GENETICS SOCIETY OF AUSTRALIA

14TH ANNUAL GENERAL MEETING

UNIVERSITY OF MELBOURNE

13-14 JANUARY 1967

PROGRAMME

ABSTRACTS

CYTOGENETICS SYMPOSIUM
JOINTLY WITH ANZAAS SECTION D
16 JANUARY 1967

PROGRAMME

Meeting 14

GENETICS SOCIETY OF AUSTRALIA

Preliminary Notice

A meeting of this society will be held immediately prior to the Melbourne Congress of A.N.Z.A.A.S., January, 1967.

The meeting will consist of :-

1. Research or Review papers -
   Friday 13th and Saturday 14th January, 1967.

2. A Symposium on "Cytogenetics" to be held jointly with A.N.Z.A.A.S. Section D (Zoology), to be organised by Professor M.J.D.White on Monday 16th January.

3. A speaker (yet to be arranged) FRIDAY evening.

4. SOCIETY DINNER - SATURDAY EVENING

ACCOMODATION: It has been arranged that the Organizing Secretary of ANZAAS will arrange accomodation for members wishing to attend the meeting. (See under Affiliated Societies ANZAAS Circular Number 1. Contact your ANZAAS State Secretary if not yet received). Further details will appear in the next notice.

B.T.O. LEE,
HON. SECRETARY.

Meeting 14

GENETICS SOCIETY MEETING

1967

PROGRAMME

Meeting to be held in Harold Woodruff Theatre, School of Microbiology, University of Melbourne.

(see diagram for location)

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Papers to be 15 minutes + 5 minutes' discussion.

FRIDAY, JANUARY 13, 1967:

9.00 Opening Remarks: SECRETARY

9.10 W.R. SCOWCROFT (Division of Plant Industry, C.S.I.R.O.): "A Genetic Analysis of Scutellar Chaetae in Drosophila melanogaster".

9.25 Discussion.

9.30 A.& R. MESA (Genetics Dept., University of Melbourne): "Complex Sex Determining Mechanisms in Three Species of South American Grasshoppers".

9.45 Discussion.

9.50 D.ANGUS (Zoology Dept., University of Queensland): "~~Non Random Association of Inversions~~ in Drosophila tetrachaeta". Cytogenetics & Speciation

10.05 Discussion.

10.10 WHARTON B. MATHER (Zoology Dept., University of Queensland): "Inter-yearly Fluctuation of Drosophila rubida Inversion Polymorphism".

10.25 Discussion.

10.30 - 11.00 MORNING TEA.

11.00 Miss J.A. WALTHO (Div. Food Preservation, C.S.I.R.O.): "Fluorophenylalanine-resistance in Pseudomonas aeruginosa".

11.15 Discussion.

11.20 B.J. MEE (Dept. of Genetics, University of Melbourne): "The Gene Loci Controlling the Steps in the Biosynthesis of Histidine in Pseudomonas aeruginosa".

11.35 Discussion.

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11.40 Miss V.A. STANISICH (School of Microbiology, University of Melbourne): (with Dr. B. Holloway)
"Conjugation in Pseudomonas aeruginosa".

11.55 Discussion.

12.00 Miss S.M. TURNER (School of Microbiology, University of Melbourne),(with Dr. B. Holloway):
"Recombination deficient Mutants of Pseudomonas aeruginosa".

12.15 Discussion.

12.20 G.W. GRIGG (Division of Animal Genetics, C.S.I.R.O.):
"Molecular Mechanism of "spontaneous" Chromosome Breakage".

12.35 Discussion.

12.40 - 2.00 LUNCH.

2.00 - 3.00 PRESIDENTIAL ADDRESS: PROFESSOR D.G. CATCHESIDE.

3.00 - 3.20 AFTERNOON TEA.

3.20 R.N. ORAM (Division of Plant Industry, C.S.I.R.O.):
"Inheritance of Tryptamine Alkaloid Concentration and Composition in Phalaris tuberosa".

3.35 Discussion.

3.40 G.M.E. MAYO (Genetics Dept.,University of Adelaide), (with K.W. Shepherd):
"Aberrant Segregation in Flax".

3.55 Discussion.

4.00 MARGARET BLACKWOOD (Botany Dept., University of Melbourne):
"Effect of Temperature on Crossing-over in Maize".

4.15 Discussion.

4.20 R.B. KNOX (Botany Dept., A.N.U.):
"Climatic Control of the Breeding System in grasses of Andropogoneae".

4.35 Discussion.

4.40 C.R. GEARD & W.J. PEACOCK (Div. of Plant Industry, C.S.I.R.O.):
"Some Complexities of Chromosome Replication".

5.00 SESSION ENDS.

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EVENING: INVITED LECTURER: PROFESSOR R.A. BRINK (Univ.of Wisconsin):

7.30: "Paramutation a Directed Form of Genetic Change in Maize".

