PERSPECTIVE

The genetic structure of the Australian sheep industry and the level of adoption of measurement-based selection and of appropriate breeding strategies by ram breeders is of great interest to me and, no doubt, to most other members of AAABG.

However, the relative lack of documented information especially about ram breeding strategies (Walkley 1987), precludes a detailed review of these topics for the industry at large by this author. A substantial review of the structure of the Australian Merino breeding industry is available elsewhere (Banks 1987).

Instead of attempting a full scale review, this paper concentrates on the area of group breeding, firstly reviewing the essential differences between group breeding schemes and the traditional stud ram breeding system, then briefly reviewing the recent fine tuning of the open nucleus ram breeding programme of the Australian Merino Society, and finally, identifying research and development priorities and challenges for the future.

ESSENTIAL DIFFERENCES BETWEEN STUDS AND GROUP BREEDING SCHEMES

Apart from over a century of tradition, the essential differences between group breeding schemes and the traditional stud ram breeding system in the Australian sheep industry boil down to

(i) Choice of breeding objectives
(ii) Level of end-user participation and servicing
(iii) Pattern of gene flows and breadth of gene pool
(iv) Degree of reliance on objective measurement
(v) Extent of adoption of genetic principles and "High Tech" breeding methods
(vi) Extent of marketing of the end product, including ram preparation
(vii) Image and price of the sale rams.
Traditionally, the stud ram breeding system has been strong on visual selection, quality control, corrective mating, ram preparation and shedding, silver ear tags, blue ribbons, white gate posts, heavy promotion and high prices.

By comparison, group breeding schemes have relied largely on population genetics and scientific principles, with heavy emphasis on measurement-based selection and normal environmental "challenges" to produce low-priced rams designed to maximise the rate of profit improvement in commercial flocks. (Peart (1976) and Winter (1987) provide details on the development and operation of group breeding schemes.)

For a time the two systems of sheep breeding followed diverging paths, with stalwarts of each system knocking the other and tending to polarise the ram breeding industry. A consequence of this polarisation was the exacerbation of a dichotomy between sheep breeders and scientists which arose during the 1950s and 1960s (Litchfield 1987), resulting in serious inhibition of adoption of scientifically based sheep breeding programmes by the conventional stud breeding sector (by far the largest component of the industry numerically), to the considerable detriment of both commercial sheep farmers and the Australian balance of payments.

Like political parties, however, the two systems are now converging on middle ground, with greater attention to quality control, product presentation and market image by proponents of group breeding schemes coupled with increasing adoption of measurement-based selection and "high tech" breeding methods by some studs.

There remains, however, a strong conservative wing of stud breeders who continue to rely primarily on visual selection and other subjective assessment which, claims Lewer (1988), is "relatively inefficient" and results in "sub-optimal genetic progress towards the breeding objective". Furthermore, Hamersley (1987), in claiming to represent the views of 500 W.A. stud Merino breeders, rejects the application of modern population genetics to the sheep industry on the stated grounds of lack of measurement precision for some characteristics of value and low heritabilities and repeatabilities of those that can be measured. It is pleasing to find that some stud breeders dismiss this "popular opinion" as a fallacy, and express commitment to the use of quantitative genetic principles in sheep breeding to achieve faster and more consistent genetic gain (e.g. Litchfield 1987).

**Choice of breeding objectives**

Given appropriate understanding of genetic parameters and their economic implications, group breeding schemes dominated by commercial sheep farmers inevitably home in on the selection index which best serves their perceived objective of maximising the profitability of their sheep enterprises. For example, the Australian Merino Society places greatest emphasis on clean fleece weight and fibre diameter, followed by easy care attributes, reproduction rate and body weight, a combination which best achieves members' collective objectives.

In contrast, stud breeders tend to concentrate more on selection for attributes which will help them to sell more rams at a higher price, i.e.
the objective tends to be increased income from ram sales. While this objective reflects in part the performance of rams in the commercial producer's flock, pressure on stud masters to produce "pretty" rams which win blue ribbons, which are desirable to other stud breeders and which show great "peas in a pod" uniformity no doubt significantly impairs the rate of genetic progress towards a more profitable Australian sheep industry.

