# SUMMATIVE ADDRESS

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It is an honour but a challenge to endeavour to draw this most stimulating and wide ranging Conference towards the conclusion which it deserves.

The review theme of the Conference, and a forward looking theme is "when and how pasture technology has fitted/can be fitted into farming practice". That theme has been woven throughout the design of agenda and structure of participants in both conference and field sessions. It would be a tremendous pity if this theme, to which all of you have so effectively contributed, is observed only for five days every five years. After all, it should properly be our continuing dedication. We have no future as pasture scientists, extension officers or producers otherwise.

The scope of the conference has extended from considerations of extensive natural sheep and beef pastures of the monsoon tropics and arid zones to the intensive pasture technologies of high rainfall and irrigated dairy situations. It has covered many components of climate - soil - plant - animal systems, a few of their interactions and their integration into systems at farm enterprise level. It has touched on many, but by no means all of the areas of disciplinary expertise - from animal genetics to economics and from research through extension to the integrating expertise of the producer.

More than at any previous Conference, we have witnessed a unity in pursuit of a common goal. That goal is to increase the productivity of our tropical grazing industries while maintaining or improving the soil and vegetation resources on which these industries and the nation rely.

This goal meets all the criteria of John F. Kennedy's maxim in challenging NASA to put a man on the moon - "if people are to work effectively together towards a common goal they must be set a goal which is bigger than all of them". How, does one capture the essence of what we each must do to meet that goal in the summative address of this very fine conference?

I have elected to proceed with the above goal in mind by reversing the sequence of this conference and following some key elements of systems down through relevant components to a few areas of disciplinary interest that appear to hold promise for change - and therefore for feedback influence on its attainment.

In doing so the term productivity is used in the economic sense of output returns relative to input costs. This usage encompasses the option of production increase but not exclusively or necessarily so. However, where productivity is being pursued by improving the nutrition of the grazing animal which is the ambit of pasture technology - whether by increasing the quantity

or quality of the animals diet or both - it is frankly impossible to see how this can be accomplished without increasing production per se. Admittedly there are more or less costly ways of doing this, but if we are to be restricted to zero production increases there will be enormous consequences to the emphasis and level of technological effort. The market future is therefore a pivotal element which has been discussed many times. It was addressed by Robert Harrison in his Stobbs Memorial Address to the Conference and it pervaded discussion on the open day with producers.

## The market future

The nature of competition is that the winners of market share offer commodities of higher quality or lower cost or both. There appeared to be a tacit assumption in discussion that we could do little more than defend our current share of American and Japanese beef markets, and that retention of the Japanese ox trade with tightening quality specifications was almost the total challenge. There is no doubt that this challenge is real and relatively short term.

It does however set an horizon which Harrison saw leading either to fewer producers with more and more of our production from native pastures being locked out of markets; or to gluts and depressed economics. There are similar connotations still in the dairy industry.

So far as beef is concerned we should be prepared to contemplate two propositions -

- that there may be major shifts to higher quality requirements in all domestic and export markets of much wider impact than the Japanese changes alone
- that an ability to offer meat of consistent high quality at competitive prices may find market share where it is not presently apparent.

I claim no real wisdom on this subject, but we have an emerging pasture technology which offers real chances of competing in this way and we must lift our competitive horizon. Ultimately, the producer will bear the brunt but there is little real risk in pasture technology proceeding on this assumption. Bearing in mind the time scale of research advance and technology adoption we have no choice but to pursue options that will enable the producer to respond to this scenario if and when it emerges.

In this context and returning briefly to the subject of consistent high quality, there is little doubt that inconsistency is a major source of consumer dissatisfaction with Australian beef. My advice is that much of this variability is explained by the immediate preslaughter treatment of cattle, and the post-slaughter treatment of carcases. Even so, there is controversy surrounding the effects of nutritional stresses on growing cattle on the eating quality of meat and this controversy needs to be removed

by appropriate research. At the very least it would provide a more certain path for many to follow in both production and marketing. It could however reveal the inadequacy of a pasture technology which reproduces the nutritional cycle of native pastures, albeit at a higher nutritional plane, which was noted with reference to Leucaena as a major example of departure from this generalization. The dairy feed year story of Lowe and Hamilton* provided another important example.

