NEW ZEALAND SOCIETY OF ANIMAL PRODUCTION

PRESIDENTIAL ADDRESS

# THE CONTROL OF ADAPTABILITY PHENOMENA

by

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In searching for a subject for this the second Presidential address of our Society, I have found myself in considerable difficulty. Any address to an association of scientists, perhaps the most critical of all audiences, has to be a little different from that acceptable to a political gathering or a Farmers' Union meeting. For one thing a scientific attitude is not merely expected - it is demanded. This automatically rules out of bounds many matters of no little interest and importance to us personally and to our society. While I would very much appreciate the opportunity of using the privilege of my position to inflict upon you my views on such topics as the organisation of agricultural production or marketing, on agricultural education and research, or even on the latest land tenure bill - all matters directly affecting our work - I am afraid that my caution as a scientist might be overshadowed by my zeal as a reformer. The relatively thin political ice blanketting these topics could be highly dangerous to one more at home in a pair of gum boots than on a pair of skates. As some of you know, I am not averse to a personal ducking from time to time, but immersion in cold deep waters is hardly the correct treatment for our infant society which as good husbandmen, it must be our first duty to foster.

Out of bounds also, I think, is the back-slapping, boost type of address. It would be easy to present a forceful picture of the great place of animal production in the scheme of things, and of the consequent social and economic significance of our work in such a way as would not only impress the public but which might send us back to our respective corners, well satisfied that we were doing a good job. I would prefer that this be taken for granted. With more than one axe to grind, therefore, but doubtful of the wisdom of grinding them under the aegis of the Animal Production Society, I have been thrown back upon a more scientific subject. Here again, decision has not been easy. I have not liked the idea of dealing with the results of any personal research project, since this would add but a further paper to a programme already heavy enough. I believe that on their evening off, members are entitled to expect from their President, more palatable if not more digestible fare. For the same reason, I have not accepted either, the advice of one member, that I might with some profit, attempt to interpret some of my published work in such terms as the ordinary mortal - his description, not mine - might understand what it is all about. At the risk therefore, of being accused of attempting to "educate" you, I have fallen back on a more general subject - that of adaptability phenomena in live stock.

It seems to me, that since we are all engaged in studying some aspect of the reactions of the animal to its environment, this is a topic with interest to all. Since the animal is essentially the product of its environment, adaptability phenomena are basic to the whole business of animal production. Since also, most of us are specialists of one kind or another, tending to find ourselves responsible for but one or two phases of animal research or extension, it might be of some advantage to spend a few moments

in an attempt to escape the inevitable limitations of this specialisation by viewing the picture presented by the wider field. Finally, it is a subject which might permit me, under the guise of scientific respectability to get away with the grinding of one or two axes already mentioned.

It will not be necessary to provide this audience with evidence of the fact that biology is strewn with examples of the adaptation of living things to their environments; with instances of modifications of form, structure, and function, both within and between species, to aerial, land and to aquatic life. While we are all familiar from our early training, with Darwin's theories re adaptation and selection, we are not always so ready to appreciate that the principles involved apply equally strikingly, and to mankind, even more importantly, to our domestic animals. In consequence, even those of us who are working in the animal field, often fail to recognise the significance of relationships between the apparently isolated phenomena with which we deal daily, and the broad evolutionary plan of which animal production is but a part. This is due partly, I believe, to the fact that orthodox biology instruction seldom gets past the study of more primitive forms, or when it does, is confined to the more exciting types of wild animal, the farm beast being far too mundane a creature to engage the serious attention of the pure scientist; partly because adaptability phenomena are frequently more subtle in their manifestation in the farm animal than in forms selected by biology for their demonstration; partly since occurring under our very nose, they tend to escape the attention their fundamental importance warrants.

