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AN APPROACH TO TEACHING ANIMAL SCIENCE
IN THE UNIVERSITY

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THE UNIVERSITY in New Zealand has been many things to many people. It has been the seat of learning in the host of professions required by a modern society. It has contributed to the flow of knowledge which has enabled our country to adopt a standard of living as high as anywhere in the world. It has been the source of many ideas, which, when appropriately weighed and evaluated, have provided the intellectual basis for the development of our people. And it has been counsel and critic of public policy at all levels, and has involved itself deeply in the affairs of the country. Currently, and inevitably this will be even more challenging in the future; the university is spreading its interests beyond New Zealand to the development of countries less well-endowed and less well-developed than our own.

Within this framework, agriculture faculties have played their part well, in spite of the very small proportion of all undergraduates who have chosen, or who have been enticed, to fulfil their ambitions for university education in the field of agricultural science. Then, within the faculties of agricultural science, it is not surprising perhaps that, in a pastoral country such as New Zealand, animal science should have been accented to the extent that has been the case in the past.

THE SUBJECT OF ANIMAL SCIENCE

The broader approach to the study and teaching of animal production, as has been developed in this country, was not achieved without challenge. For some years, the approach to animal problems in New Zealand was dominated by a narrow veterinary outlook, with undue emphasis on the syringe and scalpel and undue concern with obtaining sleek health and maximum production from every individual animal. I know a veterinarian who, even now, becomes quite emotional and distressed when a cow shows a trace of subclinical mastitis in a single quarter. Persistence with this concept of meticulous atten-

tion to minor factors hampering production per animal was not entirely helpful in fully exploiting the potentialities for improvement in animal production as a whole in New Zealand. Attention was diverted from rather more significant factors affecting whole farm production and profit such as variation in herd feeding level over the season, and intensity of stocking on the property. More recently, however, the two-pronged approach of animal science coupled with specialized animal health assistance in better perspective, has made a major contribution to the very significant improvements recorded in animal production in this country.

Difficulties with other aspects of animal science, such as physiology and biochemistry, have not presented quite the same problem, but there has been a tendency in agriculture faculties as a whole to foster specialist subjects, even subdivisions of subjects, with the attendant risks of the student seeing the trees in agriculture but not the wood — or possibly the grass without the milk. In days gone by, we had men of the calibre of Riddet and Hilgendorf, with a versatility that would be hard to match today, who were able to blend the parts of the subject into the whole to the considerable benefit of the student-product. Their modern counterparts should be found today in the ranks of the husbandry and management men who are called upon to analyse, compute and synthesize, but who in the end aim to do exactly what was achieved so easily, if comparatively imperfectly without the aid of computer paper, by those outstanding teachers in the past. It is pleasing to discern at present the beginnings of a switch-back in emphasis in agriculture faculties from extreme subject specialization to a more rational and comprehensive approach, at least at the undergraduate level.

It is interesting that only in very recent years has the subject concerned with the principles and practice of animal production achieved added sophistication by a change in name from "animal husbandry" to "animal science". There may well have been a change in the material covered in the course, too, although this could be a little difficult to assess. Basic to this move, both in the United Kingdom and in this country, has been a desire to move the focal point of the subject from the practice of breeding, feeding and otherwise handling animals to more introspective consideration of the scientific basis for such practices. If there was really a need for this move, it is a sad reflection on the teaching of the subject at university level up to that time. Perhaps there really was

some truth in the assertion, made some years ago by H. P. Donald, Director of the Animal Breeding Research Organisation in Britain, when he said that, for research workers in his group, he preferred men who had had no undergraduate training at all in animal production; he claimed they would then have no preconceived notions of the subject which were probably superficial and erroneous anyway. More recently, however, Donald admitted that, because, even after twenty years' work on the subject, his group was still struggling to define acceptable objectives in animal breeding, maybe he would now be better off if he had selected some men trained in animal production in the first place.

