AUSTRALIAN GENETICS SOCIETY

6TH ANNUAL GENERAL MEETING

?CANBERRA

20-21 AUGUST 1957

PROGRAMME

ABSTRACTS

SCANNED FROM THE ORIGINAL

Meeting No 6
This is 1957 because of the presence of Joshua Lederberg who visited U of M in that year, & contributed to a symposium in Canberra on Bacterial & Viral Genetics
Hence Meeting No 6.

AUSTRALIAN GENETICS SOCIETY

Tuesday, August 20th

Chairman: Dr. O.H. Frankel

9.00 a.m.	A.S. Fraser	Simulation of genetic systems by automatic electronic computors.
9.30 a.m.	J.S.F. Barker	Estimation of selection curves.
10.00 a.m.	J.H. Bennett	Selectively balanced polymorphism at a sex linked locus.
10.30 a.m.	MORNING TEA	
11.00 a.m.	P.A.P. Moran	Population Genetics.
11.30 a.m.	J.B. Langridge	An osmotic mutant of Arabidopsis thaliana.
12.00 noon	M.W. McDonald	Biochemical Variation in Poultry and Heterosis.
12.30 p.m.	LUNCH	

Chairman: Prof. J.H. Bennett

1.30 p.m.	H. Hoffman	Nucleo Cytoplasmic Transfer and Protein Synthesis.
2.00 p.m.	Sardool Singh	Composition of chromosomes during meiosis in grasshopper.
2.20 p.m.	G.W. Grigg & H. Hoffman	Fine structure of the resting nucleus.
2.50 p.m.	Miss Anne Levy	Cancer of the Stomach and the ABO Blood group.
3.00 p.m.	AFTERNOON TEA	
3.30 p.m.	B.L. Sheldon	The effect of temperature on the mutation rate of Drosophila melanogaster.
4.00 p.m.	O.H. Frankel, R. Gani & A.M. Munday	A Cryptic Gene System in Wheat.
4.30 p.m.	A.S. Fraser and R. Hall	Induction of Phenocopies by X-Rays in Mouse.

Evening Session

7.45 p.m.	Prof. J. Lederberg	Reproductive Versatility in Bacteria.

Following Prof. Lederberg's address the usual party will be held.

Wednesday, August 21st

Chairman: Dr. J.M. Rendel

9.00 a.m.	R.B. Dun	Selection for an Invariant Character - Whisker score in mice.
9.30 a.m.	F.H.W. Morley	Variation in Combining Ability in Poultry.
10.00 a.m.	B.F. Short	Fleece Type mutations in the Australian Merino sheep.
10.30 a.m.	MORNING TEA	
11.00 a.m.	S.K. Stevenson	Wool Follicle Development and Birthcoat fibre morphology in the New Zealand Romney and N-type sheep.
11.30 a.m.	J. McKay Doney	Maternal Effect in Estimation of heritability in sheep.
12.00 noon	R.B. Dun	The Effects of Selection on the Components of Fleece Weight in Merino Sheep.
12.30 p.m.	LUNCH	

Chairman: Dr. Max Clark

1.30 p.m.	K. McWhirter	Restoration of Fertility to Cytoplasmic male-sterile maize.
2.00 p.m.	E.M. Hutton and S.G. Gray	Variation and Mode of Reproduction in Leucaena glauca.
2.30 p.m.	D.C. Wark	The Introduction of Blue Mould Resistance into Nicotiana tabacum.
3.00 p.m.	AFTERNOON TEA	
3.30 p.m.	T. Nay	Sweat glands in different Breeds of Cattle.

WOOL FOLLICLE DEVELOPMENT AND BIRTHCOAT FIBRE MORPHOLOGY IN THE NEW ZEALAND ROMNEY AND N-TYPE SHEEP.

by

S.K. Stephenson.

The development of wool follicles in New Zealand Romney and N-type sheep foetuses has been investigated to determine the primary morphological effect of the Dominant N-gene. Measurements of pre-natal follicle and fibre diameters show that larger primary follicles develop in N-types as a result of the growth of larger primary fibres. The initial morphological effect of this gene appears to be an alteration of the relation between the size and shape of the primary papilla and the size of the follicle. This is supported by Rudall's (1955) studies on the size and shape of the follicle papilla in relation to fibre growth and morphology. Apart from the growth of horn lumps in rams, no other morphological effects of the Dominant N-gene, prior to birth, have been observed.

A study of the relation between pre-natal wool follicle density and birthcoat fibre morphology gives strong support to Fraser's (1952) suggestion that the pre-natal reduction in fibre diameter, the "pre-natal check effect", results from an increase in the density of follicles with fibres. Variations in the shape of the curve relating the age of initiation of a follicle the diameter and length of its fibre (Fraser 1953) do not appear to result from differences in follicle density.

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SWEAT GLANDS IN DIFFERENT BREEDS OF CATTLE.

Morphology and evolutionary trends.

by

T. Nay.

In Zebu (Sahi al and Sindi) the glands are large, bag-shaped and more numerous than in investigated Shorthorn strains. High density and wide diameter result in an almost continuous layer of fluid below the surface of the skin. This feature can be regarded as an unique adaptation aiming at storage of fluid in the skin, unknown in other cattle breeds.

British breeds, mainly different strains of Shorthorns, show a great variety in sweat gland shape in different animals, from simple, tapering, or slightly convoluted bag, to a long highly convoluted tube. In volume, they are well below Sahi al and Sindi.

The glands of the long, very convoluted type were found in a few animals and may be the first evolutionary step towards development of a sweat gland opposite in type to those found in Zebu, and aiming at increasing the number of secretive

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Africander cattle, Santa Gertrudis and Zebu x Shorthorn crossbreeds occupy a middle position in respect of sweat gland shape and volume.

THE EFFECT OF SELECTION ON THE COMPONENTS OF FLEECE WEIGHT IN MERINO SHEEP.

by

R.B. Dun.