The presence of a sprinkling of our University friends here tonight, prompts me to divert for a moment. I would like to suggest that perhaps the time has arrived when our pure science Universities, might with profit to themselves and their products, depart a little at the honours stage from the traditional primitive exclusivism of orthodox biology training, to the extent of employing more realistic examples for the demonstration of fundamental principles and for training in scientific method. For their encouragement in such a radical change of policy, there is the precedent set by the ultra conservative university of Cambridge. During recent years, the advanced schools of Physiology and Anatomy have made effective use of the sheep as material for the study of physiological, embryological, and anatomical phenomena with no loss to the fundamental character of the training resulting, with a definite gain to our knowledge of life processes in an animal of prime importance to mankind, and with a worthwhile improvement in the realistic outlook of students so handled.

No one appreciates more than I, the very real difficulty of persuading acceptance of this suggestion. Though one or two cases of a more broadminded outlook exists, it seems almost impossible to break down resistance to the idea that farm animals provide excellent material for fundamental work, and that in reality there is no barrier save conservatism, between pure and applied science. Perhaps a rather amusing personal experience might add point to this argument. While my research work overseas was welcomed by 'the pure' as a worthwhile advance to fundamental knowledge of growth processes, it was none the less, unacceptable for publication by the Royal Society "whose annals surely could not be soiled by such a common creature as a pig".

I do not think it is unfair comment to suggest that the sheltered cloisters of pure science may have produced by long continued selection and inbreeding, a 'pure line' relatively unaffected by environmental influences and therefore no longer capable of exhibiting adaptability.

To every farm and every animal worker the problems of adaptability are a very definite reality. Success in live stock production depends basically upon the ability of live stock to produce efficiently the product for which they are bred in the environment in which they are placed. If they are not adapted to this environment, failure inevitably results or increased costs must be incurred to adjust the environment to suit the animal.

I would appreciate the indulgence of those to whom this argument is perfectly familiar, in amplifying if but sketchily some of the more important aspects of the nature of the relationships involved. The animal is not an isolate in a neutral environment; it is a living organism, dependent upon and responsive to the external conditions in which it finds itself, for expression of its inherent capabilities. In its dependence and response it exhibits marked plasticity and resiliency; it behaves not merely like a piece of putty or clay that can be moulded by the forces brought to bear upon it; like a piece of rubber it is able also to effect considerable recovery from the effects of environmental influences.

This plasticity and resiliency are no better illustrated than by the many detailed studies of recent years of the precise effects of variations in the quantitative plane of nutrition upon the animal body - in practice, the most powerful and most common influence operating. Probably best known are the contributions of the Hammond school in this field. Work on cattle, sheep and pigs has clearly demonstrated that inadequate nutrition not merely stunts body size, but exerts a differential effect upon every tissue of the body and upon the same tissue in different body regions. The orderly nature of these effects has been shown to be dependent upon the growth gradient mechanism of the animal, and is such that later developing parts, tissues, and functions are penalised most so that the resulting animal assumes a form, structure, and performance similar to the juvenile and unimproved - to those evolved under nutritionally poor environments. Conversely, ample nutrition develops most these same parts and tissues, and the animal now resembles the adult or highly improved - those evolved under and adapted to nutritionally superior environments. Recognition of the powerful and fundamental nature of these relationships makes it relatively easy to visualise the manner by which, in the evolution of our different species and breeds of farm stock, certain characters associated with ability to thrive, to produce efficiently, to survive a long productive life within specific environments, have become through the processes of selection, species and breed characteristics. These are the qualities which the animal husbandman normally refers to when using the term adaptability. By such virtues, different species and breeds, while capable of tolerating some degree of variation, are specially suited to and perform most efficiently in the specific environments in which they have been evolved. Conversely, by physical control of environment, man is able to make more effective use of his animals.

