AGRICULTURAL SCIENCE IN THE HUMAN ENVIRONMENT

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A PRESIDENTIAL ADDRESS provides scope for all manner of latent talents to become apparent in those who have to devise them. It permits subconscious desires, long submerged by the need for professional respectability, to come to the surface. While it is true that this Society has had its share of presidents who have, wisely, been content to survey their own field of science, it has also thrown up a remarkable number of latent historians, and a few potential scientific administrators, some of whom have eventually realized their potential, and now have to reap the crop they once so unthinkingly sowed. One even turned archaeologist, reminding us of the nutritional state of Neanderthal man, and, recently, otherwise respectable scientists have gone so far as to masquerade as economists and overseas marketeers.

However, one subject we seem never to have considered at this point in the Annual Conference is the place of the New Zealand farmer in the general scene of animal production and animal science. We have neglected the human environment in which our science has to function and the impact which our scientific findings and proposed technological changes may have on that environment.

At the imminent risk of being categorized as a frustrated sociologist, it seems to me important to emphasize that agricultural science attains its highest fulfilment and is truly effective only if it achieves something more than mere technical answers to problems. To be effective the scientific solution must be readily applicable within the economic and social framework of individual farms. Many technical developments meet this requirement automatically. Thus, higher yielding crop varieties need not strain the human resources of farms where crops are normally grown, and it may be no more difficult to administer an effective anthelmintic than to give a less effective one. However, there are areas of agricultural science, chiefly those concerned with operations research and management, rather than those devoted to new product develop-

ment, where the only truly effective research answer is one which recognizes and is valid for the human environment in which it will be applied.

Let us, then, look very briefly at this socio-economic structure of farming within which agricultural science must make effective contributions.

THE SOCIO-ECONOMIC STRUCTURE OF AGRICULTURE

Some may see it as a tribute to agricultural science, but it is equally a tribute to the enterprise of the New Zealand farmer, that the industry is still economically viable even though caught between the upper millstone of rising costs and the nether one of severely declining or, at best, static prices. Increasing economic efficiency through the application of science, and farmer enterprise, is enabling the industry to meet—if not to surmount—the challenge of adverse costs and prices. This is, and always has been, in greater or lesser degree, a normal state of affairs. The need for technological adjustment to meet altered economic circumstances is one of the facts of life with which farming has always had to live. This is because the prices of primary commodities tend to remain more stable over longer periods than do the costs for labour and those secondary manufactures needed to produce the primary commodities. One needs only instance the average 1% per annum rise in the price of wholemilk over the past 15 years and set against it the average 2.6% per annum decline in the purchasing value of the currency to see how the internal terms of trade continually run against the farmer.

This exemplifies the major economic reality of agriculture and although, as farmers, we may hope for, we cannot, as scientists, logically expect any abrupt deflection of this inexorable economic tendency.

Probably the most important social reality facing New Zealand farming is the steady decline in the farm labour force (except in times of atypical deflation). Herein lies a fundamental difference between primary and secondary production which is not always appreciated but which does affect their rate and potential for expansion. The progressive manufacturer may expand existing premises, install additional machinery, and employ more labour (without the problems of housing and/or feeding it in his own home). As his business expands, his own endeavours move on to a higher, managerial plane and he employs

others to do the more mundane tasks which formerly he carried out.

Similar expansion of the means of production on the part of the progressive farmer is, paradoxically, legislated against, not for explicit reasons of economics or efficiency, but to satisfy the negative political dogma of avoiding land aggregation. Expansion of the area farmed by one individual may involve the social upheaval of moving to a new home in a new area and leaving the familiarities and friendships of half a lifetime behind. If the farmer can increase the carrying capacity of his existing acreage he, personally, has to be prepared, in very many instances, to work the longer hours, to bend the back, to exude the perspiration. Inevitably, resistance arises among farmers to undertaking extra work at the top end of the perspiration scale for small net returns at the top end of the income tax scale. The Agricultural Production Council denies this disincentive on the basis that only 5% of farmers pay the *highest* rate of tax. But farmers at this tax level are probably more analagous to the labour-employing captains of industry. It is the smaller farmer, who sees one-third or one-half of the *extra* earnings of the *additional* sweat of his own brow paid out in tax, who is going to be particularly disenchanted.

