GENETICAL SOCIETY OF GREAT BRITAIN

ABSTRACTS of Papers read at the HUNDRED AND FORTY-FOURTH MEETING of the Society held on 24th and 25th MARCH 1964, in the DEPARTMENT OF BOTANY of the UNIVERSITY OF BRISTOL

POLARISED SEGREGATION IN ASCOMYCETES

B. C. LAMB
Genetics Laboratory, Department of Botany, University of Bristol

It is suggested that polarised segregation be defined as the non-random segregation of the members of a pair of homologous chromosomes or of a pair of daughter chromosomes with respect to the two poles of a spindle in meiosis. In those Ascomycetes with linearly arranged tetrads, polarised segregation at the first- and at the second-division spindles would lead to inequalities between the two first-division, and within the four second-division segregation classes, respectively, when a single pair of characters is segregating.

Preliminary experiments in *Neurospora crassa* with crosses of *asco* (37402) with wild-type have indicated that statistically significant inequalities, as described above, arise during the maturation of the asci and not during meiosis. The apparent polarisation seems to arise by preferential bursting of asci of certain of the ascal classes. There was also a significant decrease in the percentage of second-division segregation of *asco* with maturation of the asci. The relevance of these findings to rapid methods of tetrad analysis and a hypothesis to explain preferential bursting and its possible relationship to polarised segregation in Ascomycetes are discussed.

NON-DISJUNCTION AND ISO-CHROMOSOMES OF CHROMOSOME II IN *DROSOPHILA* INDUCED BY X-RAYS

A. J. BATEMAN
Paterson Laboratories, Manchester 20

Non-disjunction of chromosome II is being studied by mating irradiated females to males of a stock in which II is represented by two isochromosomes for the left and right arms respectively. All eggs produced by normal meiosis are lethal in such matings: only the exceptions survive.

Eggs with no II are eight to ten times as frequent as eggs with two II's. A third and unexpected category is eggs with an isochromosome for the left or right arm of II. This category is three times as common as eggs with two II's.

Attached-X, which would seem to be the equivalent condition for the X, is only rarely produced by irradiation. Evidence will be presented on the relative importance of asymmetrical exchange and misdivision of the centromere in the origin of iso-II.

XO/X ISO-CHROMOSOME X MOSAIC IN A HUMAN FEMALE

F. J. W. LEWIS and VALERIE MARRIAN
Departments of Pathology and Pædiatrics, Southmead Hospital, Bristol

A female infant, allegedly born without difficulty and at full term to normal young parents was found to have a spastic quadriplegia and minor somatic deformities. Cytological investigations including autoradiography show an apparent isochromosome of the long arm of XX/XO mosaic from cultures of venous blood, no abnormal

Barr bodies were found in oral cells but abnormal nuclear appendages were identified in peripheral blood leucocytes. No chromosomal abnormalities were found in the parents. One of the nine maternal sibs gave birth to a mongol at the age of 27.

The relationship of the physical and chromosomal abnormalities are discussed.

INDUCTION OF REPLICATION AT THE CHROMOSOME ORIGIN BY THYMINE STARVATION IN *ESCHERICHIA COLI*

R. H. PRITCHARD and K. G. LARK
Department of Physics, Kansas State University, Manhattan, Kansas, U.S.A.

It now seems clear that the chromosome of *E. coli* replicates sequentially as a unit. Recent evidence by Lark, Repko and Hoffman shows, in addition, that a cycle of replication is initiated at a unique site on the chromosome (here termed the " origin ") and that initiation of replication at such sites can be blocked by amino acid starvation. We have now found that thymine starvation alters the behaviour at these sites in a different way—it initiates a cycle of replication prematurely. Consequently, if a culture is starved of thymine and thymine subsequently restored replication continues from the existing growth point and, in addition, commences at the origin. The chromosome thus replicates from two points simultaneously. This abnormal situation is not lethal *per se* and is rectified after about one doubling period.

There is evidence in the literature to suggest that chromosome replication may be modified in an analogous way in other systems such as mammalian cells in culture. Exploitation of this sytem may therefore lead to an understanding of control of chromosome replication and cell division.