An effective illustration of this situation is seen in the differences between wild and domestic types. The latter are different from related wild and tameable wild species from which they have all descended, in ways that make them adapted to life in association with man. Evolved under his care, they do not long survive if relieved of his guardianship. A good example is seen in the way in which wild and domestic animals are adapted to different food supplies. Thus the ferret will live and reproduce on a ration of bread and water, though its wild relative the fitch, starves in a very short time on such a diet. Among the many physiological adjustments of the dog to a life with man is its curious mating adaptation. Under domestication it has developed visible signs of 'heat' or estrus not shown by the wolf or fox, but possessed equally by another domestic carnivore, the ferret. In many instances, the adaptation of the domestic animal is mental in quality, to be seen in the highly developed specialised senses of the many different types of dog.

credited with a marked capacity to tolerate a high rate of infestation with internal parasites - the dominant ill of lowland high rainfall country. Developed originally under comparable conditions in Kent, it has become the universal sheep of the high rainfall areas of the North and South Islands. More importantly, it appears to have a marked capacity to thrive on a continuous diet of lush pasture not so well shared by other breeds. Thus in the sub-tropic zone of Corrientes and Entre Rios, I found that the Romney was the only breed of all British varieties that had survived the lush feed of this humid zone.

In the development of important commercial qualities lowland breeds have sometimes lost much of their foraging ability, their resistance to periods of food shortage, and their independence of man's aid, characteristic of mountain sheep, from which all have descended. Thus, today the Southdown cannot even give birth to its young without considerable manual assistance; the Scotch Blackface exhibits unique intelligence not shared by its lowland neighbours, the Border Leicester and Cheviot in its ability to survive long periods buried in snow drifts. It shows even greater intelligence in avoiding this fate. An interesting adaptation in sheep comparable with sexual variation noted in dogs may also be mentioned here. In estrus cycle studies with the Merino and its near relative the Corriedale at the Canterbury Agricultural College, we have found the greatest difficulty in procuring matings in the presence of an observer. No such trouble has been experienced with the Romney and Southdown. That the Corriedale still retains much of the wild quality of the Merino is also readily observable in its nervousness at lambing and the consequent readiness with which it leaves its young if disturbed.

Without labouring the point any further, it should be clear that so we can proceed through the thirty odd British breeds of sheep, finding each with some special virtue or defect, determining its suitability to particular environments and for particular purposes. It is true that in many instances, the special adaptabilities of our various breeds have not been well established, existing largely at present as opinions of their respective protagonists. They have been established sufficiently well however to suggest that a complete mapping of their respective capacities is well worth closer scientific investigation. This is desirable if only to remove breed characters from the field of speculation and vested interest propaganda to a factual basis by which their relative suitabilities can be adequately assessed.

It will have been obvious from the nature of many of these more striking examples that adaptability phenomena must have a complex physiological basis. This is the next point to which I wish to direct attention. Essentially, as pointed out by Hammond, the whole of the processes of life - the physiology of the animal - consist of delicate interactions between the animal and its environment. The point is perhaps no better illustrated than by the studies of Rhoad and others on Tropic and Temperate Zone cattle. Native breeds such as the Zebu are admirably adapted to high tropical temperatures and humidity, and have attained a degree of relative resistance to endemic diseases. Their improvement in the past has been for work rather than for meat and milk which have dominated man's interest in the Western world. Introduction of European breeds to improve human nutritive standards and farming productivity lamentably failed as it was bound to do. Unadapted to tropic conditions the latter were forced to speed up their general rate of body metabolism in a vain attempt to bring about adjustment to the high temperatures and humidities ruling. Respiration and transpiration rate increased, rectal temperature rose, nitrogen concentration in the urine fell indicating excessive water loss, blood haemoglobin fell and so on. Reproductive failure in males occurred owing to a breakdown in the temperature regulating mechanism of the reproductive organs. Such introduced cattle soon fell off in productivity, fell ready victims to disease, and ejoyed a short productive life. This situation forced improvement measures

along lines of selection within existing native stock, and of crossing these with European animals in an attempt to graft the temperature and disease resisting ability of the Zebu to the superior food productive capacity of the introduced animal.

In the same way differences between the wool and mutton types of sheep, between beef and dairy type cattle, between pork and bacon type pigs are likewise under physiological control. Due probably to differences in the activity and interactions of the glands of internal secretion, surplus energy derived from food is directed to the various types toward the main purpose for which they are adapted; to wool, mutton, milk or beef. Individual differences in efficiency in these respects are precisely similar in origin. A good example of the physiological basis of these relationships is seen in Wallace's work on the influence of the sex glands upon the animal. Removal of these in males and females, by altering the hormone interactions, changes materially many characters including economically important ones such as body composition and economy of food utilisation. While on a basis of economy of live weight gain the natural male is easily the most efficient and the castrate female the least efficient, the order is completely reversed when efficiency is compared on a basis of energy consumed to energy deposited, due to differences in fat metabolism and its rate of fat deposition in the castrate.

