OF THE PROTEIN IN *NEUROSPORA CRASSA*

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A survey has been made of the immunological relationships between glutamate dehydrogenase and the related proteins of the amination deficient mutants in *Neurospora crassa*. Serum against wild-type glutamate dehydrogenase has been prepared and the effect of this serum on the activity of the wild-type enzyme and the activity of activated mutant proteins has been studied. In addition the techniques of double diffusion in agar gel and of immunoelectrophoresis were used to study the relationships between the mutant proteins and the wild-type protein. A specific strain has been used to identify the relevant precipitation line on the plates; the plates have also been used to show that the precipitation line for alanine dehydrogenase is the same as the precipitation line for glutamate dehydrogenase. The results will be discussed considering the effect of the mutation, which causes the loss of normal enzyme activity, on the antigenic properties of the mutant protein.

## EVIDENCE FOR SEQUENTIAL RECOMBINATION AND REPLICATION IN SYNCHRONOUSLY DIVIDING CELLS OF *USTILAGO MAYDIS*

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A method is now available for synchronising the division of populations of cells of the smut fungus *Ustilago maydis*. In experiments carried out with a diploid strain heterozygous for several biochemical markers, samples of cells were removed at intervals through the synchronised division cycle and treated with a constant dose of ultraviolet light. Cell survival and the frequency of the various recombinants resulting from induced mitotic crossing-over were recorded. In addition the period of DNA synthesis in the non-irradiated population has been measured and found to occupy about one-quarter of the division cycle. During this period the cells are very sensitive to ultraviolet light and those that survive contain the highest proportion of induced recombinants. Cells which are irradiated early in the period of genetic replication show most crossing-over towards the end of the chromosome arms, whilst cells which are irradiated late in this period show crossing-over near the centromere. The data are most easily interpreted by supposing that chromosome replication begins at the end of the arms and proceeds to the centromere, and that the temporary interruption of this process by ultraviolet light can result in pairing and crossing-over in the vicinity of the points of interruption.

## RNA AND PROTEIN BIOSYNTHESIS DURING MEIOSIS

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Using tritiated precursors the patterns of RNA and protein synthesis are being followed autoradiographically during male meiosis in Orthopteran gonads. Particular attention is being paid to the lampbrush nature of prophase chromosomes and to the allocyclic behaviour of the sex univalent.

## THE INFLUENCE OF NUTRITIONAL VARIABLES ON THE PENETRANCE AND EXPRESSIVITY OF *EYELESS*

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In homozygous strains of *eyeless*, penetrance and expressivity are different among the flies of successive daily hatches from normal yeasted cultures. Data will be presented to show that this is not a consequence of the crowding of the larvæ, but is due to a qualitative change in the food available to them. Tests on germ-free, defined diets show that of the vitamins only folic acid and biotin affect eye size, and deficiencies of both cause eyes to be smaller. Among the major nutrients, casein and RNA are effective. Eye size increases in proportion to the amount of casein provided even when the quantity is in excess of the developmental optimum. Eye size also increases with increasing RNA up to 0.1 per cent. (development optimum 0.4 per cent. RNA) but declines when more is supplied. Although eye size is doubled on 0.1 per cent. RNA, it is not possible to make all adults phenotypically wildtype, apparently because the gene causes some eye reduction during embryonic development. The results are relevant to current concepts of penetrance and expressivity.

## A SEARCH FOR SIMPLE METABOLIC DEFICIENCY AMONG POTATO MUTANTS

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The cultivated diploid potatoes are outbreeders and their populations contain a number of deleterious recessives that are revealed by inbreeding. Twelve mutants, together with abnormal segregates characteristic of a certain diploid F<sub>1</sub> hybrid family were variously tested in attempts to identify the metabolic defects from which they suffered. The methods used were spraying of nutrients (amino acids, bases, vitamins, minerals) and grafting. None of the mutants responded to these treatments but one, a dwarf with short internodes, gave evidence of gibberellic-acid deficiency. An attempt to screen out metabolically defective mutants by selecting the weakest plants from a large mass of diploid seedlings also failed.