These, however crudely stated, are probably the chief economic and social pressures which normally impinge upon the individual farmer; costs rising faster than prices, a shortage of labour, doctrinaire, restrictive legislation, high taxation of the fruits of additional hard work, all conflicting with the desire to maintain, even improve his standard of living.

What then can be done about this apparent conflict?

A SOCIAL REVOLUTION?

The solution proposed by the late Dr Peter Sears was to make farming more like manufacturing, by amalgamation of farms into larger units, by the attraction of labour through competitive salaries, hours of work and holidays, and by the attraction of capital which would otherwise be invested in secondary industry. This sort of adjustment has, of course, been taking place since 1945 in Britain, but there the industry is based substantially on the tenant farmer. His grip on his property is less firm than that of his New Zealand, owner-occupier counterpart, and amalgamation of holdings is, therefore, more readily achieved. There have, it is true, been forays

into this type of socio-economic re-adjustment in New Zealand, and there may be more as some sheepfarmers return to the greater solvency of dairying, if the dairy companies will accept their supply and the added strain on already overtaxed capital resources for the expansion of processing facilities. However, if undertaken on any large scale, amalgamation into larger units would involve a complete social revolution in the countryside, and there are few bucolic Robespierres in New Zealand. But, more important, recent economic surveys, in particular of dairy farms in both Britain and New Zealand, show a declining gross financial output per acre and per cow, a declining net income per acre and per cow and a declining net income as a percentage of gross output as the size of farm increases. The large-scale farmer may have a greater net income to help him weather economic adversity, but, nationally, and excluding cropping farms, this seems to be a less efficient form of farming.

OR A TECHNOLOGICAL REVOLUTION?

The alternative, as I see it, to a social revolution in the countryside, is a technological revolution, guided by science, and *directed purposefully* towards greater efficiency within the bounds of the present or predictable social and economic structures of family farms. I emphasize the words "directed purposefully" because, as I have implied before, it is probably true that most applied research improves the efficiency of farming in some general sort of way, but only occasionally is such research undertaken with the primary intention of improving efficiency. And all too seldom are scientists aware of the new problems which their earlier solutions inevitably bring into being.

Perhaps this is best illustrated by referring to our recognition of the importance of stocking rate in improving pasture use. The social and managerial problems posed by this scientific solution to improved pasture utilization were abundantly clear to the farmer and should have been so to the contemplative scientist.

On the dairy farm, the technique of increasing stocking rate progressed only slowly until the milking-shed bottleneck was removed, almost entirely by the enterprise of private farmers who developed and perfected the herringbone cowshed. But the introduction of high stocking rates still leaves many problems on family farms which have

an inflexible labour supply. Here are a few examples among many.

More replacement calves have to be reared. The need to manhandle one ton of liquid milk or milk substitute for every four calves reared provides an increasing logistic problem which must and can be overcome by research.

Winter feeding of the enlarged dairy herd at the levels proposed by research workers a few years ago becomes impractical for agronomic reasons and difficult for one man and a boy. The consequences of lower winter feeding levels and ways to minimize these consequences demand urgent investigation.

The conserved fodder of choice for the wintering of stock is hay. We may argue the point about the relative feeding values of hay and silage, but at high stocking rates, under the seasonal production pattern of New Zealand farms, there are convincing agronomic reasons for later shutting up of paddocks, and the farmer, who knows his own social environment best of all, has made his choice.

Hay is, in acreage, the largest single crop harvested by mechanical means in this country. The hay acreage is five times that cut for silage and is increasing each year, whereas the silage acreage has declined steadily over the past ten years.

The farmer has given us his answer. Yet the greatest part of our research effort into fodder conservation pursues better methods of silage making. This work has contributed greatly to farming efficiency. How much more could research into hay production, curing, harvesting and storage be justified in view of the magnitude of the crop and its overall congruence with the contemporary, highly-stocked farming scene? But where should one look for sustained research into the nation's most extensive crop?

The nightmare of bloat increases in proportion to herd size. Research efforts into control are laudable, but the search must continue urgently, because the present recommended technique of pasture spraying with oil or emulsified fat clearly strains the capabilities of many local farmers—no matter how effective the technique itself may be. This in part explains the enthusiasm shown for the "flank treatment" and the use of "pluronic" in water troughs. These may be only partial solutions to the problem, but they are more realistic in the context of the farmer's life.