It should be clear therefore, that "adaptability" as a term descriptive of animal environmental relationships, applies to far more than species and breed differences. By its physiological nature it is capable of extension to include all relationships or interactions between the animal and its environment. Species and breeds are merely convenient groups of animals which as classes illustrate, usually in a spectacular manner, specific characteristics no different in their physiological basis than those demonstrated by any individual animal in its responses to similar environmental stimuli. This is one of the main points for which I would like to secure recognition. Various workers have demonstrated this effectively in producing through environmental control alone, animals showing extremes of body structure and performance of a magnitude equal and essentially similar to those characterising widely divergent breed types.

In investigating the response of any animal to any experimental treatment, we are but measuring the inherent flexibility of that animal; that plasticity and resiliency previously mentioned. By providing stock with particular conditions of feed and shelter in order to obtain particular productive results we are merely taking advantage of this same capacity.

Reference to the inherent nature of adaptability brings me to my next point: that of its genetic hookup. That such phenomena are characteristic of species and breeds is ample evidence of an association with inheritance. The whole history of breed development and improvement likewise saves further labouring of the point. We need not be concerned with the precise means whereby this genetic association has come about; as to whether orthodox genetic theories of constantly occuring random mutations along with selection provide the explanation, or whether the necessary mutations may be induced by the influence of environment. From a practical viewpoint, it is the fact thereof that matters since this provides us with our basic method of control. The development of animals under specific environments not only leads to the expression of characters determining their special adaptability to such conditions, but enables us to select for breeding purposes those showing the required responses.

Because of the powerful masking effect of environment upon the expression of all animal characters however, our control through selective breeding is limited by our efficiency in distinguishing between animals that are superior because of favourable environmental influences and those that are superior because of a favourable inheritance. The breeder is well aware of this situation when he

quotes the old adage that 'half the breeding goes down the throat'; unfortunately he is not willing to appreciate that in respect to the great majority of productive characters, this adage is well out in its estimate and really should read 'about ninety per cent of the breeding goes down the throat'. In consequence, breeding for improvement has to recognise the influence of environment to an extent which requires the use of highly specialised techniques once a reasonable level of efficiency in production standards has been attained. I will refer to such necessary modifications later.

Summarising the position then, it can be said that adaptability phenomena thus determine the conditions fundamentally necessary for efficiency in animal production. These are three: first, the choice from existing types of animals generally suited to the environment; second, selection and breeding by suitable techniques from those showing special adaptability within that environment; third, the gradual improvement of that environment insofar as this is economically possible to permit full expression of these heritable tendencies.

The foregoing is but a sketchy oversimplification of an exceedingly complex story. Many will ask my purpose in dealing with such "self evident" and "well appreciated" matters. I do not question that most of us tacitly accept the theory of the controlling influence of environment in relation to the animal, together with the physiological and genetic basis of this relationship. I do question, however, whether we do much more than this. Examination of some of the more obvious applications, were such "acceptance" much more than tacit, reveals many sins of omission and commission in our animal production work. To draw attention to a few of these is one of the main objects of this address.

A good story giving offence to none, illustrating neglect to recognise the first principle of improvement enunciated above, is told by Hagedoorn. He describes the abortive attempts of German scientists to improve the milk yield of goats kept by the peasants in Bavarian villages, by the introduction of highly improved goats from Switzerland. These highly improved high milk yielding animals could not survive the poor nutritive conditions to which they were unsuited, and which their new owners could not afford to improve by purchase of the high quality foodstuffs necessary. It was soon observed that of two villages - one of which was kept with typical Germanic thoroughness as a control - while in one, even the labourer continued to keep his unimproved goat which thrived on the coarsest of food, in the other only the school teacher, the parson and the publican could afford to do so. While most can see the point of this story, is it not curious that we are not equally prepared to see its many parallels throughout our own stock improvement efforts.