THE LECTURER AND THE STUDENT

For a university teacher to be effective, seemingly impossible things are required of him. In approach to his students he is at once required to be charged with infectious enthusiasm, and as described by Ruth Eckert, the prominent American specialist in higher education, to be "a director, designer, dreamer, diagnoser and discoverer"; guiding, advising and stimulating students is said to require these varied roles. Then there are secondary involvements, which Miss Eckert classifies as "describing, debunking, demonstrating and discussing". These requirements, if really essential, would immediately make the lot of the animal science lecturer in New Zealand quite hopeless. With the pressure of teaching load, examinations, research activities and extra-mural demands, there is precious little time and energy available for "designing and dreaming". I doubt, anyway, if any two teachers would end up with quite the same mix of instructional ingredients, especially as little effort is made in most of our universities to teach lecturers how to prepare and deliver a lecture with effective impact. With this omission both the student and the university are the losers and immediate action is desirable to meet the position.

A basic ingredient in teaching too, of course, is some knowledge and assurance in subject matter. This is not an ingredient easily obtained, for as K. L. Blaxter has pointed out, almost in despair, there is an average of four scientific papers on animal nutrition alone being published for every day of the year. To obtain more knowledge — and rather less assurance — on current developments in the subject, the teacher turns to research papers, and then to review articles, and finally to a series of recently published books.

But the accumulation of published material is so overwhelming that many important scientific publications will no doubt only be read and absorbed in time to be referred to in the teacher's memoirs rather than his daily memoranda. Some relief from this situation is available in a generous refresher leave scheme which, in my view, provides a most valuable opportunity to take stock of recent developments with a mind quite uncluttered with thoughts of tomorrow's lectures — or yesterday's.

Now, students have opinions on university teaching, and on courses they have taken. Official student appraisal of these matters has been an interesting innovation in Australia and Ireland, and to a limited extent in New Zealand too, although American lecturers have been subjected to this critical analysis for some years. The aim of such appraisals, I suppose, is to detect outbreaks of infectious enthusiasm among the students. But symptoms of a successful effort in communicating with students on the one hand, and a full grasp of subject matter on the other, are difficult to diagnose, and the fond hope might be that the student-patient could help by telling when he feels the pain most. In the Cornell type of format, questions asked range from, "Did the teacher stimulate student interest in the subject?" (1 = destroyed interest, was boring; and 7 = inspired independent effort) to "How did you find the verbal pace of the lectures?" (1 = much too slow; and 7 = much too fast). Tolerance, organization, level of instruction, personal peculiarities, scope of subject covered and availability of the lecturer for consultation, all are featured in the questions. Use of the questionnaire, in Cornell at least, is aimed at a confidential and restricted self-evaluation, and is said to be a considerable help to lecturers. At other centres the results were "confidential" but some became widely-known anyway, and have not helped either the staff recruitment problem or intra-staff relationships.

I have doubts as to whether this kind of student appraisal is of real value to a lecturer. Shortcomings in ability to sell a particular story can be painfully clear from student reaction at the time, without having the deficiencies itemized and charged in due course. On the other hand, there is little doubt that students will proceed with the appraisal anyway, so probably the more prudent course is to co-operate with them and endeavour to keep the results a close secret, if necessary.

Presentation of course material to students in New Zealand, in the more fundamental aspects of animal science,

has been improved greatly in recent years by provision of excellent laboratory facilities, and commodious lecture rooms. Improvements still required, at Lincoln anyway, to bring lecture room and laboratory presentation up to the best I have seen in North America and Europe, are material for visual aid projection — and more familiarity with sophisticated projection equipment. Especially with classes which now comprise as many as two hundred students, visual aids are very desirable to obtain the desired impact. In field demonstrations in animal production, on the other hand, it is fortunate that farm animals are large enough to be seen easily by members of a large group. In fact, the only visual aid I have ever had recommended to me for outside work is a different pair of spectacles. The subject was versatility of cattle breeds for both milk and meat production, and the suggestion, completely unjustified of course, was that I needed additional help to appreciate cattle which were not black-and-white in appearance.