But still, with expensive and frequently elusive labour, the milking-shed remains the major bottleneck in any attempt to pursue the stocking rate philosophy to its logical conclusion on the dairy farm.

We may ask if 100 or 120 cows is the maximum number one man can milk? What prevents it being 150 or 200? How far, in fact, can we go with completely automated milking? What prevents its attainment? Are we working purposefully towards this—for surely it would be the greatest leap forward in dairy farming efficiency since the introduction of machine milking almost 90 years ago. Parts of the technique are under study overseas, but where, in this, the world's greatest dairy-product exporting nation, is the problem being investigated?

The sheep farmer, too, is providing his own answers to the practical, managerial problems of applying the philosophy of high stocking rate. The chief one is euphemistically called "easy care" shepherding, meaning simply that one man shepherds less intensively many more sheep than formerly, and accepts the added losses involved. Although the technique originated to enable a natural selection pressure to operate in breeding flocks, the idea now seems to be spreading to other strata of the sheep industry. In its original context, and for its original purpose, it may have far-reaching beneficial effects, although, to be honest, we know almost nothing about the traits or the heritability of the traits which could make selection for survival-in-the-raw effective. Research must be vitally concerned in the national deployment of a technique which seeks to harmonize the scientific answer to better pasture utilization with the realities of the economic situation and the labour structure on the individual farm.

Easy care at other times than lambing would bear investigation. How much, for example, does pre-lambing crutching add to the lamb crop or to its rate of growth? Again, if mature sheep develop a resistance to internal parasites, can the expense and incessant labour of anthelmintic drenching of the young sheep not be circumvented by artificially inducing earlier resistance by a single vaccination?

Assuming that wool still has a future, the managerial problems and economics of wool farming at very high stocking rates on lowground farms may bear investigation as an alternative to easy care of lambing ewes.

I have laboured some of the unresolved consequences of applying the philosophy of high stocking rate, because this has been perhaps *the* most important technological

contribution to New Zealand's animal production in this decade. But it is also in the exploitation of this technique that some of the greatest human problems arise; problems which the technique has generated and which are amenable to solution through research if we can but recognize that they, as much as the original philosophy, are the urgent responsibility of animal scientists.

However, our very proper enthusiasm for this technique must not blind us to the simple equation:

Animal product/acre = Animals/acre × product/animal.

We may, by answering the problems I have outlined earlier, overcome some of the managerial and, hence, social problems of carrying more stock. But, in this environment of family farms, high stocking rates are at best a second best and opportunistic means of attaining high per-acre productivity. In this environment, the attaining of high production per acre through high production per animal is a much more socially functional, long-term objective. A recent N.Z. Dairy Board survey suggests that the most successful farmers are, in fact, doing this. But we are much less certain that we know how they are doing it.

Fifteen years ago, L. R. Wallace, addressing this Society, suggested that increasing output per animal might increase the efficiency of pasture use. His philosophy is equally true today, but what is even more important today is that we need this increased productivity per animal to improve the efficiency of our farm labour force. If, for no other reason, we need improved productivity per animal to enable the individual farmer to continue to meet the cost > price squeeze once he has reached the point where he is handling as many animals as practicable.

What progress have we made in the past 15 years?

Average per-cow production of butterfat has increased by about 20%. Many techniques of management, feeding and milking have undoubtedly contributed, but at least a part of the credit for this improvement must go to the enlightened exploitation of artificial insemination by the Dairy Board. What is perhaps more important is that over these 15 years this A.I. service, with a very small scientific staff, has been quietly laying a technical foundation second to none in the world. By its use of progeny testing and its pioneering work on semen dilution and extension, it is now inseminating almost one-half of the national herd with semen from bulls having an average rating of better than +45 lb of butterfat. It is now at a stage when its effectiveness is increasing rapidly. It is poised and ready for the task ahead.

We have begun, in the last two years, to do something, however belatedly, to exploit for beef purposes our annual crop of 1.3 million bobby calves. But we have not as yet resolved experimentally the conflicting claims of the Friesian and Jersey breeds, a conflict which lies not only at the heart of an efficient beef industry based on the dairy herd, but at the heart of dairy farm and dairy farmer productivity also.