## The management of trees and woody plants

The significance of woody plant competition on pasture production and preventive and remedial controls were addressed by Burrows et al. and Scanlan.

These papers evidence the sound ecological principles which have been established in recent years and which provide a basis for managing these problems at the preventive end by approaches that are also consistent with protection of wild life habitat, complementary timber production, and avoidance of hydrological problems with saline ground waters.

Translation of these principles into specific courses of action at property level leaves much still to be learnt to facilitate positive action. I am thinking particularly of the robustness of these principles in the face of episodic population explosions, the assumption of juvenile suppression by grazing pressure when ecological change is being primed by the fertility changes associated with fertilized legume inclusions in native pastures; and the explicit difficulty of defining and achieving tree species, densities and wood lot locations for the control of hydrological problems in particular landscapes. The treatment of these issues was generally reassuring in the sense that the problems are recognized and subject to current research.

Burrows et at. dealt specifically with the invasion of the Mitchell grass lands by Acacia nilotica. A subsidiary issue to any attempt to control A. nilotica will be a demand for substitute shade and fodder trees for the Mitchell grass lands. Whatever our apprehensions, and several emerged in discussion, there is an obligation to address this demand. There is already evidence with A. nilotica that first Flinders grass and then Mitchell are vulnerable to the increased grazing pressures which are associated with legume augmentation - a direct analogue of the Stylosanthes - tropical tall grass situation which adds another dimension to the future problems of these vast grasslands.

## Animal nutrition

In the excellent paper on this subject by Hendricksen et al. there was an important assertion for first stage native

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* All references in this paper are to papers that are published in these Proceedings.

pasture improvement with legume augmentation, that direct P supplementation of animals (and of other minerals) is sufficient provided the legume can be maintained without fertilization and provided all animals acquire optimal mineral intake from the supplement. It was somewhat surprising that this attracted little discussion in at least three contexts -

- the significance to immediate development strategies. If equivalent animal growth rates and hence more rapid turn-off can be achieved at lower costs this should provide an attractive option for extensive pastoral holdings.

- the separate influence of fertilizer on legume growth and presumably carrying capacity on mineral deficient soils. In such situations direct supplementation foregoes this second dimension of increased productivity.

- the practical difficulties of achieving uniform and continuous mineral supplementation of animals in commercial situations - particularly during the wet season and with uncontrolled waters. There is obvious scope for developmental work to overcome these difficulties.

Vercoe and Frisch discussed the negative correlation between the inherent productivity of livestock breeds and resistance to nutritional, parasitic and temperature stresses. The stress resistance of B. indicus and indicus derivatives associated with reduced feed intake is a matter of inconsequence at lower nutritional planes, but one which will presumably become more significant as pasture improvement increases the nutritional level. It is to be hoped that this apparent genetic linkage can be overcome, preferably directly by breeding; but if not by immunological methods of hormone control or by other methods of increasing the rate of passage of digesta.

These authors were properly restrained on the subject of genetic engineering and elected not to speculate at all on the likelihood of such advances as lignin digesting microorganisms in ruminal microflora. I shouldn't either but can't resist the observation that such an innovation would completely transform grassland science and the traditional grazing industries.

In more serious vein, there was a very useful exchange on the issue of adapted cattle, NPN supplementation and botulism vaccination combining to result in higher grazing pressures on native pastures during their vulnerable early regrowth stages in spring and early summer period. This has often been the subject of unproductive rhetoric between animal and plant scientists and it was my intepretation that both sides now see the issue as one where the managerial changes can have degradative repercussions on native pastures which will have to be adjusted by further managerial changes.

This leads logically to the next element of systems - and another example of the same phenomenon.