COURSE CONTENT IN ANIMAL SCIENCE

Approach to the subject material in animal production, as distinct from the student himself, also has its problems. Oddly enough, there is little difficulty in selling the story on reproduction in animals, partly at least because this is the first aspect of animal production covered and the student is fresh to the subject. Subsequent lectures, however, present a rather more difficult problem. There was a time, when, basing a course of lectures concerning milk secretion and ejection on the theories of C. W. Turner was quite straightforward and plausible, but later work by H. G. Turner, W. G. Whittlestone and others fundamentally altered the picture. But some of the older reviews are still around, as are some of the older graduates and teachers. Then, in later lectures, and equally seriously, the classical studies of the Hammond school, including those of L. R. Wallace of Ruakura, on the carcass composition of sheep come in for discussion. In these studies it has been held that the loin is late-developing, relative to the total musculature of the animal. As a result, great importance has been attached to the shape developed by early-maturing animals. Now, however, work by R. Butterfield has cast doubt on the validity of these concepts for he has shown that the muscles surrounding the spinal column form a virtually constant proportion of the total musculature

throughout post-natal life. So, the loin cannot be considered late-developing after all. But some of the Hammond-school graduates are still around and they do not give way easily. Nor do their books and theses which are still on the library shelf.

In animal nutrition instruction, the difficulties seem to build up in geometrical fashion. As members will know, in the United Kingdom teaching the principles of animal nutrition has been based for many years on the contents of *Bulletin 48* of the British Ministry of Agriculture, using the "starch equivalent system" as the cornerstone in the instruction. But recently, following the deliberations of a Working Party on "The Nutrient Requirements of Farm Livestock", a "new approach" based on metabolizable energy has been devised. In this approach — and I quote — "the metabolizable energy values ascribed to individual feeds are those calculated at the maintenance level of feeding, and when diets are calculated, the metabolizable energy to be expected at the particular feeding level adopted is calculated from the relationship between feeding level and the metabolizable energy of the diet as a whole. The production of weight gain or of milk yield from a particular diet is assessed by using the best available measure of the efficiency of utilization of the metabolizable energy of the diet as a whole." No doubt this new approach has simplified the picture — or at least has made progress towards a more accurate feeding system. However, I understand that general implementation of the system is awaiting the graduation and recruitment to advisory work of a new crop of animal nutrition trainees.

In New Zealand, we have been fumbling for some years with the starch equivalent system, which is not readily applicable to feeding practice in this country, and with various systems based on either D.O.M., D.M. or N.E. To date, there has been no general agreement on exactly which system should be widely advocated, let alone used, in this country and no doubt there are in general vogue at the moment at least three systems — Lincoln, Massey and Ruakura. An activity in which this Society could well interest itself, with urgency, is the development of an acceptable basis for stating the energy requirements of ruminant animals, and the adequacy of commonly-used feeds in this respect. I have made representation to the Management Committee of the Society on this subject.

Approach to the improvement of farm animals through breeding is without doubt the most difficult aspect of animal production to present successfully to students. I

doubt if more than a handful of each year's graduates really believes that "to see is not really to believe" — as far as animal breeding is concerned. There is no difficulty with simple Mendelian situations involving the inheritance of characters each of which depends for its expression on the transfer of one pair of genes. Students and lecturer usually start to part company, however, when transferring from Mendelian to quantitative inheritance.

The root causes of difficulty in appreciating the role of quantitative inheritance in animal breeding are two. First, undergraduates in agriculture, as a group, are not specially well-endowed with inherent mathematical skill and, even with the aid of excellent textbooks such as those by Falconer and by Johansson, they do have real difficulty in coming to grips with the basic algebra involved.

It could be that, with the use of a technique referred to as "programmed learning", some worthwhile improvement could be made. At each small progressive stage of the subject, testing and consolidation of the knowledge accumulated to date are carried out. Of course, this takes additional time and effort, and leaves rather less scope for "directing, designing and dreaming", but we are evaluating the effectiveness of the technique at Lincoln now.