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SATURDAY, JANUARY 14, 1967:

PARALLEL SESSIONS (To be held in adjacent lecture theatres)

9.10	R. FRANKHAM (Dept. of Animal Hustbandry, University of Sydney): "Gene Action in Quantitative Inheritance".	C.B. GILLIES (Dept.of Agriculture, Univ. of Queensland): "Morphology and abnormalities of Pachytene Medicago Chromosomes".
9.25	Discussion	Discussion.
9.30	Miss S. HOSGOOD (Dept.of Genetics, University of Melbourne): "Genetic Heterogeneity for Behavioral Traits in Populations of Drosophila".	V. BAIMAI (Zoology Dept., University of Queensland): "Cytogenetic Studies of the Drosophila serrata comple
9.45	Discussion	Discussion.
9.50	J.H. CLAXTON (Dept.of Genetics, University of New England): "Tergite Bristle Patterns in Drosophila".	W.H. EWERS (Dept. of Zoology, A.N.U.): "Polymorphism in Velacumantus".
10.05	Discussion	Discussion.
~~10.10~~ 12-20	L.P. JONES (Dept. of ~~Animal~~ † BARKER Husbandry, University of Sydney): "Effect of Artificial Selection on Rate of Inbreeding in Populations of Drosophila".	K.W. SHEPHERD (Agronomy Dept., Waite Agricultural Research Institute, Glen Osmond): "Genetics of Endosperm Proteins in Wheat".
10.25	Discussion	Discussion.
	10.30 - 1100	MORNING TEA
11.00	J.W. JAMES (School of Wool Technology, University of N.S.W.): "Artificial Selection for Homozygous Lethals"	Mrs. Y.A.E. BICK (Zoology Dept., University of Tasman "Chromosomes and DNA Content of Monotremes".
11.15	Discussion	Discussion.

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11.20 A.K. SHERIDAN (Dept. of Animal Husbandry, University of Sydney):
"Two Trait Selection and the Genetic Correlation".

11.35 Discussion

11.40 D.E. ROBERTSON (School of Wool Technology, University of N.S.W.):
"Selection from Small Populations".

11.55 Discussion

12.00 R. FRANKHAM & L.P. JONES (Dept. of Animal Husbandry, University of Sydney):
"Long Term Responses of Artificial Selection".

12.15 Discussion.

~~12.20~~ B. KOHH & B.L. SHELDON (Division of Animal Genetics, C.S.I.R.O.):
"Selection for Dominance of Hairy-Wing (HW) in Drosophila".

12.35 Discussion

12.40 LUNCH.

R. MESA (Genetics Department, University of Melbourne):
"The Chromosomes of Several Species of Australia Grasshoppers (Orthoptera - Acrididae)".

Discussion.

P. ONESTI (Haematology Dept., Royal Perth Hospit
"Cytogenetics of Leukaemia and Allied Disorders. Experience in W.A. 1963-1965".

Discussion.

H.J. WOODLIFF (Dept. Haematology, Royal Perth Ho
"Further Structural Studies in Human G Group Chr somes with Particular Reference to Chronic Leuka

Discussion.

B. BOETTCHER (School of Biological Sciences, Fli University of South Australia):
"The Blood Group Genes I^A and I^{A2}."

Discussion.

Invited Lecturer:

2.00 PROFESSOR E. HADORN (University of Zürich):

Title to be announced.

3.00 AFTERNOON TEA.

3.20 BARBARA J. HOLLINGDALE (Dept. of Animal Husbandry, University of Sydney):
"Effects of X Irradiation on Selection for a Quantitative Character in Drosophila melanogaster".

3.35 Discussion.

3.40 ~~Miss A. FLEISS (Genetics Dept., University of Melbourne):~~ Dr. FRASER (Human Genetics Unit)
~~"Behavioural Homeostasis".~~

3.55 Discussion.

4.00 I.T. MACBEAN (Genetics Dept., University of Melbourne):
"Genotypic Control of the Duration of Copulation in Drosophila".

4.15 Discussion.

4.20 P.A. PARSONS (School of Biological Sciences, LaTrobe University):
"Behaviour and Random Mating".

4.35 Discussion.

4.40 BUSINESS MEETING.

Followed by Sherry Party and Dinner.

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Those wishing to park within the University grounds should present this programme at the Grattan St. entrance.

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May 1968 — Sydney.

President — Leatherdale
Secretary — L Barker
Ghosts
Reader

Zoology Lecture Theatre

A N Z A A S Section D

Cytogenetics Symposium (in association with the Genetics Society of Australia)

REVISED AND FINAL PROGRAM

Monday, January 16, 1967

MORNING SESSION. Chairman: Professor S. Smith-White (University of Sydney)

9.30 - 10.00 M.J. Whitten (Division of Entomology, CSIRO): - Chromosomal Polymorphism in Two Leafhopper Species.

10.00 - 10.10 Discussion

10.10 - 10.40 W.J. Peacock (Div. of Plant Industry, CSIRO: - Replication and Recombination in Higher Organisms.