The clean fleece weight differences between certain of the merino sheep flocks maintained at Trangie Agricultural Experiment Station have been analysed by the percentage deviation technique described by Turner (1951). The flocks examined were the single character selection groups, clean fleece weight plus and minus, crimps per inch plus and minus, fold score plus and minus, and the ram breeding section of a selection demonstration flock.

Results indicate that the most important cause of fleece weight differences between flocks is change in the number of fibres per unit area of skin. The major part of the fibre density difference results from increase in the density of follicle groups rather than from increase in follicle group size.

The remaining components surface area, staple length and fibre diameter make small contributions which vary markedly between years.

Fleece weight increase is associated with a marked fall in crimps per inch and thus is likely to be the major barrier in selection for increased fleece weight.

J.S.F. BARKER: Simulation of Selection Curves Obtained in Experimental Populations Using an Automatic Digital Computer.

A number of experiments have been conducted showing changes in gene frequency where two alleles (or 2 chromosome types) are in competition; for example, Dobzhansky, Reed and Reed, Merrell. Some attempts have been made to analyse from the results of these experiments the selection coefficients that were operating. It is difficult to obtain reasonable estimates.

This paper presents results of an opposite approach. Using Monte Carlo methods in the Silliac (Automatic Digital Computer of the University of Sydney), it is possible to simulate natural populations.

The following are specified:-

(1) Equilibrium population size - The average total number of males and females the ecological niche of the population can support. The actual population number will fluctuate around this value.

(2) Numbers of males and females of each genotype at fertilisation; this being taken as the reference point for the beginning of each generation.

(3) Relative selective values of zygotes - Their ability to survive from fertilisation to point of contributing gametes.

(4) Relative genotypic reproductive coefficients - genetic differences in the number of offspring from each genotype.

(5) Relative selective values of gametes at meiosis in heterozygotes.

(6) Relative gametic selective values - Relative ability of gametes to take part in fertilisation.

The program operates on the specified number of males and females, applying selection and introducing chance effects at each stage, and calculating the numbers of $\underline{A}$ and $\underline{a}$ gametes produced by both males and females. Using Monte Carlo methods and logical algebra, random mating is performed and the numbers of males and females of each genotype in Generation 1 determined. These are then operated on as before to produce Generation 2; and so on.

The numbers of males and females of each genotype, the gene frequency, the equilibrium population size, and $\underline{w}$ (ratio of effective population size in the following generation to that in the present generation) are printed out each generation.

Selection curves resulting from various selection coefficients in a number of population sizes will be presented.

NUCLEO CYTOPLASMIC TRANSFER AND PROTEIN SYNTHESIS.

by

H. Hoffman.

Electron microscopic studies of lymph glands in mice manufacturing antibody in response to primary injection of sheep erythrocytes followed 5 days later by booster injections show a series of characteristic changes. Within 12 to 24 hours after booster injection the nuclea (chromosomal) spiral filament become denuded and thinner in appearance. In this situation they resemble filaments seen in nuclei digested with trypsin.

Following these changes the endoplasmic reticulum (membraneous system of the cytoplasm) undergoes substantial increase in volume, apparently partly due to the formation of new membranes. The ribonucleicacid-protein granules of Palade Siekewicz associated with the reticulum are sparse at this stage. Material accumulates in the space of this reticulum until it is heavily distended. Later - 3-4 days after injection - RNP granules appear sometimes obviously in association with the chromosomal filaments; move to the nuclea membrane and appear to pass through it via tubular pores or larger gaps not normally observed.

5-7 days after injection the nucleus has returned to normal the cytoplasm often being denser than normally and containing masses of flattened clefts of reticulum and large clumps of RNP granules.

From these observations it might be suggested that at certain stages the chromosomal filaments may be entirely devoid of protein consisting only of the central DNA thread. Further, it seems likely that RNP granules are synthesised in association with the chromosomal filaments and pass out into the cytoplasm to replace RNP utilised in protein synthesis.

POPULATION GENETICS

by

P.A.P. Moran

The work summarised here is the result of an attempt to construct a rigorous theory of gene frequency distributions as part of the general theory of random processes. There are two main problems in this subject: (1) to calculate the rate of progress towards homozygosity in a population not subject to mutation; (2) to calculate gene frequency distribution when there is mutation in both directions.

S. Wright, by more or less heuristic methods, has established the general form of the answers to most of these questions. He assumes that each generation is simultaneously replaced by a new generation. Exact solutions of the resulting mathematical equations are then too difficult and it is necessary to use approximations. Using overlapping generations exact solutions can be found, assuming a population of haploid individuals, and the rate of progress to homozygosity is twice that of Wright's model. If there is mutation, the gene frequency distribution is of the same form as Wright's but with different parameters.

These results are then generalised to obtain a rigorous theory for a population consisting of diploid individuals, two different sexes, phenotypic selection and non random mating. The same techniques can also be applied to the same situation with non-overlapping generation and prove rigorously Wright's heuristic results.

One curious consequence of the theory is that any specified degree of positive assortative mating changes the distribution only by a small parametric change but on the other hand any degree of negative assortative mating immediately collapses the distribution to the point $p = \frac{1}{2}$.

Some unsolved problems are mentioned.

BIOCHEMICAL VARIATION AND HETEROSIS IN POULTRY

by

M.W. McDonald

The existence of biochemical variation within and between breeds of poultry may be inferred from differences in nutrient requirements of breeds. These differences are being investigated from three different aspects:

a. Distribution

b. Method of inheritance

c. Physiological factors responsible.

Two breeds are being studied - Australorps and

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Two breeds are being studied - Australorps and White Leghorns - which in crosses show a hybrid vigour of the order of 20% in growth rate and egg production.

Distribution of Differences in Nutrient Requirements and Inheritance.

The following differences have been established:

in response to methionine, sex linked

response to folic acid, polygenic (?)

rate of vitamin D synthesis in the skin, autosomal (?)

dietary vitamin D, requirements

manganese requirements, polygenic

resistance to rickets due to calcium and phosphorous deficiencies, polygenic (?)

Physiological Mechanisms.