Lambs tailed in New Zealand over the same 15-year period have increased by 64%; breeding ewes have also increased by 64%. An improvement in the output of lamb per breeding ewe is not readily apparent. Greasy wool production has increased by 60% and total sheep numbers by 55%. This apparent improvement in wool production per sheep may not be all that it seems, since the proportion of adult sheep in the national flock has also increased slightly over the same period, and, with the wisdom of hindsight, it is alleged that quality and price may have been sacrificed for yield.

The ghosts of Robert Bakewell and John Ellman must feel lonely in New Zealand. Since James Little died, they may indeed have given up visiting the country altogether, except perhaps to give the Perendale their accolade for being the best attempt in 50 years. Instead, their ghosts and the geneticists and progressive sheep farmers of half the world are beating a path to the doors of Oscar Colburn and J. B. Cadzow in the heart of conservative, stick-in-the-mud old Britain, which has only one-third as many sheep as New Zealand and which is not one-hundredth part as dependent on them as New Zealand is on hers. Meantime, the New Zealand sheepfarmer is compelled to fall back, opportunistically, on still higher stocking rates and the euphemism of "easy care" to meet the challenging times.

We may be glad that a performance recording scheme for Romney stud flocks is now launched, although, as one of its progenitors, E. A. Clarke, observed to this Society last year: "It cannot . . . make an immediate and important impact on the level of production of New Zealand flocks as a whole"—until such time as sheep numbers become stable and greater selection pressure can operate. But we will be grateful for this degree of progress only if we do not allow it to blind us to the need for a more venturesome and dramatic genetic attack on the problems of productivity per ewe. We must not, like children in the dark, cringe for another 15 years behind the bogeyman of scrapie or other exotic disease,

nor must we deny the geographic certainty that there are offshore islands, larger than Somes', on which quarantine, breeding and selection could be conducted simultaneously.

Does it not seem a quaint distribution of effort that the 700,000-head national pig flock has, for a dozen years, rated a national pig breeding centre and a positive, if controversial, genetical policy, but our 60 million-head national sheep flock still depends for genetic improvement very largely on the requirements of the A. & P. showring? The pig may, for a variety of reasons, be more amenable to rapid genetic improvement than the sheep, but the pig does not pay the nation's bills.

You may think he shows a great presumption who would suggest where research emphasis should be laid. By and large I would agree. But I would squarely place the blame for this presumption on my weekend *alter ego* in his gumboots, on the muddier, mortgaged side of the fence which divides research from farming. Nor, as you will realize, am I proposing much that has not been suggested before. But I do believe it is important to develop an approach to our work which marries the scientific reality of finite research resources with the social and economic realities of the New Zealand farming industry.

This broader, philosophical, less presumptuous point of view which I have been trying to convey may, I think, be summed up best by re-emphasizing the distinction between production and productivity. A large part of agricultural science in New Zealand has concentrated on raising farm production. It has been very successful in this and, as a fortuitous consequence, farmer productivity has also been increased. I suggest that socio-economic trends in the human environment of farming which seem now to be developing, and which must with time become more compelling, make it imperative that we now concentrate more of our research specifically on raising the level of farmer productivity, with all the connotations of improved efficiency which the term implies, and for a time, at least, allow increased farm production to look after itself. It will automatically do so.

Adherence to such a philosophy inevitably has implications far beyond the mere selection of scientific projects by a handful of scientists. It impinges on any discussion of the role, size and structure of our agricultural advisory services. It could alter thinking, for example, on the level of national expenditure for land development, *vis-a-vis*

some other efficiency-orientated project. But these are too weighty and far-reaching implications to occupy us here.

Suffice it to say that our work and thinking will be less haphazard and opportunist, more purposeful and effective, if we can combine our desire, on the one hand, for the academic and scientific freedom to research as we wish with our responsibility to select from a multitude of interesting research topics those with the greatest potential national value.

By consciously giving a positive emphasis in more of our research to raising farmer productivity, we will help the farmer to overcome the human barriers and the economic disincentives which provide powerful physical and psychological hindrances to higher and more economically competitive national production.