## SOME ASPECTS OF A STUDY OF CHILDHOOD DEAFNESS

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Profound perceptive deafness in childhood is a very heterogenous entity. In at least 50 per cent. of cases the ætiology is of genetical interest. A number of recessive syndromes exist, in many of which distinctive clinical associations with deafness occur. Sex-linked and dominant forms are also found, the latter often with disorders of pigmentation. In some cases of uncertain ætiology deafness is part of a complex congenital malformation.

Because of educational and social segregation of those with childhood deafness, marriages occur almost exclusively with the deaf community. The resultant mating patterns produce situations which bear some resemblance to experimental breeding.

GENETIC CONTROL OF GERMINATION AND  
EARLY SEEDLING GROWTH IN TOMATOW. J. WHITTINGTON, J. CHILDS, J. HOW and J. M. HARTRIDGE  
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Two species of tomato *Lycopersion esculentum* var. Potentate (E) and *L. pimpinellifolium* (P) differ in their seed size and also in their time of germination. The cultivated variety (E) has the larger seed size and has been found to germinate later than (P). A study will be reported in which time to germination was followed in these parents, their reciprocal hybrids and backcross, second backcross and F<sub>2</sub> and F<sub>3</sub> generations. The early seedling growth of the parents and F<sub>1</sub> hybrids will also be discussed in relation to their initial differences in embryo size and the results of both studies will be considered in terms of the physiological basis of hybrid vigour.

GENE ACTION AND INTERACTION IN THE CONTROL OF METRIC  
TRAITS IN CHICKENS AND MICEJ. R. MORTON  
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The method of analysis (Morton and O'Donald, *Heredity*, 1962, 17, 553) used comparisons of the means of various generations derived by crossing two inbred lines.

In mice the characters studied were tail length and body weight at 2, 4 and 6 weeks of age; in chickens shank length and body weight at maturity (20 weeks) and autumn and spring egg weight.

In chickens shank length, a linear measure of body size not obviously related to fitness, was controlled by additive interaction and additive effects, while by contrast egg weight, a trait with a definite relation to reproductive fitness, was primarily determined by dominant interaction and dominant effects.

During the growth of male mice there was a change, in both measures of body size, from dominant interaction to dominance to additivity. This change was much less noticeable in females.

It is suggested that body size is an important component of fitness in young mice but declines in importance in males as maturity is reached.

HATCHABILITY EFFECTS ASSOCIATED WITH THREE EGG-WHITE  
LOCI IN CHICKENSJ. R. MORTON, D. G. GILMOUR, E. M. McDERMID and A. L. OGDEN  
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and Animal Health Trust Livestock Research Station, Stock*

A commercial strain of Light Sussex chickens is segregating for three loci controlling composition of the egg white, namely, loci II and III of Lush, and the conalbumin-transferrin (*Tf*) locus of Ogden *et al.* Analyses were made of the relation between the egg-white genotypes of 175 pure-breeding dams and the hatchability of fertile eggs laid by them. Total hatchability was subdivided into four component periods of incubation in accordance with the peaks of mortality found in the data. Loci II and III had additive effects in two periods, III and *Tf* showed epistasis in one of these two, but over the whole period no simple effects could be demonstrated.

## GENETIC STUDIES OF LUNG TUMOURS IN MICE

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The injection of urethane induces multiple tumour-nodules in the lungs of mice, and the number of tumours induced by a standard dose can be used as a measure of the susceptibility of individual mice. The variation of susceptibility can thus be subjected to genetic analysis as a quantitative character. The variance of two random-bred strains were partitioned by means of offspring-parent regressions and by comparison with the mean variance of six inbred strains and their  $F_1$ s (Falconer and Bloom, 1962, *Brit. J. Cancer*, 16: 665-685). In one strain 74 per cent. of the variance of tumour-number was genetically determined, 49 per cent. being additive and 25 per cent. non-additive genetic variance. This strain was then subjected to selection for high and for low tumour-number. The responses obtained followed very closely the rate predicted from the estimated heritability of 49 per cent. The high-tumour strain after eight generations of selection reached a mean susceptibility exceeding that of the most susceptible of the available inbred strains (A-strain). Though the variation of tumour-number in the random-bred strains gave every indication of being polygenic, a major gene difference between the most and the least susceptible of the six inbred strains (A/Fa and C<sub>57</sub>BL/Fa) was found. This gene accounts for three-quarters of the difference in tumour-number between the two strains.