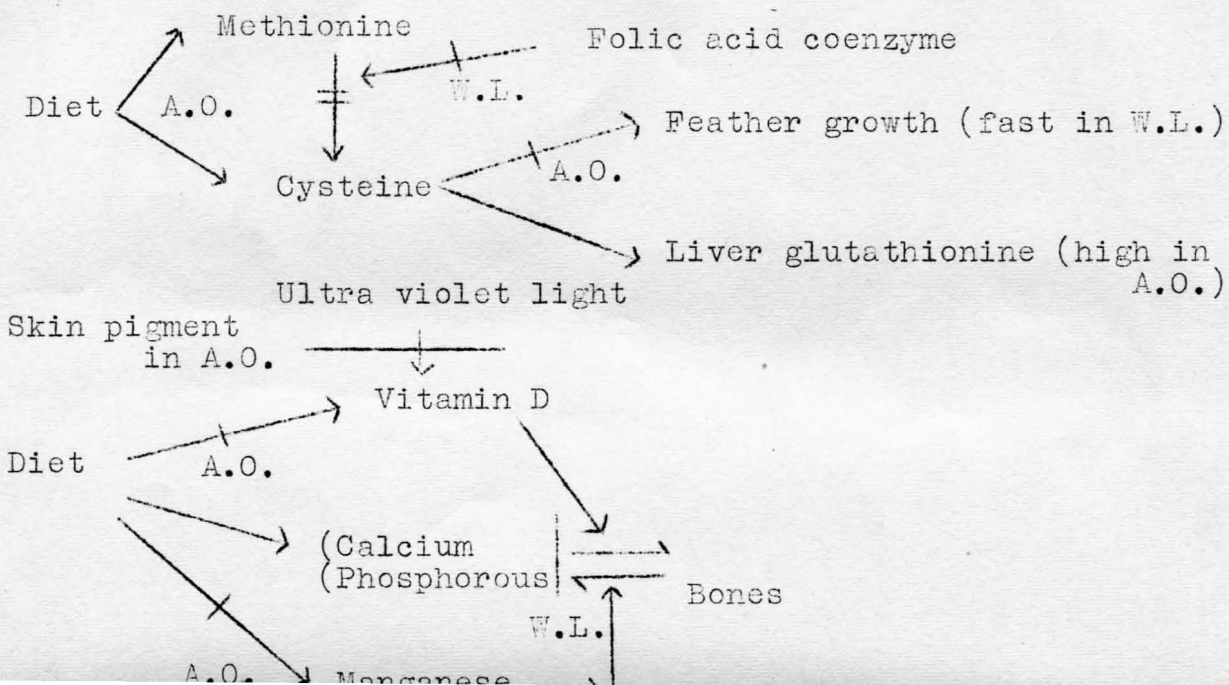
In only two cases, response to methionine and rate of vitamin D synthesis in the skin, are the physiological bases of the differences understood. The differences in response to methionine has been shown to be due to the inability of the Australorp to synthesise cysteine from methionine. The difference in rate of vitamin D synthesis has been shown to be due to greater pigmentation of the skin of the Australorp.

A further difference, in amount of glutathione in the liver, has been observed, the Australorp having approximately 30% more glutathionine in the liver than the Leghorn. There is no difference in amount in the blood.

Relationship Between Breed Differences.

There is evidence both for the independent development within each breed of balanced metabolisms each with a characteristic array of nutrient requirements and for random drift of genes determining requirements to produce unbalanced metabolisms in each breed.

Some of the known differences may be summarised into two metabolic systems.



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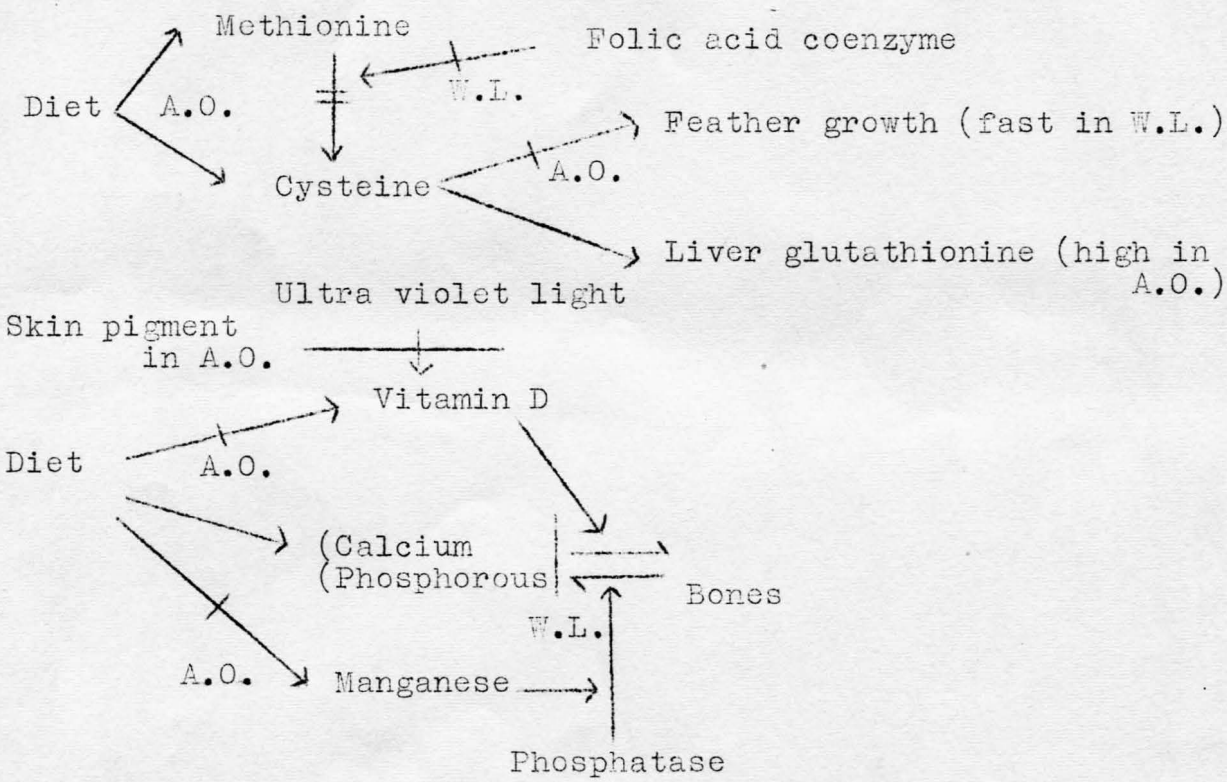

Both breeds have either blockages or inefficient processes in both systems such that the metabolism of each might be considered unbalanced.

