GENETICAL SOCIETY OF GREAT BRITAIN

ABSTRACTS of Papers read at the HUNDRED AND THIRTIETH MEETING of the Society held on 16th and 17th JULY 1959, in DUNDEE under the auspices of the Scottish Horticultural Research Institute

PHENOPLOIDY AND THE DISTRIBUTION OF EUROPEAN AND BRITISH BLACKBERRIES (*RUBUS FRUTICOSUS AGG.*)

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The changes in proportion of the various sub-sections of apomictic polyploid *Rubus* across Europe are demonstrated : the north-western countries have a higher frequency of simple forms of blackberries, whereas south-eastern countries, such as the Caucasus and Hungary, have a higher proportion of complex types.

The distribution of the 344 " species " of blackberries in Britain is analysed for the five sub-sections, being based upon Watson's posthumously published data. The centre of diversity in south-east England is demonstrated ; this may be related to the proximity with the Continent, or to greater numbers of botanists in this area. The general pattern of distribution appears to reflect the limits of glaciation, with the diversity of species north of the original limits of glaciation falling off very rapidly. The relation between taxonomy and scarcity indicates that the sub-sections with the simpler types are less restricted in their distribution than the sub-sections of complex forms.

The relative abundance of *Rubus* species in Great Britain will be demonstrated. The number of species plotted against the vice-comital frequency shows a log series. The number of species per vice-county grouped in geometric X_3 classes shows a close fit with the theoretical Poisson distribution.

The basis for the variation in these apomictic polyploid *Rubi* will be considered in relation to the cytological origin of the apomictic mechanism.

PROBLEMS IN BREEDING BRUSSELS SPROUTS (*BRASSICA OLERACEA GEMMIFERA*) AT MYLNEFIELD

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The aim of the Brussels sprout breeding work is to produce uniform strains adapted to the Scottish climate. This is being attempted by selection and controlled pollination to combine the desirable characters of several strains, *e.g.* large, firm and dark-coloured sprouts and resistance to lodging.

Some of the practical difficulties of this work will be discussed and the following special techniques used at Mylnefield will be described : (1) the routine technique for hand pollination, (2) the use of small honey bee colonies in artificially heated hives, (3) the use of ramets of selected clones, (4) the objective measurement of " sprout " firmness mechanically.

The possible use of male-sterile plants to produce F_1 hybrid seed of Brussels sprouts on a commercial scale will be discussed. Male sterile plants have been found, and the inheritance of this character is being studied. Preliminary experiments on the artificial induction of male sterility by chemical sprays have given promising results.

GENETICS AS AN AID TO THE CONTROL OF PLANT VIRUS INFECTION

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The production of varieties of plants which resist, or are immune from, infection by viruses, or which escape infection because unpalatable to virus vectors, seems to offer the most lasting solution to the problem of controlling virus spread in the field. These possibilities seem not to have been fully explored by geneticists, particularly in the raspberry, where genes controlling immunity or resistance to aphid- and soil-borne viruses exist among commercial varieties.

SOME ASPECTS OF PLANT DISTRIBUTION IN BRITAIN

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Since Britain is a continental island of relatively recent origin, it is not surprising that its flora is closely allied to the flora of the European mainland, even although it is no more than an impoverished portion of that flora. Nevertheless, the time factor would appear to have been adequate to allow of the production of a number of endemic species such as *Primula scotica*, *Cochlearia micacea* and others. Apart from endemics, the bulk of our native flora may be resolved geographically into three major components, each of which, however, is capable of sub-division. These several elements will be briefly described and it will be shown that what is applicable to the flora of Britain as a whole may apply also to a more limited area such as Perthshire.

SOME PROBLEMS IN BREEDING STRAWBERRIES RESISTANT TO RED CORE DISEASE (*PHYTOPHTHORA FRAGARIAE* HICKMAN)

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Breeding for control of this disease has been proceeding for over 25 years. In applied work, testing is by field and bench methods. Susceptibles, when selfed, never produce resistants. Proportion of seedlings resistant in first test usually shows progressive increase of susceptibility in subsequent years. Selections resistant over many years may break down owing to attack by specialised physiological races of pathogen. Tolerants are now being produced which, while biologically susceptible, are field resistant. Octoploid *Fragariae* species have been used extensively. (R. D. R.)