10.40 - 10.50 Discussion

10.50 - 11.20 MORNING TEA

INTERVAL FOR OFFICIAL OPENING OF CONGRESS BY THE GOVERNOR-GENERAL

AFTERNOON SESSION. Chairman: Professor R.A. Brink (University of Wisconsin)

2.00 - 2.30 Graham Webb (Dept.of Genetics, University of Melbourne): - Autoradiographic Studies on Chromosomes of Morabine Grasshoppers.

2.30 - 2.40 Discussion

2.40 - 3.10 M.J.D.White (Dept. of Genetics, University of Melbourne): - Chromosomal Rearrangements and the Theory of Stasipatric Speciation in Morabine Grasshoppers.

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3.10 - 3.20 Discussion

3.20 - 3.50 J. Grant Brewen (Oak Ridge National Laboratory):
- Sister Chromatid Exchanges: Are they spontaneous or induced?

3.50 - 400 Discussion

4.00 - 4.30 AFTERNOON TEA

4.30 - 500 R.N. Nankivell (Dept.of Genetics, University of Melbourne):
- Pericentric Inversions and Segregation Distortion in the Grasshopper Austroicetes interioris.

5.00 - 5.10 Discussion

5.10 - 5.40 W.B. Mather (Dept. of Zoology, University of Queensland):
- Cytogenetics and Speciation in Drosophila rubida.

5.40 - 5.50 Discussion

5.50 - 6.20 D.L. Hayman (Dept.of Genetics, University of Adelaide):
- Marsupial Sex Chromosomes.

6.20 - 6.30 Discussion.

Meeting 14

COMPLEX SEX-DETERMINING MECHANISMS IN THREE SPECIES OF SOUTH AMERICAN GRASSHOPPERS (ORTHOPTERA - ACRIDOIDEA)

A. Mesa and R. Mesa. Genetics Department, University of Melbourne.

Two chromosome races of Leiotettix sanguineus are analysed. One of them has eleven autosome pairs, and a free X chromosome. Another, as far as is known limited to the Cerro Chato population, underwent an X-autosome fusion, and then the sex mechanisms changed to a neo-XY type.

Two chromosome races also exist in L. politus, one of them with six autosome pairs, two of them metacentric, and an ancient XY sex mechanism. One specimen collected in Rio Tacuari presents a supplementary Y-autosome fusion that has reduced the autosome to five pairs and changed the sex mechanism to an X_1X_2Y type.

The karyology of three specimens of Dichroplus dubius is studied. They show nine acrocentric autosome pairs and an X_1X_2Y sex mechanism. According to the observed characteristics of the X_1X_2Y systems, the X-autosome fusion is very old and that which fused the two Y arms is relatively recent. In one of the specimens, asynapsis between X_1 and Y reaches 25.3% and frequently bridges between these two chromosomes are observed in first and second meiotic divisions. Furthermore, a high precentage of diploid second spermatocytes are formed.

CYTOGENETICS & SPECIATION IN

DROSOPHILA TETRACHAETA

D. Angus. Zoology Department, University of Queensland.

Drosophila tetrachaeta is a member of the tropical quadrilineata group of Drosophila. It has 5 pairs of rods and a pair of dot chromosomes, excellent salivary chromosomes and cultures easily in the laboratory. So far 12 paracentric inversions (11 simple 1 complex) have been detected in addition to an arbitrarily selected gene order for each chromosome. Comparisons have been made of inversion frequencies between Bulolo and Port Moresby populations; between sexes at each site and at different times at each site.

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At Brown River, Port Moresby and Cairns populations were detected that while morphologically indistinguishable were reproductively isolated from D. tetrachaeta populations at Port Moresby.

Cytological investigationsof hybrid larvae revealed poor synapsis between homologous chromosomes and at lease 8 differences in gene order.

Both these sexual isolation studies and the cytological investigations have led to the separation of a new species - D. pseudotetrachaeta.

INTER-YEARLY FLUCTUATION OF D. RUBIDA INVERSION POLYMORPHISM

W.B. Mather. Zoology Department, University of Queensland.

This species of Drosophila, belonging to the immigrans species group was discovered in northern Queensland in 1958. Since that time it has been collected throughout the Territory of Papua and New Guinea and in the Solomons. D. rubida has four pairs of chromosomes: one pair of V's, two pairs of rods and one pair of dots. Twenty inversions in relation to an arbitrary standard strain have now been detected and plotted on a giant chromosome photographic map. These inversions of which twelve are simple and eight complex, occur in the 2nd and 3rd chromosomes. Extensive geographical, ecological and intra-yearly variability in inversion frequency have previously be detected.

It is the purpose of this paper to report on the first triennium of a long range investigation of trends in inversion frequencies in this species at Bulolo and Port Moresby in the Territory of Papua and New Guinea.

D. rubida is a particularly suitable species for this type of work in that it thrives in the laboratory and excellent giant chromosome preparations can be routinely made. Further this species can be easily collected by sweeping over fermenting banana baits.

Cf Aug. — No inv = Comm F

Only one = II + III

THE GENETICS OF HISTIDINE BIOSYNTHESIS IN *PSUEDOMONAS AERUGINOSA*

B.J. Mee. Genetics Department, University of Melbourne.