Heterosis.

The above observations indicate that further work may provide confirmation of the "physiological balance" theory of heterosis in diploid organisms. In crosses between the breeds, each of the blocked or inefficient processes may be either recessive or combine additively to produce an efficiency intermediate between the parents but the total effect on the particular metabolic system could easily exhibit overdominance by a better balance of rates of reactions.

RESTORATION OF FERTILITY TO CYTOPLASMIC MALE STERILE MAIZE

by

K.S. McWhirter

112 inbred lines of Maize of Australian and U.S.A. origin have been surveyed in F_1 crosses with a "T", or Texas, male sterile inbred, for reaction on the male sterile character. Australian inbreds proved to be a fruitful source of fertility restoring genes, 22% of the inbreds studied restored complete fertility. The frequency of fertility restoring inbreds in U.S.A. is about 7%, though the group of introductions studied yielded 12% fertility restorers.

There are five possible ways in which cytoplasmic male sterility may be employed to eliminate detasselling in the production of commercial double cross hybrid seed. The present genotypes of the inbreds used in N.S.W. hybrids has been determined and these indicate that conversions to male sterile, fertile non-restorer and to fertile-restorer will be required. Eckhardt's backcross technique is being used for the latter conversion.

A test of 4 inbreds, including two fertility restorers, on both "T" and "S" (or U.S.D.A.) sources has revealed a specific restorer gene - plasmagene interaction and indicates these to be distinct sources of "male sterile" cytoplasm.

The inheritance of fertility restoration on "T" cytoplasm has revealed two instances of single dominant gene action and one in which a dominant complementary gene interaction is involved.

SELECTIVELY BALANCED POLYMORPHISM AT A SEX-LINKED LOCUS

by

J.H. Bennett

The necessary and sufficient conditions for a selectively balanced polymorphism dependent on two allelic genes to exist and be stable if the genotypic selective values are the same in both sexes are well known and these conditions have been found to be satisfied in many natural and laboratory populations. Recently, the corresponding conditions have been described for other polymorphic situations including: (i) the case where there are sex differences in the genotypic selective values, (ii) the case of three or more allelic genes and (iii) the case of more than one locus with or without linkage. Examples of all these polymorphic situations are known in nature. However, relatively little attention has been given to the study of selectively balanced polymorphisms dependent on allelic genes or inversions, etc. in the sex chromosomes. The conditions for such a polymorphism to exist and be stable will be described.

VARIATIONS IN COMBINING ABILITY AMONG LINES OF WHITE LEGHORNS AND AUSTRALORPS EXPRESSED IN CROSSBRED PROGENY

by

F.H.W. Morley

The commercial value of White Leghorn - Australorp crosses has been well established. Therefore the possibilities of selecting purebred stocks to produce improved crossbred progeny should be evaluated.

The 500-day egg production, average egg-weight, and broodiness of 305 surviving White Leghorn male x Australorp female hens, and 269 hens of the reciprocal cross, were obtained at the N.S.W. Department of Agriculture's Poultry Research Station, Seven Hills in 1952. The birds tested were produced by crosses between males from 22 lines of White Leghorns (F = 0.25 - 0.50) and hens from 10 lines of Australorps or males from 10 Australorp lines (F = 0.25) crossed with hens from 12 lines of White Leghorns. Each cross consisted of one male from a line of one breed and one female from a line of the other breed. Fertility and productivity of the inbred birds were so poor that many crosses did not produce progeny.

The following questions were asked:

1. Is tnere genetic variation among lines of either breed in productive characteristics of crossbred offspring.

2. Are interactions between lines important.

Estimates of Components

Components	(500-day production)/10		Egg Weight		Broodiness	
	B/W	W/B	B/W	W/B	B/W	W/B
White Lines≠	67^{xx}	27^{x}	20^{xx}	18^{x}	0.25^{xx}	0.22^{xx}
Australorp Lines≠	70^{xx}	19^{x}	60^{xx}	0	1.50^{xx}	0.00
Interaction	48	112	39^{xx}	88^{xx}	0.00	0.20
Residual	625	577	126	105	3.50	0.73
Sires	50^{xx}	26^{x}	41^{xx}	6^{xx}	1.0^{xx}	0.11^{xx}
Dams	77^{x}	129^{xx}	48^{xx}	70^{xx}	0.0	0.25^{xx}
$h^2\ {}^{4S}/_{(S+D+E)}$≠	27	14	76	13	88	40
$h^2 2(S+D)/(S+D+E)$≠	34	41	83	84	44	66

B/W = Crossbred Black (Australorp) male, White Leghorn female

W/B = reciprocal to B/W.

x - $P < 0.05$ xx - $P < 0.01$.

≠ Estimates made assuming all effects random. Tests of main

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W/B = reciprocal to B/W.

x - $P<0.05$ xx - $P<0.01$.

$\neq$ Estimates made assuming all effects random. Tests of main line effects slightly over-sensitive.

$\neq$ Inbreeding of parents ignored so these estimates biassed upwards.

RESULTS

Estimates of components indicate that there are real differences between lines of each breed. However interactions, although not always significant, seem likely to be large. The interaction term is inflated by genetic differences among birds of the maternal lines.

Assuming each sire is mated to a random sample of dams, estimates of sire and dam components can be derived from a conventional hierarchial analysis. Dam components were larger than sire components in each case except broodiness in B/W (sex-linkage important here). This indicates that non-additive genetic variation is important.

Estimates of heritability for these characters are similar to those from purebred flocks.

CONCLUSION.