Laboratory method of assessing susceptibility of seedlings and runners to physiologic races of *P. fragariae* is described. Results obtained by selfing named varieties and wild species of *Fragaria* indicate that it may be possible to increase the resistance of commercial varieties to this disease. Inconsistencies obtained in degree of infection in some of the material tested are discussed. (I. G. M.)

IN- AND OUT-BREEDING IN HIGHER FUNGI

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Work carried out over the past few years at Liverpool and St Andrews on the mating systems of species of *Coprinus*, *Hypholoma*, *Nidularia*, *Polyporus*, *Polystictus* and *Varraria*, will be reviewed in connection with the following topics (*a*) numbers and stability of mating-type factors in natural populations ; (*b*) size of breeding populations and nature of the mycelium ; (*c*) genetically imposed inbreeding.

MATING-TYPE FACTORS OF *POLYSTICTUS VERSICOLOR*

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The physiological genetics of fungal mating systems are little investigated and poorly understood. Using the tetrapolar fungus *Polystictus versicolor* the effects of different mating-type factors, in compatible matings, on (*a*) hyphal fusion ; (*b*) nuclear migration ; and (*c*) clamp connection formation, were investigated. The results will be described and a suggestion made concerning a model for gene action in connection with the formation of clamp connections.

THE RELATIVE ABUNDANCE AND BALANCE OF SPECIES IN WILD POPULATIONS

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The number of individuals in a species at any moment is a synthesis of all the effects of both biological and physical environment in the past, acting on the genetic make-up of that species. The relative abundance of all species in a wild population is the synthesis of all these syntheses, and through its very complexity, may become possible to analyse by statistical methods, particularly as there seems to be a general pattern common to most populations.

Samples from populations of many groups of animals, and insects, and also analyses of data from plant quadrats, have shown that in any wild population, consisting of a number of species, there are always more " rare " species with small numbers of individuals than " common " species with large numbers. The greater proportion of the individuals, however, belong to the few commonest species.

On an arithmetic scale the frequency distribution forms (in nearly all small samples) a hollow curve, which closely resembles a logarithmic series. For large samples, if the number of individuals per species are grouped on a geometric scale, the frequency distribution more closely resembles a " log-normal " distribution.

The sizes of genera, as measured by the number of species in each, also seem to follow the same general pattern.

Examples will be given and discussed. An attempt will be made to extend the reasoning to give a conceivable distribution in species of all the insects in the world. Also on the botanical side, to discuss the relation between area and number of species of flowering plants, from the smallest quadrats to the total area of the world.

ABSTRACTS of Papers read at the HUNDRED AND THIRTY-FIRST MEETING of the Society held on 13th and 14th NOVEMBER 1959, at UNIVERSITY COLLEGE, LONDON

A " LUXOID " MOUSE MUTANT WHICH LACKS THE SPLEEN

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Dominant hemimelia (*Dh*), 5 units from leaden in linkage group XIII, is very variable in the expression of its manifold effects. Heterozygotes may have a normal skeleton, but usually the pre-axial side of the hind-limb shows one or more of the following defects :—(i) elongation and triphalangy of the hallux, (ii) poly- or oligodactyly, often with syndactyly, (iii) tibial reduction, leading to fibular distortion and twisting of the leg, (iv) reduction of the femur, (v) reduction of the pubic element of the pelvic girdle. Homozygotes show severe pre-axial oligodactyly,

with loss of up to three digits ; hind-legs are small and twisted, with their skeletal elements greatly reduced. Fore-limbs are unaffected in both hetero- and homozygotes.

One constant visceral abnormality is of particular interest : both heterozygotes and homozygotes entirely lack the spleen. This happens even in some heterozygotes in which the skeleton is unaffected, suggesting that the spleen defect is a more basic one. Stomach size is also reduced, often very greatly in homozygotes, which also tend to lack the distal part of the gut. Homozygotes suffer from extreme hydronephrosis ; they may also lack the bladder and have a number of other visceral defects. They usually die a few days after birth.

The fertility of *Dh* heterozygotes seems unimpaired, despite the absence of a spleen. Preliminary results of developmental studies will be given.