In all the microorganisms so far studied, histidine is synthesised from phosphoribosyl pyrophosphate and ATP in ten enzymatic steps. The genes controlling these enzymes in *Salmonella* and *Staphylococcus* are clustered into an operon type arrangement, and continuity between the gene loci has been assumed from the existence of polarity mutations. On the other hand, most of the genes for histidine biosynthesis in *Neurospora* and *Saccharomyces* are unlinked and located on different chromosomes. Three genes however are clustered and appear to be contiguous in both organisms.

The investigation of histidine biosynthesis in *Pseudomonas* was initiated in order to critically examine the reports of non-clustering of functionally related genes in this bacterium, and to compare this system with those outlined above.

Histidine biosynthesis in *Pseudomonas* appears to be controlled by five loci which are not clustered. The distribution of these loci has been determined by transduction and by the modified interrupted mating technique. Linkage of some of these loci to unrelated biochemical markers has been shown by cotransduction experiments.

One of the five loci (which is tentatively called group 1) has been investigated in more detail by donor phenotype selection and thin layer chromatography of accumulated intermediates. This locus seems to control more than one biosynthetic step.

CONJUGATION IN *PSEUDOMONAS AERUGINOSA*

B.W. Holloway and V.A. Stanisich. School of Microbiology, University of Melbourne.

A mating system exists in two strains, 1 and 2, of *Ps. aeruginosa* where strain 2 acts as donor (male) and strain 1 as recipient (female) of genetic material. The agent which determines donor ability has been called sex factor and strains possessing it are designated FP^+, while those lacking it are FP^-.

This FP factor can be transferred from strain 2 to strain 1 so that $1FP^+ \times 1.FP^-$ matings are possible. Certain male recombinants derived from $2FP^+ \times 1.FP^-$ matings have the ability to transmit sex factor infectiously to strain 1 females, so that in essential features the system in *Pseudomonas* appears to be analogous to that in *E. coli* K.12.

As yet, a strain equivalent to the Hfr types of *E. coli* has not been isolated. Such an organism would allow accurate mapping of the *Pseudomonas* chromosome and facilitate further genetic and biochemical study on this organism.

An interrupted mating system between FP^+ and FP^- strains has been developed which may be of limited importance in determining which genes are relatively closely associated on the chromosome, and whether one or more linkage groups exists.

MUTANTS OF *PSEUDOMONAS AERUGINOSA* WITH REDUCED RECOMBINATION ABILITY

B.W. Holloway and S.M. Turner. Microbiology Department, University of Melbourne.

Mutants have been isolated with reduced ability to form recombinants following conjugation and to form transductants.

The mutants have also been found to have increased sensitivity to ultra-violet irradiation; this supports theories that repair processes in UV-damaged cells and genetic recombination are related enzymatic processes.

The mutants were selected from a group with reduced ability to be lysogenized by phage D3 - among them are mutants unable to support the normal growth of other temperate phages B3, A3 and F116.

Quantitative work is being done on lysogenization, phage multiplication and on the induction of phage synthesis in lysogenic derivatives of the mutants.

RECOMBINATION BETWEEN GENES AFFECTING RUST RESISTANCE IN FLAX

G.M.E. Mayo and K.W. Shepherd. Department of Genetics, University of Adelaide.

Originally, Flor (1956) postulated from F_2 analyses that the genes in flax conferring resistance to rust occur as multiple alleles at five loci, named K, L, M, N and P. Subsequent work, using the more efficient test-cross procedure, has shown that at least some of these 'alleles' can be recombined with low frequency (Shepherd, 1961; Flor, 1962).

The isolation or recombinants with genes conferring rust resistance in coupling phase has made it possible to extend these recombination studies, by using an efficient method of analysis adapted for F_2 progeny.

This method is being used to study the linkage relationship between genes at the M locus in flax and the initial results will be presented. The advantages of this method and its possible application to studies of allelism at the L and N loci will be discussed also.

CLIMATIC CONTROL OF VERSATILE REPRODUCTION IN DICHANTHIUM

R.B. Knox. Botany Department, Australian National University.

In Dichanthium aristatum (Angleton Grass, Andropogoneae), a short-day plant and tetraploid facultative apomict, photoperiod during a critical phase of reproduction controls the incidence of aposporous apomixis (Knox and Heslop-Harrison, Bot. Notiser 116: 127, 1963). Apospory is readily recognizable cytologically, and this paper presents preliminary results from a survey of seasonal drifts in the incidence of apomixis in inflorescences of D. aristatum in the field. Two sources of material were used:

1. Wild populations naturalized in Queensland.
2. Race C.P.I. 14366, a versatile apomict, grown from seed at six latitudinal stations.

A proportion of the wild populations proved to be obligate apomicts with a constant low level of sexuality. Others showed versatility, the incidence of aposporous embryo sacs varying during the flowering season. In one population from Mareeba, North Queensland, a sample collected in April 1963, following the summer rains and in decreasing daylengths (12.5 to 11.6 hours) showed inflorescences with 86.39 ± 3.05 per cent aposporous sacs, and only 8.75 ± 1.92 per cent sexual sacs (balance unclassified). A further sample in December 1963 showed only 45.69 ± 2.54 per cent aposporous sacs, but 42.87 ± 4.07 per cent sexual sacs. This highly significant decreasing incidence of apomixis occurred during increasing photoperiods (12.3 to 13.0 hours).