## Legume augmentation

It is clear that injection of legume into native pasture starts a successional change mediated via grazing pressure that leads almost inevitably to the loss of the original grass dominants. In some cases, such as the coastal Burnett other successional grasses like couch grass emerge without further intervention. On the Darling Downs the equivalent is Urochloa following annual medics. In other cases, such as the dry tropics, the succession is often to inedible weeds or bare ground.

There are arguments that low-input systems may be managed at lower grazing pressures to obtain the advantages of legume to animal growth rates while retaining the original grasses, but the general recognition is that even minor interventions start a chain of events that lead to further interventions and ultimately the introduction of more resilient grass species. Whether we proceed via low P and S requiring grasses to husband cash flows or jump directly to P/S fertilization of a different suite of grass species - proceed we must once the process has been started.

What is our professional responsibility on this issue. The first responsibility is one of honesty and some humility about the fragility of our technology. The second is to treat the subject of second stage technology as a matter of priority. Provided we do this we can be confident that the problems are surmountable, and probably producers will feel likewise and be prepared to run with the risks.

At the opposite end of this spectrum of change is the situation of sown grass pastures on high nitrogen fertility clay soils that revert due to nitrogen immobilization and to reduction in the rate of nitrogen cycling through above ground biomass.

## Rate of N cycling

The understanding of this phenomenon that has emerged in recent years has provided the important unifying principles that animal production relates directly to the amount of nitrogen cycling, and that for given amounts of cycling nitrogen, animal production is (with only minor variations) almost independent of grass species - native or exotic. These principles were barely touched in formal conference sessions, e.g., Clewett et al but it was my observation that they featured quite prominently in many discussions out-of-session.

In the case of declining grass pastures the obvious recourse is to search for adapted legumes - and this particular need for legumes on clay soils was highlighted by both Williams and Clements and Staples et al.

There is however a much wider need in many climatic and edaphic situations which leads to the general topic of

## Selection of adapted legumes

There were references to the time scale of sown pasture evolution in temperate Australia, and to the genetic diversity that has evolved there to match the needs for specific plant adaptations to environment. These references were used to substantiate the relatively rapid progress in tropical Australia over thirty years, and the need for a plethora of specifically adapted cultivars and possibly species.

The history in southern Australia evidences rather the extraordinarily wide adaptation of a relatively few legume species and very few genera - Trifolium, Medicago and possibly Ornithopus. It is suggested that this might be transcribed into the pursuit of broadly adapted herbage species in tropical Australia. Is it not likely that the apparent need for very specific adaptations is the result of temporary enthusiasm for some species with very narrow adaptations, and the absolute aversion to even minor management modifications that could broaden significantly the useful adaptation of others?

Leucaena leucocephala is showing all the signs of a broadly adapted species but it is important to note that it is not the "throw it from the saddle, flog it into the ground" species that many keep saying we must have. It does in fact require a fairly sophisticated management and industry appears ready to observe its requirements.

Stylosanthes also has very broad climatic adaptation and is managerially resilient. In this case it has been challenged by disease, and is requiring the major intervention of pathology and plant breeding outlined by Irwin et al.

The concept of adaptation as something that has to encompass all the interactions of climate and soil and withstand the total range of managerial finesse and abuse is surely fallacious.

The cooperative species evaluation strategy now in place in Queensland is directed towards broad adaptation. Do we know what this means and how we can identify it? Adaptation reflects the degree of stability of production across sites and seasons. My impressions are that pasture agronomists do not put nearly enough weight on plant responses between seasons within sites and that this is a source of the belief in specific adaptation. Specifically, we rely on perennation from single plantings to assess this yet so often the success of a perennial is determined in its establishment phase. Could we find advantage (and economy) in learning more about between season variation within sites before proceeding to evaluations across sites? A major impediment to this is the lack of experimental machinery for land preparation, planting, forage harvesting and seed production which would mechanize the labour intensive procedures of herbage plant evaluation and permit a quantum jump in the logistic scale of this work.