A second major difficulty in teaching animal breeding in this: The whole environment of animal improvement through breeding in New Zealand is not conducive to an acute appreciation of the extent to which characters of commercial value in our livestock, all of which are inherited in a quantitative manner, are influenced in degree of expression by environmental conditions. Research workers in this field have done well to provide the basic data involved on the relative importance of heredity and environment as exemplified by the classical work with monozygous twins by I. Johansson and by J. Hancock, and the more extensive field experimentation by P. J. Brumby and G. Wiener. Studies of this kind have been ably supported by analyses of breed structure by J. L. Lush, A. Robertson and A. S. Stewart, all of which demonstrated that genetic differences among animals and herds within breeds are not large.

Quite apart from the usual misinterpretation of such work to the effect that "breeding is therefore unimportant in livestock improvement", there is another serious problem. This is the almost insurmountable mental barrier in overcoming the actual practice of stock improvement as carried out by the large majority of private breeders of

pedigree stock, as widely publicized in the farming press and at agricultural and pastoral shows throughout the country. A dairy herd average of 500 lb (227 kg) butterfat per cow still makes the headlines, with the implication that genetic superiority of the stock is the major factor involved. Similarly, an average gain per day of 3 lb (1.4 kg) liveweight in Charolais-Aberdeen Angus cattle is still automatically accepted by many as evidence beyond question of genetic superiority of the Charolais as a crossing sire, without any reference to a control group of cattle, or to feeding level used. Some pig breeders are almost frantic in their efforts to introduce artificial insemination as a genetic aid in pig improvement without appreciating that a first requirement is to establish a testing system to identify boars of proven genetic superiority. A. & P. show organizations persist in organizing competitive classes for livestock, presumably with the aim of identifying relative genetic merit for production among the stock, without incorporating any reference to production records in most cases, or to relative production records in any case at all.

This touching faith in a supposed relationship between type and production is perpetuated, not only in the showing in New Zealand, but also, incredibly enough, at breed society field days organized in conjunction with at least one American university. Recently I enjoyed the experience of attending a stock-judging field day sponsored by the University of Wisconsin. Without the blink of an eyelid I ranked yearling Friesian bulls in order of merit, from a genetic point of view, by visual appraisal alone. Like others present, I used with aplomb words such as "upstanding" and "promising" and, although I failed to win the competition, I was not the poorest in the assessment either. I probably failed to notice that the bull I placed first had insufficient white hairs on his tail. And this was in July, 1968.

At Lincoln, I lost faith in type assessment as an indication of producing ability and genetic merit many years ago when a College cow, ranking as "Champion" at the Canterbury A. & P. show in one year, had to be culled for low production the following year. As an alternative scheme for making a realistic contribution to the genetic improvement of the dairy cattle in this country, we now deliberately breed bulls for prospective sale to the N.Z. Dairy Board for use in artificial breeding. Although some of the bulls we have sold for this purpose have proved to be most satisfactory under subsequent progeny test, we have

also achieved the distinction of supplying three of the five young Friesian bulls which have ended up with a "minus rating". But this, of course, is merely additional evidence of the complexity of the whole problem of genetic improvement in stock.

It is not surprising, then, that undergraduate students find this aspect of animal production rather confusing. It is possible to make some measurable impression though, and there is hesitating acceptance of the performance requirements for Coopworth sheep and general approval for the flock recording and the beef cattle performance testing schemes recently launched in this country. Further, if students are nimble enough, they can just keep up with the apparently ever-changing methods used by the N.Z. Dairy Board in assessing genetic merit in dairy stock. Nevertheless, it is likely that in 1969 they will be more impressed by the physical prowess of a bull that is going to sire 100,000 calves, and with P. Shannon's work that is going to make this possible, than with the genetic implications involved.