This, and other evidence to be presented, suggests that in these latitudes, versatile apomicts such as Dichanthium aristatum, show maximum incidence of apomixis during the optimum growth conditions of late summer and a minimum during the dry period of spring and early summer. Such behaviour is paralleled in the animal kingdom by aphids. Versatile reproduction, under photoperiodic control, provides the short-term advantages of continued replication of successful maternal genotypes, with the long-term benefit of a pool of sexual recombinants capable of adapting to changing environments.

SOME COMPLEXITIES OF CHROMOSOME REPLICATION

C.R. Geard. Botany Department, University of Tasmania.

W.J. Peacock. C.S.I.R.O. Division of Plant Industry. Canberra.

Some problems in chromosome structure and replication in higher organisms will be discussed. Data from autoradiographic experiments with Vicia faba will be presented. Support is given to the hypothesis that each chromatid contains two non-identical subunits.

GENE ACTION IN QUANTITATIVE INHERITANCE

R. Frankham, Department of Animal Husbandry, University of Sydney.

R.A. Fisher provided the present approach to quantitative inheritance. He made a statistical description of a population based on the multiple factor hypothesis. This deals in terms of the average effect of a gene substitution and unless gene action is additive then this is a static description of a particular population.

However, a dynamic model is required to deal with genetic changes in a population. In an attempt to provide such a model, a quantitative character is considered as the end product in a biochemical reaction chain of gene controlled steps. Some of the properties of such a system will be discussed. As the worst step in the chain ("bottleneck") has the major effect in determining the phenotype two alternative simple mathematical functions are suggested for the relationships between genotype and phenotype.

The consistency of the model with the findings of quantitative genetics will then be considered.

GENETIC HETEROGENEITY FOR BEHAVIOURAL TRAITS IN POPULATIONS OF *DROSOPHILA*

S.M.W. Hosgood. Department of Genetics, University of Melbourne

Two components of mating behaviour, mating speed and duration of copulation, which are known to be partly under genetic control, have been used to examine genetic heterogeneity in populations of *Drosophila melanogaster*. Strains derived from single inseminated females from the same natural population were found to differ significantly for both traits. This is in agreement with other work for these traits in *D. pseudoobscura* and for scutellar chaeta variation in *D. melanogaster*. These differences may result from genetic heterogeneity (i.e. genetic drift) among the founder of the strains.

TERGITE BRISTLE PATTERNS IN *DROSOPHILA*

J.H. Claxton. Department of Genetics, University of New England.

The numbers and distributions of bristles on the third and fourth abdominal tergites have been compared in wild type and scute Drosophila with the object of determining whether the changes brought about by the mutant gene could be accomodated within the framework of prepattern and competence systems.

There was a general reduction in tergite bristle number in scute flies. Although the tergites and the proportional area of their surface which developed bristles were also smaller in the mutants, there appeared to be a general reduction in bristle density. The nature of the changes in the distribution of tergite bristles suggested a hypothetical model for the shape of a non-specific prepattern in a longitudinal cross section of the tergite, but the same model was not able to account simultaneously for the density differences between wild type and scute and for the regional gradients of density on individual tergites.

EFFECT OF ARTIFICIAL SELECTION ON RATE OF INBREEDING IN POPULATIONS OF *DROSOPHILA*

L.P. Jones. Department of Animal Husbandry, University of Sydney.

Although there has been appreciable theoretical and computor simulation on the effect of artificial selection on the rate of inbreeding, experimental evidence is rather scarce. As imbreeding is a major factor limiting the longterm response to selection, an idea of the effect of selection intensity on inbreeding is important to selection theory and practice.

Populations of *Drosophila melanogaster* were selected at intensities of 10/20, 10/50 and 10/100 in each sex for eight generations, for the number of bristles on one abdominal segment. Selected parents were single-pair mated at random, with each parent being used in only one mating. The inbreeding coefficient and the contribution of each family was computed. The rate of inbreeding was higher in the lines with higher selection intensities, but there was considerable variation in both responses to selection and rate of inbreeding. Inbreeding was generally greater in lines which gave the most response. These lines also had a higher variance of the contribution of the original families used to establish the selection line.

ARTIFICIAL SELECTION FOR HOMOZYGOUS LETHALS

J.W. James. School of Wool Technology, University of N.S.W.

In lines of Drosophila artificially selected for quantitative characters, homozygous lethal genes often reach high frequencies. It is unlikely that such high frequencies could be reached in opposition to natural selection unless the genes involved have large effects on the character selected for, though it is not obvious what constitutes a large effect. It is possible that when the viable homozygote is less fit then the heterozygote, only moderate effects of the gene on the selected trait may suffice for its frequency to be raised to a high value, and this will be especially so under very intense artificial selection.