Level of end-user participation and servicing

End-user servicing in the conventional stud system is usually limited to occasional newsletters (largely promotional), field days (again promotional) and, in some cases, assistance with ram selection and sheep classing.

In contrast, members assume a high profile in group breeding schemes, typically participating not only in the setting of breeding objectives but also in:
- ewe contribution to ram breeding flocks
- ewe classing
- ram culling
- joint learning exercises (field days, etc), and even
- price setting.

Services often provided include a regular newsletter, plus advice on and assistance with sheep selection, breeding programs and management. In addition, the local ram breeding co-operative (RBC) often serves as a focal point for meeting with and learning from fellow progressive sheep farmers.

Patterns of gene flow and breadth of gene pool

Stud society rules and purple books have largely prevented the upward flow of genes in the form of elite base flock ewes which, according to James (1987), could lift the rate of genetic progress by 10 to 15 per cent.

In contrast, the movement of measured elite ewes into ram breeding flocks from all levels in two and three tiered populations has been a universal hallmark of open nucleus group breeding schemes, satisfying Jim Shepherd's oft-stated concern

"That to have these elite ewes breeding wethers is almost a national sin". (Shepherd pers. comm.)

Notwithstanding, some contribution programmes involving daughter studs have been set up within the Merino industry. In some cases, these programmes have been abandoned because of lack of perceived worthwhile benefits.

The harvesting of elite ewes into a smaller nucleus within the overall stud flock is practised in some stud breeding programmes to avoid inbreeding and to concentrate desirable genes, but is not extended to base commercial flocks.
Ram preparation and marketing

The Australian Merino Society can not boast about rams which cut over 20 kilograms of wool, nor of ram prices in excess of $200,000. Most AMS members are content with paddock reared rams bred for ordinary wool cuts at commercial stocking rates, coupled with low fibre diameter and a high sheep enterprise profit per hectare, for which they typically have paid only $120 to $150.

Nevertheless, most members do want to be proud of their sheep and to know how they really compare, and prospective members are no doubt influenced by the glamour image presented by the stud industry. Accordingly, some group breeders are now directing resources towards scientifically valid comparisons with alternative genotypes or strains, whilst other groups, for example GRASS Merinos, have consciously lifted their ram preparation/presentation/promotion package and delighted their members with the prices received for rams surplus to their requirements.

Ram pricing

The normal group breeding approach of cost-of-production plus a reasonable return for effort by the RBC manager is miles apart from the stud breeders' normal criteria of "whatever the market will stand".

Two unfortunate implications of the co-operative type pricing policy of group breeding schemes have been

(i) Low quality image - since price is normally regarded as indicative of quality; and
(ii) Poor RBC profitability - because inaccurate pricing has failed to give the ram breeder
(a) a reasonable profit
(b) adequate reward for extra effort and presentation
(c) surplus funds for capital improvement, adoption of improved breeding technology and for research and development.

This emphasis on low ram prices to achieve perceived social equity in group breeding schemes, but which in reality has transferred a disproportionate share of the benefits to commercial flock owners, has undoubtedly inhibited AMS and other group breeding schemes by precluding adoption of the best possible package of breeding strategies and also by restricting research and development. The Federal Executive of the AMS has recently addressed this problem and has lifted the recommended flock ram price to $300 for 1988, with a minimum price of $200.

BREEDING STRATEGIES OF THE AUSTRALIAN MERINO SOCIETY

The recent review of the AMS breeding programme by a Consultative Committee including eight of Australia's leading sheep geneticists (Winter 1988) has