PHYSIOLOGY AND BEHAVIOUR IN F_1 MICE SHOWING HETEROSIS

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F_1 mice derived from an A2G × C57BL cross have previously been shown to display greater heterosis in a cold environment than in a " normal " one (*J. exp. Genet.*, in press). Studies are now being made on various aspects of the physiology and behaviour of such heterotic mice. Traits which are being investigated include (*a*) aspects of " vigour " such as (i) activity, (ii) resting oxygen consumption and (iii) resistance to " stress " in the form of cold exposure, and (*b*) aspects of " energy " such as nest-building. Some account will be given of such observations as have yielded intelligible results by the date of the meeting.

GENETICS OF SOME BEHAVIOUR PATTERNS IN MICE

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A programme of comparison of behaviour of inbred strains of mice has shown significant differences in learning efficiency, voluntary alcohol consumption, and locomotor activity.

In the latter characteristic, two sublines of the C57BL strain are highly active, and two sublines of the A strain are very inactive. Comparison of activity measures under white and under red illumination suggests that part of the phenotypic difference is attributable to differences of the visual mechanism between the strains. Maternal effect appears negligible in view of the essential identity of results on reciprocal F_1s between C57BL/10 and A/Jax.

F_1 and F_2 backcross generations derived from C57BL/Crgl and A/Crgl have been tested. With a square root transformation of data to equate parent strain variance, the F_1 variance significantly exceeds that of the parents. Average partial dominance in the direction of high activity is indicated in that the F_1 mean exceeds the midparent value, the F_2 mean is lower than the F_1 mean and the variance of the backcross to C57BL is less than that of the backcross to A. Comparing the arithmetic mean of the variances of parent strains and F_1 with the variance of F_2 suggests the degree of genetic control to be approximately 70 per cent.

OBSERVATIONS ON MUTANTS OF *ASPERGILLUS NIDULANS* INDUCED BY MONOCHROMATIC ULTRA-VIOLET LIGHT

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An account of mutants obtained by irradiating dry conidiospores in the Uvispek monochromator is given. Wave-lengths in the regions 265 and 280 m/u were

mainly used and absorption in the spore was measured by the Hilger photomultiplier and recorder. Efficiency of mutation production corresponded to the absorption curve of protein rather than nucleic acid, the mutants scored being (*a*) lethals, (*b*) abnormal growth patterns, (*c*) colour changes in conidia, (*d*) biochemical requirement.

EFFECTS OF SEED TREATMENT WITH IONISING RADIATION IN THE GROUNDSEL PLANT (*SENECIO VULGARIS* L.)

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Dry seeds of groundsel were irradiated in the Cobalt 60 source of the Christy Hospital, Manchester, at dosages from 500 to 100,000 r units. Germination of irradiated seeds gave no clear indication of any lethal effect below the 50,000 r level. One dwarf and sterile seedling in the 100,000 r group survived for 92 days. One small distorted seedling in the 75,000 r group survived for 120 days, producing a sterile flower.

The effect of radiation on fertility began at about the 30,000 r level. In this group more than 25 per cent. of the plants were sterile. Another 25 per cent. were of low fertility with less than 4 seeds per head.

At dosages of 20,000 r and below, the number of seeds per head was not significantly different from the control.

Progenies from all plants in the 30,000 r and 50,000 r groups were grown. No abnormalities appeared in the X_1 generation, and none were observed in X_2 progenies of the 50,000 r group. In the X_2 generation of plants of the 30,000 r group various recessive abnormalities occurred and are described. One abnormal form exhibited a type of blending inheritance.

The results are discussed in the light of changes in genetical architecture which might be expected to result from irradiation. It is considered that the most important consequence of irradiation is the production of numerous mutational changes in modifier or minor gene systems, *i.e.* in the general genetical background. This would lead to greater adaptational possibilities and would explain cases of blending inheritance.

STRUCTURE OF THE MATE-KILLING (MU) PARTICLES IN *PARAMECIUM AURELIA*, VARIETY 1

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An account will be given of studies on these *mu* particles by electron microscopy, fluorescence microscopy, and ordinary optical methods. The main conclusion is that the particles have a complex differentiated structure which will be described. They do not appear to be exactly like any known group of organism, but most nearly resemble certain bacteria.