An analysis has been made of the relative importance of the intensity of artificial selection, the magnitude of the gene effect and the fitness of the viable homozygote as factors determining the frequency which may be attained by a homozygous lethal gene. The results of this analysis will be discussed.

TWO TRAIT SELECTION AND THE GENETIC CORRELATION

A.K. Sheridan. Department of Animal Husbandry, University of Sydney.

Using Drosophila melanogaster, selection was carried out with independent culling levels and an overall selection intensity of 20 per cent on right third coxal bristle number and right sternopleural bristle number for eight treatments (⇑⇑, ⇓⇓, ⇑⇓, ⇓⇑, ⇑-, ⇓-, -⇑, -⇓) and a control. One hundred pairs were scored per line there being for replicates. The genetic correlation was about +0.3.

After ten generations the single trait lines and the controls were terminated, and the two trait lines were carried on to generation 22 at half the population size. Single trait lines for both characters in both directions were split off all four replicates of the ⇑⇑ and ⇑⇓ lines and from two replicates of the remaining lines. These were used to estimate the realised genetic correlations. At generation 21, the two trait lines were crossed both within and between treatments. At generation 22, single trait lines were split off at replicates, the two trait lines being maintained as relaxed lines.

Both the effect of the two trait selection treatment on the genetic correlation and the direction of the single trait selection on the realised genetic correlation within a treatment will be discussed.

LONG TERM RESPONSES TO ARTIFICIAL SELECTION

R. Frankham and L.P. Jones. Department of Animal Husbandry, University of Sydney.

The effects of population size and selection intensity on the long term response to artificial selection for a quantitative character in Drosophila melanogaster were investigated.

Populations with 10, 20 and 40 pairs of parents were selected at intensities of 10, 20 and 40% for 50 generations for the number of bristles on one abdominal segment. By this stage several of the smaller populations had plateaued, but most of the larger populations were still responding. In general, the response increased as the number of parents used and the selection intensity increased, i.e. as more individuals were measured.

Agreement between replicate lines for long term response was poor and the long term behaviour of selected lines remains virtually unpredictable.

SELECTION FOR DOMINANCE OF HAIRY-WING (Hw) IN DROSOPHILA

B.K. Ohh and B.L. Sheldon. Division of Animal Genetics, C.S.I.R.

In Fisher's theory of the evolution of dominance the emphasis has usually been placed on selection of modifers which move the expression of the heterozygote towards that of the homozygote. In the model of canalisation of development proposed by Rendel, Sheldon and Finlay, the mechanism of dominance proposed is that the expression of the homozygote is moved towards the level of the heterozygote by selection of the regulator genotype controlling gene activity at the heterozygote level. This paper reports attempts to select for dominance of Hairy-wing by these two different pathways.

In each of two lines selection has been between families for the minimum difference between Hw/Hw and Hw/+. In one line only Hw/+ and Hw/. individuals with 5 or 6 bristles, the mean level of the base population, were used as parents. A high degree of canalisation at this level of phenotype has already been achieved in 25 generations. In the other line, the highest Hw/+ ♀♀ were used, i.e. those closest to Hw/Hw. No dominance was obtained in this line at the original level of Hw/Hw, as both Hw/Hw and Hw/+ had a large, rapid increase in their mean expression. However, it is possible that dominance is now developing at a level of 40 bristles, some 2½ times higher than the unselected level of Hw/Hw.

CYTOGENETIC STUDIES ON THE *DROSOPHILA SERRATA* COMPLEX

V. Baimai. Zoology Department, University of Queensland.

The *Drosophila serrata* complex belongs to the *melanogaster* species group. In the earlier reports by Dobzhansky & Mather (1961), and Ayala (1965), 3 members of this complex are desbribed: *D. serrata* and *D. birchii* from Eastern Australia, New Guinea and New Britain, and *D. dominicana* from Madang (New Guinea); they are fully sexually-isolated.

The present investigations show some interesting metaphase chromosome configurations in this group. Generally, there are 4 pairs of chromosomes: 2 pairs of V's, 1 pair of dots and 1 pair of rods. *D. birchii* shows variations in karyotype, particularly in the sexchromosomes, of which 4 types have been detected:- 3 types from Port Moresby and 1 type from Cairns.

Crosses have been made between strains of *D. birchii* from Cairns (C) and from Port Moresby (P_2). Apparently, all the ♂-hybrids with P_2 X-chromosomes and C Y-chromosomes are sterile. The ♀-hybrids are fertile.

Preliminary salivary chromosome analyses show that the Cairns strain differs from the P_2 strain in having inversions in 3 of the 5 long arms of the polytene-chromosome figure. Morphologically, the 2 strains are not distinguishable.

MORPHOLOGY AND ABNORMALITIES OF PACHYTENE *MEDICAGO* CHROMOSOMES

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The pachytene stages of pollen mother cell meioses were examined in two species of *Medicago* - commercial purple flowered lucerne, *Medicago sativa* (2n = 32), and yellow flowered Siberian lucerne, *Medicago falcata* (2n = 16). In both species most chromosomes were characterised by having one telomeric arm, large blocks of heterochromatin surrounding an unstained centromeric region, and long euchromatic regions in the non-telomeric arm. The pachytene chromosome length ranged from approximately 25 to 55 microns. The nucleolar organizer chromosome was much more heterochromatic than its fellows.