(i) Confirmed the genetic advantage of the basic structure of the AMS breeding programme;
(ii) Highlighted the need for groups of members in geographically remote...
The upward flow of elite ewes, coupled with acceptance of members from all strains or bloodlines, gives many open nucleus breeding schemes, such as the Australian Merino Society (AMS), an extremely wide genetic base. The AMS programme, as a consequence of its wide geographic spread and open entry, includes genetic material from practically all strains and bloodlines of Merino in Australia. Some groups, however, have elected for a restricted base, for example, the GRASS Merino group in New South Wales which has accepted only members with flocks of Haddon Rig bloodline. In the traditional stud industry, ram source has been the prime determinant of breadth of genetic base in any particular stud. Historically, many studs have maintained relative "purity" by purchasing bought-in sires only from their parent stud or other closely related studs, i.e. the gene flows have been mainly vertical, within strains or bloodlines (Banks 1987). In recent years, however, relaxing of attitudes and the ready availability of frozen semen from a wide range of sires has increased the lateral flow of genes between studs and bloodlines, as well as greatly improving access to elite rams in parent studs of the same bloodline. In the South Australian stud Merino industry, at least, the flow of genetic material as frozen semen has not been well documented.

Reliance on objective measurement

The extent of reliance on objective measurement remains a major fundamental difference, although many stud breeders are increasing their use of measurement, especially as an aid to ram marketing. A few studs placed heavy reliance on measurement long before group breeding schemes evolved, but, despite substantial evidence to the contrary, it is still claimed by one prominent stud breeder that "Experienced Merino breeders generally consider their own eyeball appraisals as accurate and much quicker to apply than machine skills" (Hamersley 1987).

Measurement-based selection remains a central philosophy of group breeding schemes, and although quality control screening has become increasingly practised, the overall level of measurement is rapidly increasing in some groups, for example, the adoption of micron testing of ewes, testicle scoring of rams, fleece colour appraisal and progeny testing in the AMS.

Adoption of genetic principles and improved breeding methods

Close liaison with the scientific community and extension services by group breeders has undoubtedly facilitated early adoption of improved breeding methods as they have become available, by comparison with much of the stud sector where influential stud owners and advisers/classers have perceived the scientific approach to be of little value or relevance and/or a threat to their existing position.

Nonetheless, the price structure, profitability and market orientation of several leading studs has enabled more rapid adoption of some of the latest breeding technology, firstly frozen semen with laparoscopic insemination and more recently multiple ovulation and embryo transfer. As well as being first off the rank with adoption of high cost leading edge breeding technology, these same high-tech studs have been able to devote resources to further research and development of improved techniques.
and/or environmentally dissimilar areas to review their breeding objectives, and, if necessary, form separate nuclei;

(iii) Identified an urgent need to upgrade the process of identification of ewes being introduced into ram breeding flocks; and

(iv) Identified a number of "fine tuning" refinements which would enhance the overall rate of genetic progress.

The recommendations of the Consultative Committee were considered in detail and adopted in principle by the Federal Executive of AMS at a meeting in February 1988 and a committee of Federal Executive was formed to incorporate the recommendations into the AMS breeding plan.

AMS breeding objective

The ultimate breeding objective of the AMS is "To maximise the rate of genetic progress towards improving the profitability of members' sheep enterprises".

This, of course, is subject to reasonable practicality and costs. Accordingly, the acid test applied by Federal Executive to any proposed changes to breeding and/or management programmes is now and will continue to be, "What will be the effect on the rate of genetic progress?"

Members' perceptions of how best to achieve their basic profit objective have been surveyed and documented (Winter 1988), the general consensus being that bodyweight is adequate and that lowering fibre diameter should receive high priority, coupled with higher clean fleece weight and higher reproductive performance. There is also a preference for increasing polledness, even better easy-care attributes and general quality improvement.

Basic AMS programme

For the AMS programme, the Consultative Committee confirmed:

- a 15% genetic advantage over a closed flock system of similar size
- approximately 6% difference in genetic merit between tiers
- an achievable rate of genetic gain of approximately 2.0% per annum with a three-tiered system
- slightly slower progress (1.95% per annum) with only two tiers
- very low rates of inbreeding, even in relatively small populations, and
- near-maximum rates of genetic progress in a ram breeding flock of 1000 ewes - i.e. large population size is not critical.

Groups of members with compatible breeding objectives

Given their preference for relatively low micron white wool and strong resistance to fleece rot, AMS members breeding sheep in the high rainfall areas in New South Wales and Victoria have for several years questioned the wisdom of using rams from a nucleus flock comprised primarily of ewes from wheat-sheep and medium rainfall areas, mainly of S.A. strains.