Our breeders of cattle, sheep and pigs all employ a far higher standard of nutrition and husbandry in the development of their stock, than the commercial farmer can possibly attain. Have not we, through our extension work, encouraged the farmer to persist in purchasing such "hothouse" animals as sires for improvement purposes.

The commercial dairyfarmer relies on pasture and its products for his cow feed. He milks for a season of 280 days. His animals are out of doors. He milks twice daily. He selects his bull from a cow that has yielded say 600 lbs. butterfat under official test. Since his herd average is only 300 lbs. he feels - and I submit we have encouraged him in this belief - that his selection basis is sound. He forgets that the stud breeder has specially prepared the mother of the bull for her test record by appropriate prefeeding treatment and a long dry period; forgets that she has probably received rich concentrates to supplement her pasture feed; forgets that she has been milked thrice daily and has been protected from the vagaries of weather by housing covers and shelter; forgets that she has been deliberately withheld from the bull so that she milks for a season of 365 days and calves but

twice in three years. In short he ignores that fact that her record has been put up in an artificially high environment, quite foreign to that where the daughters of her son are expected to "go thou and do likewise". Quite apart from the fact that the 600 lb. record is no index of the real productive backing of the bull. surely we must have some doubt in the light of the principles we have been discussing as to the soundness of the technique involved.

This latter query brings up the further question of the apparent conflict of ideas between the two principles commonly stated in relation to stock breeding; first, that because of adaptability animals should be selected in the environment in which they are to be used; second, that in order to increase the efficiency of selection, animals should be provided with environmental conditions optimum to the development of characters required. I believe that this conflict is more apparent than real, provided that by 'optimum' we mean conditions comparable with the highest level of feeding and husbandry economically possible in the environment under consideration. Only when this is so are both principles sound in practice as well as in theory. Such optimum conditions will change as our control over environment becomes more effective and our knowledge of the animal's reactions to specific conditions becomes more complete.

In these circumstances it is pertinent to ask whether we have not passed the point where our factual information in this connection no longer allows us to support stock breeding methods of the type outlined. Hamilton's extremely pertinent paper of this morning is timely. He drew our attention to the disturbing fact that improvement in the quality of our national dairy herd is almost stationary, and has been so for some years. Approximately five per cent only of the observed improvement in per cow production over the last twenty-five years can be attributed to selective breeding. The inescapable conclusion from examination of the factors involved in this situation is that the key to progress on the breeding side lies in increasing the efficiency of selection methods; that this can be achieved either by limiting the number of sires used to the upper ten per cent of pedigree cattle through progeny testing and artificial insemination, or by considerably increasing the average production capacity of our pedigree nucleus which today is no more efficient than the grade herds it exists to improve. Both methods are essentially similar in principle though they may differ in their ease of application.

To produce any acceptance of such ideas by breeders it is necessary that we should be of one mind on the questions involved. One may ask therefore whether we are prepared to recognise the failure of 'well established' methods of selection which ignore the powerful masking effect of environmental conditions upon the inheritance of commercial qualities to an extent which renders dam selection relatively useless today as a major stock improvement method; to recognise that a continuation of our outworn adherence to 'type' by which we hopelessly confuse cause and effect in refusing to recognise the physiological basis of milk secretion, and by which we needlessly complicate and retard advance through selective breeding is equally unsound; to advocate that our slavish regard for the much prized but surely illusory "purity" of pedigree stock needs abandonment insofar as it causes us to neglect the great reservoir of high producing high grade cattle as a source of an enlarged and more productive 'pedigree' nucleus; and finally that we believe that some constructive recognition of the desirability of breeding a type of cow adapted to the specialised conditions of grassland dairying in New Zealand would be more efficient than continued recourse to imported stock in a vain attempt to retain overseas characteristics.