These results indicate that considerable improvement of crossbred birds should be possible. Selection among lines for general combining ability (using progeny tests) should be valuable initially, but selection for specific combinations will probably be necessary at a relatively early stage.

CANCER OF THE STOMACH AND THE ABO BLOOD GROUPS

by

A. Levy

Recent work in Britain and North America has shown that there is an association between the ABO blood groups and susceptibility to cancer of the stomach. Other studies have revealed a familial tendency for susceptibility to the disease. It is here shown that the expected similarities in ABO blood group constitution of members of the same family are not sufficient to account fully for the observed familial likeness in susceptibility to the disease.

MATERNAL EFFECT IN THE ESTIMATION OF HERITABILITY IN SHEEP

by

J. Mackay Doney

Methods of estimating the heritability of any character depend in principle on the likeness between related animals. In general the relationships used are full or half-sibs or parent-offspring. These methods have been used and discussed by many authors. In most cases, with the larger livestock, the paternal half-sib method is unreliable because of the small number of selected sires in use. Lush (1940) suggests that the dam-offspring pair is less likely to be affected by maternal effect than is the maternal half-sib pair. In addition the error will be less due to the smaller multiplication factor. The expressions used are:

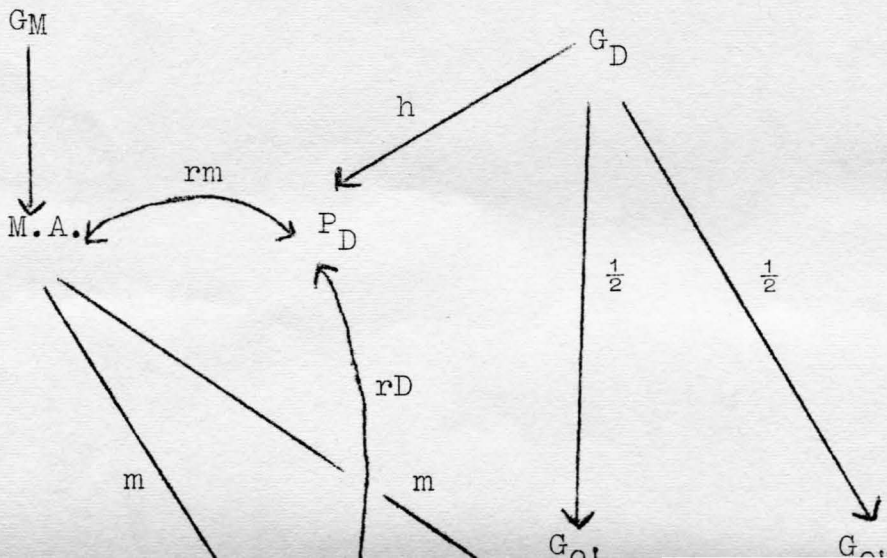
$$r_D = \tfrac{1}{2} h^2$$

or $$r_S = \tfrac{1}{4} h^2$$

where r_D = dam-offspring correlation (or regression)

and r_S = maternal half-sib correlation.

In many cases, particularly with sheep, both the above correlations will include some maternal effect. This is illustrated by the path diagram in Figure 1.



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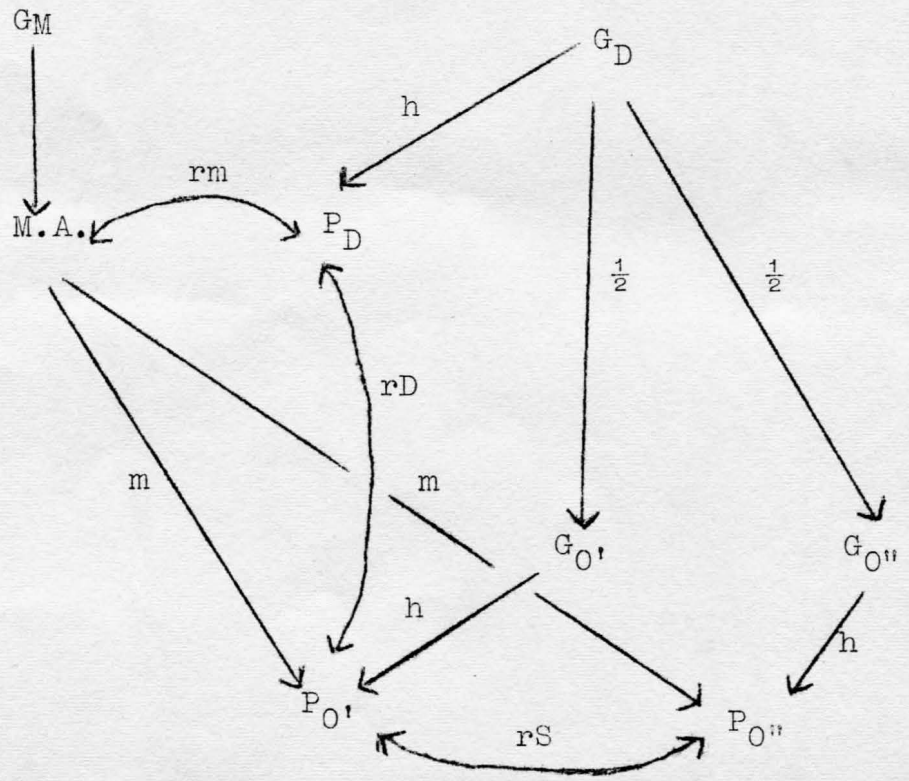

VARIATION AND MODE OF REPRODUCTION IN LEUCAENA GLAUCA BENTH.

by

E.M. Hutton and S.G. Gray

Leucaena glauca is a member of the Mimosoideae and is native to the Caribbean region. It is naturalized in parts of coastal and sub-coastal Queensland and has potential as a browse legume here. The protein content of the leaves varies from 25 to 30 per cent.

Thirty accessions have been examined for inter- and intra-strain variation. There was a high degree of uniformity within lines and three definite types of strains differing in growth habit and in vegetation vigour could be recognized. The Peru, El Salvador and Hawaiian strains are representative of the three types, and of these Peru is outstanding in yield of herbage over the season. Significant differences between strains occurred in plant height, time of flowering, leaf size, seed yield, and certain other morphological characters.