The Consultative Committee concluded that "two or more nuclei with different selection indices and foundation genetic material may now perform better than a single nucleus", and also, that a separate breeding
group is warranted if there is less than 80% correlation of the breeding objectives of members in a particular environment (or with different end-product objectives) with the breeding objectives of the mainstream Merino programme.

The AMS is now investigating the feasibility of setting up a separate Merino top tier nucleus near Armidale in New South Wales (in conjunction with the University of New England) to cater for the requirements of members in high rainfall areas. One local ram breeding group in a high rainfall area in north-eastern Victoria has already decided to operate with a two tier nucleus structure under the AMS umbrella, but with no gene flow to or from a top tier flock. Other groups remote from or in environments significantly different from the mainstream nucleus flock at Kojonup W.A. are evaluating the genetic and financial implications of participating in separate nuclei.

**Micron testing ewes**

For reasons of simplicity and low cost, the AMS sheep breeding programme evolved with ewes selected on greasy fleece weight and body weight alone, despite prominent inclusion of lowering of fibre diameter in the overall breeding objective. The markedly divergent directions of selection implicit in the old AMS indices for ram and ewe selection, and the consequent loss of efficiency in the breeding programme, is arguably the most serious shortcoming identified by the Consultative Committee.

To meet this challenge, Federal Executive has now endorsed a policy of micron testing all suitable replacement ewes at ram breeding flock level and is pressing for testing of at least a portion of maiden ewes at contributor level. At 1987/88 AWC floor wool prices, micron testing of commercial flock maidens to identify flock replacements as well as contribution ewes is justified financially (England 1988), the payoff being even greater at 1988/89 floor prices.

Two RBCs have micron tested their maiden ewes for the past three years and many more members adopted micron testing of ewes in 1987 as testing services became more widely available at reasonable cost. Analysis of wool samples from ewes contributed to Keilira RBC in 1987/88 has revealed fibre diameter variations of approximately 5 microns within contributor teams (each of only 10-15 ewes) and a fleece value variation of over 100 per cent. Hard evidence of this type coupled with a strong promotion campaign will undoubtedly result in a high rate of adoption of micron testing at all levels of AMS in 1988. To encourage micron testing, many RBC managers are providing assistance to contributors both in fleece sampling procedures (and subsequent sample processing) and in identification of ewes most suitable for inclusion in ram breeding flocks. Contributors are being encouraged to test all maiden ewes (apart from visual culls).

**Fine tuning refinements of the AMS programme**

To improve the overall rate of genetic progress, the Consultative Committee has also recommended:

* use of top-measuring RBC-bred rams for ram breeding at RBC level, together with rams from the appropriate top-tier nucleus (in about equal proportions)
revision of ewe contribution rates so that contribution ewes comprise about 40% of total ewe number in all ram breeding flocks
progeny testing of all rams used in top-tier nuclei or in AI programmes
winding down of the large scale fresh semen AI programme
sequential culling of both rams and ewes, to optimise the balance of selection differential and generation interval
adoption of linear Woolplan-type selection indices for selection of both ewes and rams
testicle measurement and inclusion of testicle score in the ram index
genetic separation of the evolving Meridale and F-gene programmes, pending full evaluation and proof of merit
improved accuracy of animal identification and measurement, including pregnancy testing, mid-side sampling for fleece testing; adequate wool growth before testing; additional recording of progeny groups by age of dam, date of birth, etc; and fasting before body weighing, and
evaluation of true genetic merit and rate of progress.

These recommendations have been accepted and promoted by Federal Executive and are being incorporated into the AMS Breeding Plan. Several of the recommended breeding strategies have been practised in a number of AMS ram breeding flocks, including the top tier nucleus, for several years. Following their endorsement by the Consultative Committee, widespread adoption of most of these breeding strategies by AMS RBC managers is expected to occur rapidly.

Three specific areas need further clarification and development:

(i) Progeny testing will be applied to all new sires used in the top tier Merino flock at Kojonup, but may not be widely adopted at RBC level, pending further evaluation. Keilira RBC has progeny tested over 20 rams in each of the past three years, and will continue to test all new sires at their first mating, together with a few top older rams as reference sires,
   (a) to detect inherited faults (if serious, the entire sire progeny group is automatically culled)
   (b) to more accurately ascertain the genetic merit of individual rams
   (c) to generate sib information to enhance accuracy of estimation of breeding values.