It is essential, therefore, that approach to subject material should remain flexible, and some recognition given to the fact that today's science can become tomorrow's nonsense, as somebody inclined to be cynical might phrase it. It is this kind of fluidity in approach, in a world where scientific endeavour is so rapidly pushing back the frontiers of knowledge, that makes a subject so fascinating to students who are more than incredulous anyway.

EXTRA-MURAL INTERESTS

From time to time, university lecturers do emerge from their reputed "ivory towers". On most of these occasions life really does become interesting. For example, an unforgettable experience is to be obtained in trying to convince a group of pedigree beef cattle breeders that there is no ideal breed for beef production and that most favourable meat production can be obtained from some dairy breeds. An equally indelible mark is left on a lecturer, and on his reputation with his audience, when he tells a group of pedigree dairy cattle breeders that, after a hundred years of selection for milk production, they now have an animal which is really outstanding for beef. Or again, explaining why mastitis continues to be a major health hazard in dairy herds, in spite of a never-ending stream of advice on how to control it, can really tax the resources of the speaker in regard to plausibility and conviction.

But quite outstanding in my own experience in regard to extra-mural activities and to the incredible conservatism encountered, at all levels, has been in connection with husbandry aspects of the so-called "low solids-not-fat problem" in town supply dairy herds. These activities have been in association at various times with producers, scientific workers, milk control authorities, and consumers, over the period since 1947. Then, as now, 22 years later, many milk consumers in this country, at predictable times of the year, are supplied with milk which could be as much as 0.2% below the desired content of 8.5% in regard to solids-not-fat content. In one pint (473 ml) of milk, this represents a deficiency of 0.5 g of skim milk powder equivalent, and in 365 pints (173 l) about 200 g skim milk powder equivalent. This deficiency is regarded as being sufficiently serious to warrant the operation of a penalty payment scheme to producers. Scientific work on this topic has clearly defined the husbandry factors involved in the situation, at least to the satisfaction of the workers themselves. But producers have been slow to accept the idea of, and to adopt in fact, the recommended adjustments to husbandry practice, mainly for the reason that higher quality milk would mean lower quantity, and higher costs would mean less profit under the present system of payment. In many cases, too, a change in breed of cattle would be involved. So, little progress has been made there.

Other scientific workers have recommended that skim milk powder could be added to town milk, as required, at the milk treatment station, as this would be a cheap, effective and technically feasible way of meeting the situation. However, the reaction to this suggestion by producers, many consumers and even some politicians is comically conservative. And there is little to be gained, either, from referring to overseas practice in regard to milk treatment practice. Many milk consumers in the United States, for example, are confronted every day with milk that has been standardized, fortified, homogenized and pasteurized, and never ask a question. They probably suspect that the milk has been treated in some way, but they drink it happily. There is no sign of the volatile reaction to the idea of adjusting the composition of milk at the treatment station as has been shown in this country, and by many consumers in Christchurch in particular — or possibly it just seems to be that way.

Milk controlling authorities have made an earnest endeavour to meet the situation. They have appointed to committees of investigation several of those who have been

most interested in, and well qualified to appraise the problem, from either a technical or economic point of view. Recommendations from such committees have consistently stressed the logic of avoiding inevitable added production costs by attempting to improve milk quality on the farm, and to meet the problem instead at the milk treatment station by cashing in on developments in milk technology. In spite of these recommendations, it seems that political factors are hampering, if not completely arresting progress. The end result is that consumers are still occasionally supplied with milk which is tainted, but only in name, with the stigma of being "low" in solids-not-fat. Producers continue to be distressed and frustrated when they are penalized for a "low" solids-not-fat content in their bulk milk. Generally they appreciate the insignificance, in terms of human nutrition, of the deficiency in the milk, and they are therefore reluctant to do much about it themselves. On the other hand, official policy of town milk producers is against the idea of adding solids-not-fat at the treatment station to town milk as required. This objection could well be based on a fear of confusion between fortified milk and recombined milk, which, if carried to a logical conclusion, could well result in a reduced requirement for milk from town milk farms. In the meantime, university staff have the difficult task of explaining the whole enigma to interested parties.