The flowers open soon after midnight and all pollen is shed rapidly about 7 a.m. to 8 a.m. This ensures a relatively high degree of self-pollination. Pollen grains become lodged inside the cup-shaped stigmas, where they germinate.

Studies were made of the reproductive efficiency of the three types of strains.

	Flower heads/ plant	No. florets/ plant	No. pods/ 1000 florets	No. seeds/ pod	Wt. seeds in grms/plant
Hawaiian	265	47,500	8.2	15.19	174
El Salvador	466	77,300	6.9	16.06	326
Peru	666	93,000	0.5	13.47	27

In spite of its high floret number per plant the Peru strain is the least efficient in seed production. This appears to be associated with a high proportion of pistil abnormalities.

A method of emasculation by shaking the newly-opened flower heads in water containing a non-phytotoxic spreading agent, Gardinol K, has been developed. The effect of the operation is to remove or render inviable all the pollen grains that lodge in the cup-shaped stigmas. Emasculation should be done as soon as practicable after the anthers have dehisced, and before pollen tubes have penetrated into the stylar tissue; that is between 8 and 9.30 a.m.

Pollen is collected in porous-type cellophane bags placed over the flower heads of the male parent prior to flowering. The pollen is transferred on the operator's finger-tips to the stigmas of the female parent about an hour after the flower-head is emasculated.

F_1 seedlings have been raised from a number of inter-strain crosses. It is thought that the cross between Peru and El Salvador will give progeny with the most desirable

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F_1 seedlings have been raised from a number of inter-strain crosses. It is thought that the cross between Peru and El Salvador will give progeny with the most desirable recombination of characters.

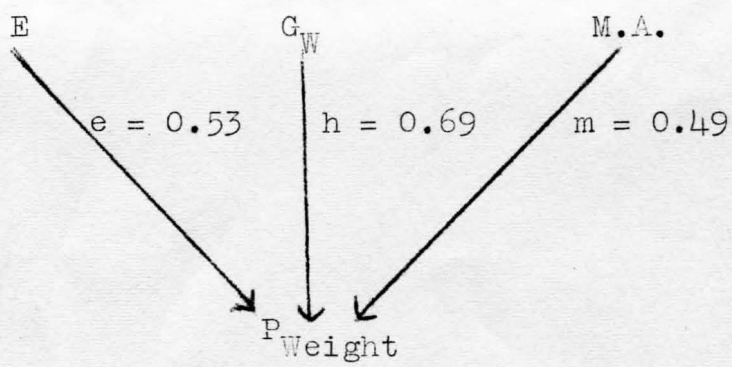
From this diagram it is evident that the two expressions now become:

$$r_D = \tfrac{1}{2} h^2 + r_M \quad M$$

$$\text{and } r_S = \tfrac{1}{4} h^2 + M^2$$

The efficiency with which r_D estimates h^2 will depend on the strength of the correlation between the maternal environment, provided by the dam (regarded as part of the dams phenotype) and the expression of the character in the dam (r_M). If a value can be assigned to this then the two equations can be solved simultaneously to give a more accurate estimate of the true heritability. Whilst the "maternal environment" can not be directly measured, available milk supply must be responsible for most of it in so far as r_M is involved. Thus the use of the correlation between milk yield and any character in the dams will allow the modified estimate of heritability to be made.

As an example, the method is applied to data on weaning weight derived from a flock of Welsh Mountain sheep. The intra-sire dam lamb correlation was found to be +0.34 for 1065 d.f. and the maternal half-sib value to be +0.36 for 512 d.f. On the same flock the correlation between dam's milk yield and weaning weight was found by Owen (1955) to be +0.26 $\pm$ 0.6. Using the lower limit of this correlation as an approximation to r_M the heritability of weaning weight, originally estimated as 0.68 by the dam-lamb correlation, is reduced to 0.48. The path coefficients for determination of weaning weight are as shown in Figure 2.



FLEECE-TYPE MUTATIONS IN AUSTRALIAN MERINO SHEEP

by

B.F. Short

The effective female population of Merino sheep in Australia is of the order of 60 million so that some 50 million offspring are produced annually. Since almost every lamb is handled individually for marking it is worthwhile trying to collect fleece-type mutants which show in the early lamb coat.

Further, almost all females have their fleeces examined at 1 to 1½ years of age and since little if any artificial selection is practiced before this time, identi-

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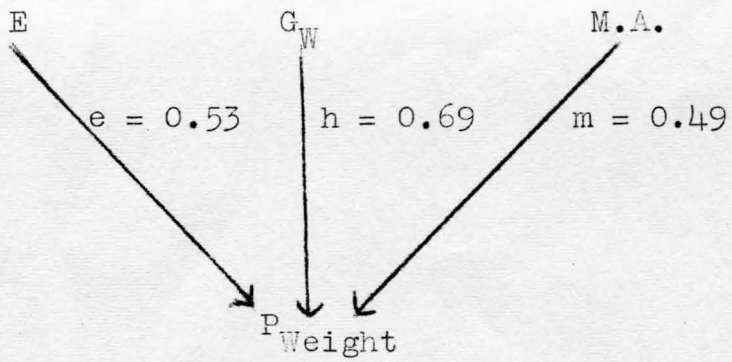

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Further, almost all females have their fleeces examined at 1 to 1½ years of age and since little if any artificial selection is practiced before this time, identification of fleece-type mutants is practicable.

Widespread publicity given to descriptions of several fleece-type mutants observed incidentally in the course of other investigations has resulted in considerable

additions to experimental stocks.

Families of these mutants have been developed. One mutation is a simple recessive, the other a simple dominant. The phenotypic deviations from the normal Merino fleece-type are given, and the potential usefulness of such mutants for fleece structure and wool production studies are discussed.

THE INTRODUCTION OF BLUE MOULD RESISTANCE INTO NICOTIANA TABACUM

by

D.C. Wark

No high level resistance to this disease caused by Peronospora tabacina has been observed in the cultivated species of tobacco. Resistance of a high order occurs for certain strains of the Australian native species of the genus Nicotiana, including N. debneyi, N. goodspeedii, N. exigua and N. excelsior.