GENETIC ANALYSIS OF SOME CONSEQUENCES OF DISRUPTIVE SELECTION

J. B. GIBSON and J. M. THODAY
Sheffield and Cambridge

Thoday and Boam (*Heredity*, *13*, 205 (1959)) by disruptive selection for sternopleural chaeta-number in *D. melanogaster* produced a population polymorphic for second chromosomes of low chaeta-number effect and second chromosomes of average chaeta-number effect.

We have investigated these second chromosomes with the following results. (1) The " low " second chromosomes are homozygous lethal. (2) Females made homozygous for an " intermediate " chromosome, when crossed to *y bw/bw st/st* males of a standard stock give progeny with a chaeta-number variance of 2 and a normal distribution, but females made heterozygous for two separately extracted intermediate chromosomes give progeny with a variance of 5 and a bimodal distribution, because recombination produces about 20 per cent. of " recombinant low " chromosomes. There is no sign of the expected reciprocal recombinant high class. (3) The " recombinant low " chromosomes prove homozygous lethal and lethal in combination with the " low " chromosomes originally extracted. (4) The original " intermediate " chromosomes can be classified into two classes $+-$ and $-+$ by such recombination tests. The low chromosomes are $--$. (5) Tests among the progeny of $+-/-+$ females have not so far demonstrated $++$ recombinants. It seems likely that they are dominant lethal.

GENE-FLOW AND DIVERGENCE UNDER DISRUPTIVE SELECTION

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Sheffield and Cambridge

Thoday and Boam (*Heredity*, *13*, 205 (1959)) have shown that two halves of a population between which there is maximal gene exchange (50 per cent. gene-flow) can diverge under disruptive selection. Random mating involves 25 per cent. gene-flow and we have therefore run two 25 per cent. gene-flow populations under disruptive selection with positive assortative mating and, for comparison, two "populations" with 0 per cent. gene-flow between the two halves which were selected in opposite directions for sternopleural chaeta-number (*D. melanogaster*). Divergence with 25 per cent. gene-flow was slower than with complete isolation but its ultimate magnitude in these very small populations was of the same order. A line taken from one of the 25 per cent. gene-flow populations and put under a regime involving 25 per cent. gene flow with negative assortative mating also maintained a large difference between its high and low halves. This regime is the exact equivalent of random mating between two populations selected in opposite directions in the pre-reproductive lives of the component individuals and is a clear demonstration that random mating cannot prevent evolutionary divergence. These populations are now being analysed genetically.

THE BREEDING STRUCTURE OF A LITTORAL POPULATION

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In three analyses of a wild population of *Coelopa frigida* (Fab.) several recessive egg lethal factors were found to be repeated. The repetition was found to be due both to method of sampling and to finite population size. The method of testing allelism of the lethals makes use of the fact that a female must copulate before each clutch of eggs is laid, and involves no dependance on visible markers. After correction for sampling method the gene frequency estimates for these loci were found to exceed the frequency expected on the basis of the census population size, N_0. From shifts in the lethal gene frequencies the size of the effective breeding unit N_e has been calculated. The ratio $N_e/N_0 = 0{\cdot}2$, shows that in this wild population a wide discrepancy exists between the observed and effective sizes. There is a non-Poisson variation in clutch size. An estimate of the reduction in size of the effective unit from this cause on a hypothesis of random progeny survival is small, but reduction on a hypothesis of family unit survival is large and approaches the estimate from frequency shifts. The ecological structure of the population strongly favours the latter type of survival.

A MECHANISM FOR INTER-ALLELE COMPLEMENTATION

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In *Neurospora crassa* several mutants, assignable to the *am* locus, lack detectable glutamic dehydrogenase, yet two kinds of heterocaryons formed from such mutants (am^1+am^2 and am^1+am^3) have this enzyme activity. In each case the enzyme formed has been shown to be qualitatively different from wild type glutamic dehydrogenase, and the enzymes in the two heterocaryons are different from each other.

It is suggested that there are probably two distinct kinds of complementary interaction between mutants which may be encountered in studies of the genetic control of the structure of single enzymes : (*a*) inter-locus interaction, in cases where the enzyme consists of non-identical sub-units (e.g. *Escherichia coli* tryptophan synthetase) ; (*b*) intra-locus interaction (complementation), which may be pictured as occurring where the enzyme consists of normally identical sub-units, with the possibility that sub-units which are the products of different mutant alleles, and which are defective in different respects, may polymerise together to give a complex with some activity. Interaction of type (*a*) is expected to result in qualitatively normal enzyme, that of type (*b*) in more or less abnormal enzyme.