POLYGENIC CONTROL OF CORRELATED SEED AND TUBER DORMANCY IN THE CULTIVATED POTATOES

N. W. SIMMONDS
John Innes Institute, Bayfordbury, Hertford, Herts.

The two great cultivar groups among the South American potatoes are diploid ($2n = 24$) and autotetraploid ($2n = 48$); both are extremely variable in morphological characters, among them seed and tuber dormancy. Seed dormancy was estimated as the germination percentage of fresh seeds after four weeks in the petri dish; tuber dormancy by the number of days taken for sprouts to appear on tubers buried in moist peat in the glasshouse. Two selection experiments, one with diploids, the other with tetraploids, each yielded two lines having, respectively, high and low seed dormancy; on a family mean basis, tuber dormancy of the lines was highly correlated with seed dormancy and hybrid families were intermediate in both respects. The complementary test, comparison of the seed dormancies of various combinations of stocks known to differ in tuber dormancy, revealed the same correlation between the two dormancies which are thus inferred to have a common physiological basis. A diallel cross among the diploids suggested additive polygenic control of seed dormancy but with significant reciprocal effects. Implications for potato evolution and breeding will be discussed.

EXPERIMENTAL TAXONOMY OF *MENTHA*

R. M. HARLEY
Cytology Laboratory, Botany Department, Bristol University

Cytological studies and breeding work indicate that the spicate mints, which include the commercial spearmint, are diploid and tetraploid self-compatible

species. It is shown that crosses between species with the same chromosome number, whether diploid (2n = 24) or tetraploid, are highly fertile. Some of the possible implications of this with respect to the tetraploids *M. spicata* and *M. microphylla* are considered. Distinctive clones, often sterile and of hybrid origin, owe their wide distribution to the prevalence in *Mentha* of vegetative reproduction, as well as to cultivation. Recognition of many of these clones as species has caused confusion in the taxonomy of the group.

CHROMOSOME NUMBERS IN *HERNIARIA* FROM BRITAIN AND BRITTANY

L. C. FROST
Genetics Laboratory, Department of Botany, University of Bristol

Previous counts on *Herniaria glabra* L. had established the chromosome numbers n = 9 and 2n = 18; on *H. ciliolata* Melderis from Cornwall and Guernsey 2n = 72 and on *H. maritima* Link. from Portugal 2n = 108 (n = 63, possibly an error).

The present author has examined plants showing considerable micro-morphological variation from Cornwall and Guernsey by meiotic counts (PMCs). They have given n = 36 throughout. Plants collected in Brittany were morphologically variable and often intermediate between *H. ciliolata* and *H. maritima* but gave n = 54 in all cases. Material from Jersey, with little variation between plants, referable to *H. glabra* var. *subciliata* Bab. or *H. ciliolata* var. *angustifolia* (Pugsl.) Melderis has given consistently n = 54.

Besides the varietal difference, the Jersey plants are self-fertile unlike plants from Cornwall, Guernsey and Brittany which are self-sterile. Thus the Jersey population appears to have undergone evolutionary divergence on that island and the evidence at present available suggests that this " variety " with 2n = 108 may well be endemic to Jersey.

SYMPATRIC AND ALLOPATRIC SPECIATION, ILLUSTRATED BY GIANT CHROMOSOME STUDIES OF EIGHT CLOSELY RELATED BLACK FLIES IN THE *EUSIMULIUM AUREUM* GROUP (DIPTERA: SIMULIIDAE)

ROBERT W. DUNBAR
Zoology Department, University of Durham

The maintenance of heterogametic species as single interbreeding populations depends on any new mutation being first spread by " gene flow " and second, recombined by " crossing-over ". The division of a species by barriers into isolated populations prevents these two processes from operating between the isolates. Speciation could then result from the accumulation of different but mutually exclusive sets of mutations in each isolate. Allopatric speciation is achieved after physical barriers isolate populations of individuals (and therefore populations of chromosome complements). Sympatric speciation is achieved by chromosome barriers; cross-overs occurring between the opposed segments in inversion heterozygotes are lethal. The two opposed segments represent therefore isolated populations of chromosome material.

Where chromosomal rearrangements resulting from two or three inversions accompany speciation it is possible to predict the expected results, starting with the same inversions, invoking first allopatric, then sympatric speciation. With allopatric speciation any combination of homozygous and heterozygous inversions could be expected in any new species, but for sympatric speciation only certain combinations are possible. In the *aureum* group the observed giant chromosome rearrangements in all but one instance are restricted to those few combinations expected from sympatric speciation. These findings are used to show how the group evolved.

CHIASMA FREQUENCY, RECOMBINATION AND GENETIC DIVERGENCE IN PERENNIAL RYE-GRASS POPULATIONS

J. ROSEWEIR
Cytology Laboratory, Department of Botany, University of Bristol and Department of Agricultural Botany, University College of Wales, Aberystwyth

There is now ample evidence for the genotypic control of chromosome behaviour especially of chiasma frequencies. Heritable variation in chiasma frequencies in turn controls variation in the amount of recombination at meiosis. This determines the distribution of varying amounts of genetic variability among the offspring of the genotype and indeed of the population. It is to be expected that variation in the amount of genetic variability would be adjusted by selection with the result that different populations in different environments are adapted to different levels of variability.