The whole evaluation - commercialization chain has attracted considerable attention at this Conference - particularly in the

regional papers. I have canvassed what appears to be a consensus that the science has not put nearly enough effort into the development phase of new species, and that a greater involvement of the producer coupled with a greater preparedness of scientists to wrestle with problems identified by producers in this phase is necessary. There is also consensus that overpromotion and unwarranted confidence in the robustness of technology has had some very negative outcomes. Surely we can do better in future.

## Integration of systems

This very broad subject was examined in economic terms (Wicksteed and Williams), in descriptive terms (Clewett et al.) and in terms of modelling and computer simulation (Teitzel et al., McKeon and Rickert). It was further examined in the context of Australian technical support for developing countries (Shelton et al.).

Many excellent points on pasture research and adoption of improved pastures in developing countries were made in the last mentioned paper and in subsequent discussion on this topic. A number of the issues are mirror images of issues in tropical Australia. It seems that our expectations of our effectiveness in developing countries are somewhat in excess of our effectiveness and our expectations at home. The roots of these problems lie in the inadequacy of much current technology and it is in this direction that we should look for improvements.

On the subject of systems I would like to link up two points that emerged in the Conference

1) The idea of demand-pull vs. supply-push technology.

2) The idea of component technology being subservient to the system.

The paper on dairy pastures (Lowe and Hamilton) illustrated the tight relationship which has been developed between weaknesses in the dairy feed year and research response. This is a very real demand-pull system with matching producer involvement which has made impressive progress and achieved relatively rapid adoption. A less obvious feature is that much of the component technology has its origins elsewhere, e.g., in NZ rye grass and southern Australian legume breeding programmes, and in past research on grass responses to nitrogen fertilization.

There are real dangers in the pragmatic demand-pull orientation that excessive emphasis will damp down the rate of component innovation, and ultimately progress in system productivity. It is also characteristic of demand-pull that the time horizon is short term. This is understandable but can lead to avoidance of longer term problems and to a procession of research from one crisis to the next. The professional has an obligation to fight for those things that his training enables him to foreshadow.

The producer has a responsibility to permit and expect a sensible balance between pragmatic, systems-oriented research and the creative, component or discipline-oriented resear ch.

The progress with modelling of production systems is offering two very positive outcomes in quite different directions.

It is, on the one hand, providing a research framework which increases the cohesiveness of research teams, the sense of purpose in scientists and it can capture an applied orientation of process science which is nevertheless creative and otherwise uninhibited There are obvious opportunities being identified for process science which are not being pursued as readily as they might.

On the other hand there is a proliferation of userfriendly software for producers and extension officers which will facilitate the design and analysis in biological and economic terms of production strategies. This latter development is to my mind the major priority at present. Success in this area will have an enormous feedback on the credibility of modelling which will in turn lead to further improvement in the power, accuracy and utility of models.

## Research and extension resources

On a number of occasions during the Conference, concern was expressed about the limitations and decline of research and extension resources relative to the major problems which still confront pasture stabilization and improvement in northern Australia. Tropical pasture research and development deserves strong advocacy in the political arena and can be projected in cost:benefit terms of national significance. Nevertheless, agricultural science is caught up in the move to reduce government expenditure relative to that in the private sector and we are unlikely to escape the influence of that movement.

This behoves us - scientists and graziers - to find other ways of accelerating the development of effective technologies and their adoption. Graziers have played a significant innovative role in tropical pasture improvement; but their contribution has been limited by scepticism and traditionalism and to a degree, by underpromotion of their role by scientific organizations.

There is considerable scope for expansion in the innovative effort of graziers in pasture improvement. Such an expansion could accomplish much towards establishing plant adaptations and developing systems to make best use of new species in production enterprises. The feedback effect of this on pasture research would be very valuable. Uncertainty about new technology tends to obscure the fact that industry has the total stake in productivity gain. The challenge is there for industry to accept more direct responsibility, and for the pasture science profession to facilitate such an emphasis. This Conference has provided excellent examples of what could be achieved on a much larger scale.