The F_1 hybrids have a lower resistance, but high level resistance occurs in the amphidiploids.

Resistance is low in the first backcross to N. tabacum, high in the backcross to N. goodspeedii.

Selfed progeny of the first and subsequent backcrosses to N. tabacum yield a low proportion of highly resistant plants among the progeny.

Thus high level resistance appears to be due to the accumulation of gene effects of small magnitude.

FINE STRUCTURE OF THE RESTING NUCLEUS

by

G.W. Grigg and H. Hoffman

Electron microscopic studies of nuclei in cells of animals and plants reveals a basic element, consisting of 50-70 A.U. thick filaments, coiled in a series of spirals. The smallest spiral is a few hundred angstrom units in diameter, the second spiral is about 1000 A.U. Further spiralling is seen in early mitotic prophase.

This basic filament may be further subdivided by the application of appropriate enzymes to water-permeable ultrathin sections: a relatively low density central core of DNA is surrounded by a tube of protein of higher electron density. At prophase intertwined double spirals may sometimes be detected. A second non-spiralised protein filamentous element is interspersed between the spiralised filaments, it differs from the cortical protein of the chromosomal filaments in its enzymatic sensitivities and its extractibility with molar NaCl.

SIMULATION OF GENETIC SYSTEMS BY AUTOMATIC DIGITAL COMPUTERS.

by

A.S. Fraser.

Electronic computers, such as the SILLIAC, can be set to produce a series of pseudo-random numbers. This allows the simulation of stochastic processes, such as segregation and recombination, mating etc. A program has been written and run, based on a genetic system of six loci, with complete dominance. A single population of N' individuals produces N' progeny from which a sample of N' individuals are selected. Repetition of this cycle allows simulation of the rate of advance under selection. Actual runs of the program have shown that the phenomenon of "lag" periods in selection curves occurs at linkages of less than 5% in small populations.

INDUCTION OF PHENOCOPIES BY X-RAYS IN MICE.

by

A.S. Fraser and R. Hall.

X-irradiation of mouse foetuses has shown that, as in previous studies, specific types of phenocopies were produced depending on the age of the foetus at the time of irradiation. Alteration was concentrated on the facial vibrissae since the genes Ta, cr, and Ra affect these vibrissae and it has been suggested that these genes act at specific times causing lack of only those vibrissae which were "sensitive" at the time of action. The patterns of loss of vibrissae due to X-irradiation correspond approximately to the patterns of loss due to mutant genes.

BIOCHEMICAL VARIATION IN POULTRY AND HETEROSIS.

by

M.W. McDonald.

Extensive Biochemical variation within and between the two major breeds of Poultry, White Leghornes and Australorps exists. This is reflected in differences in requirements for Manganese, Riboflavin, Vitamin B12, Thianin, Vitamin D, Calcium, Folic acid, Protein. They also differ in ability to synthesise cystine from methionine and in liver glutathione content.

Sulphur amino acid metabolism in the two breeds demonstrate an interlocking of deficiencies which may serve as a model for the extension of the "physiological balance" theory of heterosis to diploid organisms.

SELECTION FOR AN INVARIANT CHARACTER-WHISKER SCORE IN MICE.

by

R. Dun.

Vibrissae are distributed on the head and forelegs of the mouse in one large and five minor groups. These latter groups are easily counted and together constitute 'whisker score' which is practically invariant in normal mice. It is therefore impossible to change 'whisker score' by selection in normal mouse stocks.

The difficulty has been overcome by introducing the 'tabby' gene, which reduces 'whisker score' to a variable degree. The aim of the selection experiment is to produce changes in 'whisker score' of normal mice by selection within the 'tabby' phenotypes.

Embryological development of vibrissae has been studied from serial sections. The results have suggested a theory of gene action whereby 'tabby' limits production of a localised follicle growth substance. The selection experiment can be interpreted on this theory as:-

(a) Selection for and against production of follicle growth substance, or:-

(b) Selection for and against follicle sensitivity to lack of follicle growth substance.

Progress has been rapid in the separation of high and low lines and by the 5th generation, average 'tabby' whisker scores are 1½ standard deviations apart. This movement has been as sociated with changes in dominance of the gene. Evidence is also accumulating that whisker score is breaking down in normal mice from the low line.

COMPOSITION OF CHROMOSOMES DURING MEIOSIS IN GRASSHOPPER.

by

Sardool Singh.

An attempt has been made to study the changes in composition of chromosomes as they undergo process of Meiosis, through histochemical techniques. RNA has been demonstrated in the boundries of the chromosomes at Diplotene and Diakinesis. DNA forms the main core. Pure Methyl Green and Pyronin are quite satisfactory for picking up DNA and RNA respectively. Spiral Structure of Metaphase may be revealed by RNA digestion. That chromosomes consist of protein and Nucleic Acid fibres can be shown by PCA and Trypsin digestion. Stretched and beaded appearance of the prophase chromosomes result after pepsin digestion. A different behaviour of chromosomes at Metaphase is discussed.

At diakinesis pink layer at edge with methyl green

DNA present in light polynucleotide form RNA at Diakinesis at different edge

THE EFFECT OF TEMPERATURE ON THE MUTATION RATE IN DROSOPHILA MELANOGASTER.

by

B.L. Sheldon.

The incidence of sex-linked recessive lethal mutations in Drosophila melanogaster after heat shock treatment of both larvae and adult males is reported. There was no increase in the mutation rate after treatment of larvae and the results with adult males were not consistent. Treatment of the latter at 38°C caused an increase in mutation rate, due apparently to the large response of a few sensitive males. Treatment at 40°C caused no increase, and if one sensitive male was excluded, the mutation rate was significantly less than control. These results do not entirely support those of previous workers in the literature and possible reasons for this are discussed.

The mutation rate has also been studied, over a series of successive daily mating periods, of males undergoing development at three different temperatures. There was a significant regression (both linear and quadratic) of mutation rate on age, mutation rate decreasing with age of male, and this age effect did not differ between temperatures.