Furthermore under conditions of an excess of hybridity, as in crosses between distantly related species, the genes which control meiotic chromosome behaviour may be unbalanced. Under these conditions abnormalities of the chromosome mechanism occur. Hence if there is genetic divergence within the species, crosses between different populations should show symptoms of genotypic unbalance.

A diallel cross between six widely distributed populations of perennial rye-grass confirmed these expectations. By this means it was possible (*a*) to assess the way in which the genes act and interact to control chromosome behaviour at meiosis, (*b*) to detect genetic divergence within the species and (*c*) to show that high levels of recombination are an adaptive feature of annual populations since there is a positive correlation between chiasma frequency and "annuality". This last discovery supports recent observations on experimental hybrid rye-grass populations and on different rye species. It is suggested that this pattern of variation may in fact be a widespread adaptive feature of natural populations.

SOME CHIMERICAL MUTANTS IN POTATOES

N. W. SIMMONDS
John Innes Institute, Bayfordbury, Hertford, Herts.

Many somatic mutants of Tuberosum group (tetraploid) potato cultivars are known; they affect a wide range of foliage and tuber characters. Some of them are known to become stabilised as periclinal chimeras; periclinal structure can be demonstrated by the removal of buds from tubers and subsequent growth of adventitious shoots from callus developed from underlying tissues. The results of trials with somatic mutants affecting foliage characters will be described. Five out of seven mutants tested gave evidence of periclinal structure; two did not.

PATERNAL PREDOMINANCE OF PLASTID INHERITANCE IN *PELARGONIUM ZONALE*

R. A. E. TILNEY-BASSETT
Botany School, Oxford

The chimera, Flower of Spring, normally has a white germ layer, but it can give green bud variations that have a green germ layer; the nucleus remains the same in the two. The isogenic, reciprocal crosses G × W and W × G give green, variegated and white offspring showing that plastids are contributed by both pollen and eggs. Unexpectedly, reciprocal crosses do not give reciprocal proportions of green and white offspring, instead most are green and the W × G cross gives twice as many variegated seedlings as the G × W.

Recent anatomical, breeding and fertility studies suggest that these observation can no longer be explained by a differential viability of white embryos. On the contrary, the proportions of offspring appear closely to reflect the different plastid contributions from the parents. This is quite contrary to a well established assumption of extra-nuclear inheritance, for it means that the male gamete of *Pelargonium* contributes more plastids than the female egg cell. Two further observations modify this relationship: firstly for either gamete there appear to be more green plastids than white, and secondly, the total number of plastids contributed by the two gametes is greater in the W × G cross than the G × W.

EGG WEIGHT, YOLK WEIGHT AND THE YOLK WEIGHT, EGG WEIGHT RATIO IN THE DOMESTIC HEN

W. P. JAFFE
School of Veterinary Science, University of Bristol

The most nutritious part of the egg is the yolk; yet breeders have directed their efforts to improving egg weight. To determine the effect this policy is likely to have on the nutritional quality of eggs, analyses of variance and covariance have been carried out on the above characters and the heritabilities as well as the phenotypic, genetic and environmental correlations between them have been determined.

Both egg weight and yolk weight have approximately the same heritabilities (around 50 per cent.), and a high positive genetic correlation. The yolk weight, egg weight ratio has a heritability of around 20 per cent. This figure is derived only from the sire component; there is a (so far unexplained) large negative dam component. The genetic correlation of this ratio with egg weight is large and negative.

It is concluded that the selection for egg weight will increase yolk weight nearly as much as direct selection for this character, although the yolk weight, egg weight ratio will decline. Selection for a more favourable ratio is tantamount to selecting for small eggs.

THE USE OF COMPUTER SIMULATION TECHNIQUES TO STUDY A POLYMORPHIC SITUATION

D. NASH, J. C. POWELL and E. M. McDERMID
Thornber Brothers Ltd., Mytholmroyd, Halifax, Yorks

An outbreeding population has been simulated on an electronic computer. Techniques similar to those described by J. L. Crosby were used to simulate meiosis, and a population structure has been developed around this model. The organism involved has two multiple allelic loci on separate chromosomes which show interaction, and a third locus linked to one of these two. By ascribing different selective values to alleles of the same gene at a number of stages of the life cycle, a polymorphic situation has developed over a number of generations of " natural " selection.