A number of the *M. sativa* plants were found to be heterozygous for a reciprocal translocation, and at pachytene formed cross-shaped translocation quadrivalents. Partial asynapsis of paired chromosomes occurred at interchange points and quadrivalents. Asynapsis was also seen in portions of some bivalents. Plants with quadrivalents appeared to have normal anaphase I separation and showed a range in per cent pollen abortion.

Two *M. sativa* plants at pachytene had a frying pan shaped bivalent, with an apparent centromere. This was possibly due to an inversion.

POLYMORPHISM IN VELACUMANTUS AUSTRALIS

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V. australis is a common gastropod along the Australian coast. The species lives south of the tropic of Capricorn to Port Philip Bay (Vic.). It also occurs in Tasmania and near Perth. It occurs as fossil in Western Victoria, and South Australia. A white banded form occurs in all populations from the Australian mainland. The frequency of this form fluctuates irregularly between 8-16% in living populations from the Northern extreme of its range (Harvey Bay Qld) to Smiths Lake (about the middle of N.S.W. coast). The frequency in living populations from Smiths Lake to Malacoots Inlet (Vic.) fluctuates between 2-5%. However, populations from Lake Illawarra (near Wollongong) within this area had frequencies of about 8%. A population from Port Phillip Bay had a frequency of 0.05% while no banded snails were found in a sample from Tasmania. A sample from Swan River (W.A.). had a frequency of 9%, about the same as samples from the eastern coast on the same latitude.

The frequency of banded snails is highest in juveniles and decreases with age. It is usually about the same in living and fossil smaples from the same or nearby areas, suggesting the polymorphism is balanced and very stable.

Banded snails are less often infected with larval trematodes than unbanded snails. These infections cause either complete castration or considerable degeneration of the gonads. There is a relationship between the incidence of larval trematode infection and the frequency of banded snails. Thus parasitism probably plays an important role in the maintenance of the polymorphism.

Predation by boring gastropods and fish act differentially on banded and unbanded snails.

THE CHROMOSOMES OF SEVERAL SPECIES OF AUSTRALIAN GRASSHOPPERS (ORTHOPTERA - ACRIDIDAE).

M.J.D. White, A. Mesa R. Mesa. Genetics Department, University of Melbourne.

The karyotype of 53 species of acridids are reported. Two species of the family Pyrgomorphidae (*Psednura* sp. and *Atractomorpha crenaticeps*) have 19 chromosomes (♂♂) as expected. The great majority of the Acrididae have the normal chromosome number of 23 (♂♂); only three species differ from this basic number; *Genus nov.* 60 sp. 1 (according Dr. K.H.L. Key's temporary nomenclature) has 21 acrocentric chromosomes, *Percassa rugifrons* shows also 21 chromosomes, one of its autosome pairs being metacentric. In *Stenocatantops angustifrons* an X-autosome fusion has changed the sex mechanism from the primitive XO to a neo-XY one (♂♂).

THE ABO BLOOD GROUP GENES 1^{A1} and 1^{A2}

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It seems that, rarely intragenic recombination involving the genes 1^{A1} and 1^{B} can occur to give a gene 1^{A2B} and, therefore, the gene 1^{A2} is one part of the gene 1^{A1}. However, the gene 1^{A1} adds more A antigen to preformed H-substance than does the gene 1^{A2}. Hence, the other part of the gene 1^{A1} appears to be responsible for adding A antigenicity, also. Consequently, it has been proposed that the gene 1^{A1} is basicelly the duplication of the gene 1^{A2}.

Two lines of experimentel evidence suggest that the gene 1^{A2} leeves unmasked H activity whoch would be unreactive under the influence of the gene 1^{A1}. First, Ulex europaeus (anti-H) extracts show reactivity with red cells in the order O A_2 B A_1, whereas secretor salivas have the capacity to inhibit Ulex extracts in the order O A_2 A_1 B. It is proposed that the different orders for the reactivity of A_1 and B salivas and red cells with Ulex extracts is because the A_1 antigen molecule has very little H activity and, also, because, in saliva, the gene 1^{B} is more active in converting H-determinants to B than is the gene 1^{A1} in converting them to A, whereas almost all H-determinants on red cells are converted to A or B. And, secondly, red cells from group A_1 individuals genotypically $1^{A1}1^{A2}$, appear to be more reactive with Ulex europaeus extracts that those from individuals genotypically $1^{A1}1^{A1}$ or $1^{A1}1^{o}$. This indicates that H determinants on the red cells which would be unreactive, do to the action of the gene 1^{A1}, are still reactive despite the reactivity with the Ulex extract.

A saline extract from the seeds of Cytisus sessilifolius has anti-H activity as has that from Ulex

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europaeus seeds. But, whereas the anti-H activity of the former is inhibited by salicin but not by L-fucose, that of the latter is inhibited by both. A_1 salivas show equal reactivity with both types of extract, whereas A_2 salivas show increased reactivity with the Ulex extract.