FLARE REACTIONS TO INTRADERMAL INJECTIONS OF XANTHOSINE AND CHYMOTRYPSIN

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Intradermal injections of 5-10 micrograms of the nucleoside xanthosine, though painful to everybody, produced flares only in about half of 400 people of all ages. Reactions of xanthine but not to other nucleosides were perfectly correlated to the xanthosine reaction, and 24 individuals produced flares to xanthosine and the enzyme chymotrypsine, while 9 did not react to either. Mepyramine maleate, an antihistaminic suppressed flaring by xanthosine or chymotrypsin and prednisolone modified it. The skin reactions of a number of people, among which were sufferers from skin diseases, to acetyl choline, histamine and histamine releasing substances and to xanthosine were tested. In males flaring was a constant attribute of the individual but in some females it varied with the menstrual cycle. In spite of this difficulty in classification the following figures give some indication of the genetical situation ; all 16 children of 7 unions of non-reacting parents failed to produce flares ; 10 children of 5 reactor unions produced flares, but one, a son, did not ; of 13 children from mixed unions, 10 produced flares and 11 did not. This indicates a strong familial tendency for flaring ; formulation of a special genetical hypothesis will depend on improvements in female classification and on additional volunteers for the test.

HUMAN ISONIAZID METABOLISM. A STUDY OF THE GENETIC ASPECTS

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It has been shown that human subjects metabolise isoniazid in two different ways. " Slow inactivators " (S) have a gradual fall in free isoniazid concentration in the blood following an oral dose, and considerable amounts of the free drug appear in the urine. In " rapid inactivators " (R) there is a more rapid fall of blood concentration of free isoniazid, and a smaller amount appears in the urine after the same oral dose has been taken.

291 unrelated subjects have been examined. A single oral dose of 10 mg. isoniazid per kg. body weight was given and the plasma concentration of free isoniazid determined thereafter using a biochemical technique. All subjects were scorable into either S or R and the Caucasians were found to be about 50 per cent. S. The occurrence of these two phenotypes was shown not to be significantly different in 128 tuberculous patients and 91 American Negro subjects. A study of 53 Caucasian families has yielded data consistent with the hypothesis that the characters are controlled by a pair of autosomal allelic genes, the phenotype S being recessive.

EVIDENCE FOR A DISTURBED SEGREGATION OF ECTRODACTYLY IN MAN

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In a study of members of a large family with ectrodactyly first described by Karl Pearson in 1908, it was realised that the excess of affected in offspring over affected on a simple dominant hypothesis, noted by Pearson, persisted after a further three generations had been added to the family.

It was further remarked that this was explained entirely by an excess of affected males, and that this phenomenon only applied to the offspring of affected fathers and not to the offspring of affected mothers.

Study of the literature revealed a marked disturbance of sex ratio of affected and analysis of pedigrees where no generations were missed in manifestation of the abnormality, and where there were recorded inheritance through at least three generations, suggests strongly that the pattern in the Pearson family is not unusual. Summation of data shows an excess of affected males from affected fathers significant at a 1 per cent. level.

Analogies with the " T " allele system in mice are discussed and some thoughts engendered by presumptive evidence of disturbed segregation in man are presented.

ABO BLOOD GROUPS AND SECRETOR CHARACTER IN RHEUMATIC CARDITIS

C. A. CLARKE, R. B. McCONNELL and P. M. SHEPPARD
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Data are presented of a series of 263 Liverpool patients suffering from rheumatic carditis. They show a significant reduction in the incidence of blood group O and a non-significant increase in non-secretors compared with controls. There is no heterogeneity with series of rheumatic fever patients from Taplow collected by Dr L. E. Glynn and his colleagues. Their data show a significant excess of non-secretors and a non-significant decrease in group O. On combining the results of the two investigations there is a significantly increased incidence of the disease both in those who are not group O ($\chi^2_1 = 8{\cdot}15$) and in those who are non-secretors ($\chi^2_1 = 6{\cdot}63$).

The levels of significance are very suggestive of there being a relationship between rheumatic fever and the ABO blood group antigens, but the collection of further data is indicated, not only of rheumatic fever but also of uncomplicated streptococcal throat infections and acute nephritis.