(ii) The winding down of the fresh semen AI programme (on the grounds of limited availability of progeny tested sires of significant genetic superiority over back-up sires) is of concern to some members. This concern must, I believe, be alleviated by making frozen semen available from proven elite sires as soon as possible, involving laparoscopic insemination in the short term. Two laparoscopic programmes on AMS ewes in 1988 (including one at Keilira RBC) gave outstanding results, costing approximately $15 per lamb reared (excluding semen cost). Hopefully, an early breakthrough in AI research will soon provide members with a low cost intravaginal frozen semen option.

(iii) The inclusion of four AMS ram breeding flocks in the ABRI strain comparison trial in W.A. plus a separate linkage with the University of N.S.W. control flock should provide a meaningful comparison between AMS and other bloodlines. The Consultative Committee's
recommendation of establishing a semen bank to measure long term genetic change has not yet been implemented.

Projected payoff from genetic progress - the bottom line

The predicted rates of genetic progress per generation with the recommended breeding strategies are CFW +0.14kg; FD -0.6 microns; RR +0.6%; HLW +0.3kg and mature live weight +0.1kg. Over 10 years, this equates to an extra 0.4kg of clean wool of 1.8 micron lower fibre diameter, coupled with a 2% increase in lambing percentage and a small increase in bodyweight. This "package" corresponds closely to members' perceived breeding objectives, and, on the ultimate profitability objective, equates to an increase in enterprise income of around $12 per breeding ewe (equivalent to a net profit increase of around 60 per cent!).

THE CHALLENGES OF THE FUTURE

The main challenges facing AMS in the immediate future are

(i) Implementation of a breeding plan which simply and efficiently achieves the identified capacity for genetic gain towards improved profitability of members' sheep flocks

(ii) Identification and evaluation of additional opportunities to further enhance the rate of genetic progress, for example, use of BLUP type data handling techniques and multiple ovulation and embryo transfer

(iii) To rapidly develop AMS into a suitable umbrella organisation to service and provide benefits to all member groups of performance breeders, irrespective of whether or not they participate in the mainstream Merino programme:
   (a) Education - to improve members' understanding of genetic principles and of practical breeding and management strategies
   (b) Management - to develop systems to make better use of performance bred sheep
   (c) Marketing - to improve returns from sale of superior wool and surplus performance bred sheep, including rams surplus to members' requirements
   (d) Research and development - to conduct certain research funded entirely from AMS resources, but primarily to initiate joint research programmes into problems of high priority to AMS but also of relevance to the rest of the industry

(iv) To ensure equitable distribution of genetic improvements and knowledge (management systems, etc) between participating members, with appropriate sharing of rewards by the managers of ram breeding flocks.

RESEARCH PRIORITIES

As from July, 1988 AMS will have a clearly identifiable source of research funding in the form of a research levy collected on a per capita basis.

A formal research priority evaluation process has been initiated and already the AMS Research Committee has identified the following high priorities:
frozen semen techniques for intra-vaginal insemination
accuracy of measurement (including optimal wool sampling site and
effect of diet on selection accuracy)
design and analysis of progeny testing programmes
pigmented fibres and associated selection strategies
disease resistance, and
Meridale and F-gene projects.

It is anticipated that most research proposals will be formed up on the
basis of joint programmes involving one or more of the traditional
research organisations (Universities, Departments of Agriculture, CSIRO,
etc) with the primary AMS role being in the areas of
problem definition and prioritisation
preparation of joint submissions to funding bodies
provision of sheep, grazing and other facilities
evaluation of research findings and development into practical manage-
ment packages, and
communication to members for rapid adoption.
The Australian Wool Corporation funded frozen semen research project
involving AMS in conjunction with Sydney University, the South Australian
Department of Agriculture and Collinsville is a classic example of the way
in which AMS may become increasingly involved in large scale applied
research projects.