These observations and conclusions lead to a concept of a qualitative difference between the products of the genes 1^{A1} and 1^{A2}.

EFFECTS OF X-RADIATION ON SELECTION FOR A QUANTITATIVE CHARACTER IN *DROSOPHILA MELANOGASTER*

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Lines selected for increased bristle number on one abdominal sternite (5th in females, 4th in males) were derived from two base populations :

i) a highly inbred stock, 160 generations of full-sib mating.

ii) the Canberra wild-type population, maintained as a large cage population.

The radiation treatments were 1000r delivered over 30 minutes to the selected parents in each generation, and Or. In addition, unselected irradiated and unirradiated control lines were maintained for the first 10 generations.

Comparison of selection responses in irradiated and non-irradiated lines under a selection regime of large population size (initially 100 pairs selected parents, later 80 pairs) and 50% mass selection was continued for 20 generations in the inbred lines. The response to selection in the irradiated lines (5 replicate lines) was small. Over the last ten generations the irradiation line means were consistently 0.5 to 1.0 bristle greater than the means of the 3 unirradiated selection lines, which remained at their initial level (mean = 21, phenotypic variance = 3 in females).

The Canberra lines (5 at 1000r/gen, 3 at Or), were selected as for the inbreds until generation 24, then at 20% selection intensity and 20 pairs of selected parent There was no discernible difference between response patterns of irradiated and non-irradiated lines which could be directly attributed to the irradiation treatment.

THE GENETIC CONTROL OF THE DURATION OF COPULATION IN *DROSOPHILA*

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Experiments with inbred lines of *D. melanogaster* and their hybrids have given rather low heritabilities in the region of 0.15 to 0.20 for the duration of copulation. Even so, directional selection for long and short durations of copulation has been successful. The genotype of the male has the predominant influence upon the duration of copulation, while the female has little or no influence. This is in agreement with other work, both in *D. melanogaster* and *D. pseudoobscura*, where variations in the duration of copulation are almost entirely male determined in crosses between strains and karyotypes. Various correlated responses to selection, relating to the time before sperm is transferred, will be also discussed.

BEHAVIOUR & RANDOM MATING

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Much of the current work in theoretical and experimental population genetics is based on the assumption that mating is at random. It is the purpose of this paper to query this assumption. The mechanisms to be discussed are :

1) Selection of mates in multiple choice situations in *Drosophila*.
2) Density-dependent mating frequency in *Drosophila*.
3) Assortative mating in *Drosophila* and man, and
4) Imprinting and previous experience in mice and other organisms.

Evolutionary implications will be considered briefly.

GENETIC CONTROL OF ENDOSPERM PROTEINS IN WHEAT

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ABSTRACT

Zone electrophoresis on starch gels has been used to study the genetic control of differences in wheat endosperm proteins. This technique provides a means of separating many of the endosperm proteins as discrete bands and, furthermore, it can be applied to single wheat grains.

Prior to inheritance studies, the gel patterns of endosperm proteins from a large number of wheats (including hexaploids, tetraploids and diploids) were examined. Many different patterns of slow-moving proteins were observed in this survey, but the fast-moving components of different wheats were much less variable. However, there was an indication that the pattern of fast-moving bands, unlike the slow-moving group, is characteristic for each ploidy group.

Genetic studies have been confined to the slow-moving group of proteins. In a conventional genetic analysis, the hexaploid wheat varieties, Gabo and Selkirk, which differ in at least six protein bands, were used as parents to produce F_1, F_2 and F_3 progeny. Analysis of band patterns observed in F_2 and F_3 progeny showed that at least two gene loci are concerned with the differences in protein of the parents.

In addition, aneuploid stocks of the variety Chinese Spring have been used to locate genetic factors controlling endosperm proteins, on particular wheat chromosomes. The slow-moving protein patterns of ditelocentric and compensating nulli-tetrasomic stocks have been compared with that of disomic Chinese Spring. In this way, genetic factors controlling eight of the fifteen major bands of Chinese Spring have been assigned to particular chromosomes and, in some cases, to one arm of the chromosome.

REPLICATION AND RECOMBINATION IN HIGHER ORGANISMS.

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The long-standing supposition that genetic recombination occurs at the time of appearance of cytological chiasmata in prophase of meiosis, has been challenged in recent years, particularly on the basis of findings of gene conversion and negative interference in a number of organisms. It has been suggested that genetic recombination may coincide with genetic replication. This would place crossing over in the interphase preceding the first meiotic prophase. The demonstration of the molecular nature of the recombination process in some bacteriophage has further focussed interest on the question of the time and nature of crossing over in higher organisms.

Experiments bearing on these points have been performed recently in a number of organisms and will be reviewed here. In particular, some experiments using Goniaea australasieae, the Australian ridge back grasshopper, will be discussed. These experiments bear on the time of replication and recombination and the relationship of crossing over to cytological chiasmata and to other features of meiosis.