Interest in such "low" solids-not-fat problems is not world-wide. In Toronto for example, I caused a little embarrassment at the provincial Milk Marketing Board headquarters recently when seeking information on the local problem. It was difficult to find anybody who was quite sure as to even the legal minimum content required for solids-not-fat in milk.

It is difficult indeed to effect any change in fundamental approach to animal production problems on a national scale, but it seems clear that there are alternative methods which can be employed. One technique is to press ahead quietly but deliberately and bring about a *fait accompli*. An outstanding example of this is in the application of artificial breeding in dairy herd improvement. Considering the significance of this practice and its realized and latent potential in animal improvement, it is almost unbelievable that by 1969 about half the dairy herds and over 40% of the dairy cows in the country are involved in the A.B. scheme, and so are cashing-in on the superior genetic gains available through this New Zealand scheme. This situation has been reached with a minimum of re-

search expenditure and very modest publicity; the system has virtually sold itself. There has been no need to confront the advocates of less effective methods of dairy herd improvement, and the fact that stock assessment techniques still used in the showring and by similar organizations have serious shortcomings is of little consequence in the national scene. At least the annual A. & P. shows do serve as a reminder to the people of New Zealand of the debt owed by the country to the pastoral industry, even if the most significant animals concerned are not themselves at the show.

Other aspects of animal production are not likely to yield so readily to the application of modern and more refined techniques. For example, the system commonly used for grading beef at the freezing works appears to be subjective in the extreme, and hence not necessarily the best measure of the true value of a carcass in a world which is demanding lean meat. To clarify this situation, however, it is extremely doubtful whether a discrete and painless approach could be successful. A symposium or even a conference, or possibly a Royal Commission would be required to clarify the basic principles involved to the satisfaction and benefit of all.

EXTRA-TERRITORIAL INTERESTS

Involvement of university staff in human affairs extends their activities beyond New Zealand. This is as it should be because of the increased interdependence between agriculture in this country and the agriculture in the rest of the world. Then there is the secular relationship between the rate of population growth and the rate of increase in world food supplies; this results in both the opportunity for expanded commercial markets abroad and the possibility of providing such agricultural commodities as might be useful in promoting more rapid economic development abroad. Direct and indirect assistance to the development of agriculture in less-developed nations is very much the concern of the universities in New Zealand, and indeed, the country as a whole. Agriculture faculties in New Zealand are playing their part well. Not only have we seen a steady stream of undergraduates from such countries entering our universities, but also most of them have emerged in due course as well-trained people with much useful knowledge to take back for the benefit of their home country. In addition, specialist staff from both Lincoln and Massey have spent varying periods of time

working at universities and research institutes in such countries.

Nobody would claim that we have performed these tasks perfectly. For example, there has often been imperfect scientific knowledge and understanding on our part of the agricultural sector of overseas nations, and much useless or inadequate information has been fed to sometimes reluctant students from less well-developed countries. Then, on occasions, there has been real consternation and question in the minds of many faculty members in relation to the efficacy of training scientists in an academic environment removed not only in space but also in time from the surroundings in which they will practise their profession. At the same time, there is genuine sympathy in the university community for the plight of the less-developed world in its quest for manpower trained at this highly-essential level. In the short run, New Zealand universities will join with those in other affluent countries to train a significant share of the scientific manpower required for the rapid development of the poorer nations. To contribute to this programme, no doubt further faculty members will take opportunities to obtain extended in-depth experience in foreign agriculture. On return to their home university, their experiences will almost inevitably result in the injection of appropriate international content into their course. This will ultimately be to the benefit of both New Zealand and the less-developed countries overseas. In this area, it would be most appropriate for the N.Z. Society of Animal Production, too, to develop a rather greater interest than has been considered necessary or desirable in the past.