SHORTCOMINGS OF EXISTING KNOWLEDGE AND TECHNOLOGY IN ANIMAL
BREEDING

Independently of the research priorities identified by the AMS Research
Committee, I have identified several problem areas which I believe deserve
high priority.

(i) Computer software systems for upgrading the estimated breeding
value of animals as additional data becomes available (e.g. subsequent fleece weight, bodyweight and fibre diameter measurements;
own reproductive performance; average measured performance of
4 sibs; measured performance of offspring, etc)

(ii) Market forecasting - more guidance is needed to help animal
breeders to select appropriate economic weightings for inclusion
in linear indices.

(iii) Effect of regular index upgrading - What is the expected loss of
efficiency of a breeding programme which modifies economic
weightings in the selection index regularly (maybe even annually)
as new information and changing market prospects dictate, by com-
parison with another programme which sticks hard and fast to a
"best bet" set of economic weightings, irrespective of short
term market fluctuations?

(iv) Sheep identification systems
- significant ear tag losses have been experienced, causing serious
loss of breeding system efficiency
- products at present available for identification of ewes on
oestrus or those backed up after an Al or progeny test programme
have serious limitations in some circumstances, especially with
long wooled ewes.
One colour (Yellow) has arbitrarily been removed from the range of spray mark products available.

(v) Clarification of the real importance of product characteristics, for example, the significance of increased tensile strength and lowered variability of fibre diameter on the processing performance and end-use value of wool

(vi) Improved knowledge and accuracy of genetic parameters, especially the heritability and correlations associated with testicle score and tensile strength of wool

(vii) The effect on genetic parameters of long periods of selection.

SUMMARY

I believe that group breeding schemes will continue to be a force in the Australian sheep industry and that they will play an increasingly important role in the researching, development and evaluation of breeding strategies and technology.

Because of their unique structure, especially the concern for and communication with "grass roots" members, group breeding schemes will experience very rapid adoption of advantageous new technology and management practices, thereby greatly shortening the lag time for adoption of research findings in the sheep industry at large. This has implications for public and private research organisations and for industry research and development funding bodies who may find it advantageous to redirect effort towards members of group breeding schemes to ensure rapid adoption of available technology and new findings.

Operators of group breeding schemes will, I believe, increasingly liaise and co-operate with the closed studs which follow sound measurement-based breeding programmes, with consequent improvement in the effectiveness of research, development and general advancement of the Australian sheep industry. This concept has recently been supported publicly by Neil Garnett, principal of Collinsville.

Although the hierarchical stud system will become increasingly performance oriented in the future, three major differences from group breeding schemes will persist. Firstly, unless rules are changed, studs will not be allowed to introduce outstanding ewes identified in the base flocks; secondly, closed studs are not likely to fully adopt the strictly commercial profit-oriented objectives of their clients and, thirdly, studs will be unable to effectively develop the integrated "ram/breeding-system/management" packages which profit-conscious members of group breeding schemes like the AMS will increasingly demand and receive - only with a good sheep nutrition/management programme will commercial sheep farmers reap the full benefits from an efficient breeding programme.

REFERENCES


APPENDIX: SUMMARY OF ANNUAL BREEDING PROGRAMME FOR KEILIRA RBC

January: Quality control screening of all breeding ewes, plus sequential culling; surplus ewes sold off-shears to contributors

February: Progeny test mating of 16 maiden rams (8 home-bred + 8 from top tier) with 4 older rams as reference sires

March: Natural mating and back-up mating after AI and progeny testing

April: Shearing (ewes and worker rams); maiden ewes and rams remeasured

May: Pregnancy testing

June: Testicle scoring of hogget rams

July/Aug: Lamb marking with double tagging of sire progeny groups

September: Hogget body weighing and shearing, including fleece weighing, fleece sampling and colour scoring

October: Mean lamb/shearing; worker ram shearing and remeasurement

November: Ranking and distribution of rams plus surplus workers

December: Intake of contribution ewes

August to December: Final ranking of hogget ewes, identify ewes for contribution

FLOCK STRUCTURE OF KEILIRA RBC

<table>
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<th>Age at Lambing</th>
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<th>Age at Mating</th>
<th>Rams Present</th>
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