The linear regression of mutation rate on temperature was significant, mutation rate decreasing with increased temperature. Previous results in the literature have supported the opposite conclusion that mutation rate increases with increased temperature. It is postulated that the previous results may have been due to confounding with the effect of temperature on storage of mature sperm. The present results indicate that temperature during development has no direct effect on the mutation rate, since the higher rates with lower temperature are probably a function of longer developmental time at the lower temperature.

B.L. Sheldon.

TABLE 1.

Mutation rates after heat shock of larvae.

Treatment	Number of X-chromosomes tested	Number of recessive lethals	Percentage lethals	Fiducial limits 5% level.
Control	6410	15	0.23	0.13-0.39
36.5-38°C for 1hr. on 4th day	1489	7	0.47	0.19-0.97
36.5-38°C for 6hrs. on 4th day	1387	3	0.22	0.05-0.63
36.5-38°C for 12hrs. on 4th day	1425	4	0.28	0.08-0.72
36.5-38°C for 24hrs. on 4th day	none survived			

TABLE 2.

Mutation rates after heat shock of adult males.

Treatment	Number of X-chromosomes tested	Number of recessive lethals	Percentage lethals	Fiducial limits 5% level.
Control				
38°C for 15 mins.				
Replicate 1	2468	28	1.13	0.76-1.64
Replicate 2	1533	7	0.46	0.18-0.94
40°C for 15-30 mins.				
Replicate 1	918	1	0.11	0.003-0.61
Replicate 2	1809	0	0.00	0.00-0.20
Replicate 3	1922	8	0.42	0.18-0.82

TABLE 8.

Effect of age of male and temperature during development on the mutation rate

20°C			25°C			30°C		
No. of tested X-chromosomes	No. recessive lethals	Percentage lethals	No. of tested X-chromosomes	No. recessive lethals	Per-centage lethals	No. of tested X-chromosomes	No. recessive lethals	Per-centage lethals
126	1	0.79	615	3	0.49	310	4	1.29
482	4	0.83	1010	6	0.59	900	2	0.22
773	5	0.65	1036	3	0.29	797	-	-
901	1	0.11	939	4	0.43	826	1	0.12
1007	1	0.10	849	3	0.35	646	-	-
1082	3	0.28	1000	1	0.10	638	2	0.31
535	-	-	929	2	0.22	453	-	-
435	-	-	821	1	0.12	214	-	-
670	1	0.15	756	-	-	172	-	-
672	-	-	744	1	0.13	147	-	-
533	2	0.38	617	-	-	32	-	-
499	1	0.20	613	-	-	46	-	-
555	-	-	552	1	0.18	21	-	-
440	1	0.23	545	-	-	13	-	-
278	-	-	446	-	-	-	-	-
292	-	-						
282	1	0.35						
294	-	-						
294	-	-						
251	-	-						
194	-	-						
269	-	-						
8988	20	0.223	11472	25	0.218	5215	9	0.173

TABLE 2.

Effect of age of male and temperature during development on the mutation rate

emperature	20°C			25°C			30°C		
of Males	No. of tested X-chromosomes	No. recessive lethals	Percentage lethals	No. of tested X-chromosomes	No. recessive lethals	Per-centage lethals	No. of tested X-chromosomes	No. recessive lethals	Per cent leth
day	126	1	0.79	615	3	0.49	310	4	1.
" (s)	482	4	0.83	1010	6	0.59	900	2	0.
"	773	5	0.65	1036	3	0.29	797	-	-
"	901	1	0.11	939	4	0.43	826	1	0.
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"	251	-	-						
"	194	-	-						
"	269	-	-						
15th day	8988	20	0.223	11472	25	0.218	5215	9	0.1

B.L. Sheldon TABLE 4.

Analysis of variance of square root transformations of percentage lethal frequencies in Table 1.

Source of Variation	DF	Mean Square	F
Between temperatures	(2)		
Linear	1	0.3435	5.90*
Quadratic	1	0.0495	0.85
Between ages	(14)		
Linear	1	1.9421	33.37***
Quadratic	1	0.4230	7.27*
Remainder	12	0.0243	
Interaction			
Linear x Linear	1	0.0024	0.04
Linear x Quadratic	1	0.0012	0.02
Quadratic x Linear	1	0.0114	0.20
Quadratic x Quadratic	1	0.0900	1.55
Error	24	0.0582	

* $P < 0.05$ *** $P < 0.001$

The Introduction of Blue Mould Resistance into *Nicotiana tabacum*

by D.C. Wark.

Range of Variation between Seed Lines of Australian Species of Nicotiana, in Percentage Resistance to Blue Mould.

All Seed Lines Tested in Seedling Stage.

Species	Number of Seed Lines	Range of Variation in Percentage Resistance between Lines
N. benthamiana	3	0-33
N. debneyi	4	93-97
N. excelsior	4	90-100
N. exigua	5	50-100
N. fragrans	1	0
N. goodspeedii	5	66-100
N. gossei	6	17-100
N. ingulba	1	96
N. maritima	1	86
N. megalosiphon	14	29-100
N. occidentalis	11	0-84
N. rotundifolia	7	25-100
? *N. stenocarpa*.?	3(small.)	0-100
N. suaveolens	6	50-100
N. velutina	10	90-100
New species	3	14-100
Unidentified	18	0-100
N. glauca		

Seedling resistance in hybrids between *N. goodspeedii* and *N. tabacum*.

Generation F_1	No. of plants tested	Percentage Resistant
F_1 sterile*	161	0
F_1 amphiploid	3,341	92.3
B.C.1.	4,426	24.6
B.C.1. (selfed)	2,186	18.3
B.C.2. (from unselfed B.C.1.)	1,269	0
B.C.2. (from selfed B.C.1.)	7,680	52.0

No pairing between parent chromosomes - transfer by means of whole chromosomes
Intend to eliminate all other than N. tabacum ones except those carrying resistance
T A
4.8 + ?(3-5) Then X-ray to get resistant genes into N. tabacum by Translocation