I would like to seriously suggest that some thought be given by members to the possibilities of utilising as nucleus material for a New Zealand type of dairy cow, the highest producing

grade animals of the commercial dairyman. These animals fulfil our requirements; they are adapted to our grassland environment. Selected under the best commercial conditions a very large nucleus headed by "Proven" sires could be gathered together of a standard far above the existing level of pedigree stock. These have already four and more topcrosses with purebred bulls in their ancestry, so that from the viewpoint of breed purity are of such a breed standard as to be eligible for entry into some existing 'pure breeds' so that little worry should exist on this score. There is surely something wrong with our existing concepts of animal improvement when a high grade herd of the quality of that of H.J. Macartney of Tai Tapu, producing at an average level of over 500 lbs. of fat, should be lost to the industry as a source of improvement material.

Later in this conference, McMahon will be providing us with some measures of the relative intensities of inheritance of commercial qualities in our sheep. These not only emphasise the dominating influence of environment in masking the inheritance of most characters of economic importance, but if accepted call for equally radical changes in our sheep improvement methods. So great is the limiting effect of environment in this connection, that Hamilton's paper on dairy cattle could be rewritten for sheep were the comparable field data only available. This conclusion is inevitable if we apply the principles we have been discussing, yet most of us are loath to suggest to the sheep breeder of "forty years experience" that some modification of his methods is essential to progress.

It is not the fault of the breeder and farmer that these situations exist. While admittedly a tough nut to crack, particularly in matters cutting right across long cherished convictions, he is dependent upon us for guidance in the long run. Can we, who number among us university teachers, extension workers, and research workers, claim that we have made much attempt to apply an academic acceptance of the principle of adaptability.

Dealing first with the Agricultural Colleges - these have a great responsibility in this connection; essentially they may be described as "the pedigree nucleus of animal workers". They can control the level of production through their influence at least upon the 'attitude' of their products to animal work in no less degree than the level of production of the purebred herd controls the level of production of commercial stock. Do not our Agricultural Colleges, in their teaching and farming methods still pay greater tribute to empirical practice, to farmer and public opinion, and to outworn traditions than to established scientific principles and all the repercussions thereof. My personal experience over the last sixteen years forces me to admit that we tend to devote far more attention to phenotypic selection methods of early stock improvers and subsequent propagators, to the genetics of Mendel with its few applications to animal breeding, than to the genotypic selection of modern progeny testing techniques and the genetics of Lush. We tend still to be more influenced by the vested interests of breed societies in our handling of the subject of 'type' in live stock than by the physiological and factual basis of Hammond. Our stock are still largely employed primarily as a source of profits and a proof of our abilities to compete with the stud breeder rather than as demonstrational and investigational material for establishing a factual basis to performance under specific environmental conditions. It is sound business to win a Royal Show beauty contest but a regrettable commentary on our attitude to animal production.

In connection with these rather strong criticisms of a state of affairs for which I personally am prepared to accept my full responsibility, it is only fair to state that some measure of improvement has been noticeable of recent years. There is however, still a long way to go.

Our extension workers are not blameless in respect to our neglect to tackle energetically problems such as those I have mentioned. That they are not doing so is no better illustrated than by the fact that the young farmer movement with which many of us are associated, is concerned more with stock judging along traditional lines than with training youth in scientific principles of animal production.

The veterinarian cannot escape without some share of the responsibility. Essentially, he also does not admit the basic importance of environment to animal behaviour when the greater share of his attention is centred on the repair of animals who have failed in their adjustments to the conditions in which they are placed; to questions of disease control by treatment of the sick rather than disease control by concentration on the environmental conditions necessary to prevent it. As Dr Hopkirk has suggested in his advocacy of veterinary training facilities in this country, we need a school of animal health rather than a school of animal disease.

On animal research men rests equal, if not greater, responsibility to supply grist to the mill; to hasten the essential work of mapping the whole field of animal environmental relationships and of passing on the information in a form palatable and acceptable to those engaged in extension and educational work.

The adequate mapping mentioned needs more than the animal man. It needs the soil, plant, and animal worker linked in close co-operation. I would like to endorse here Hamilton's suggestion that a comprehensive picture of the whole field of animal production would be well worth while from the viewpoint of providing a "national stocktaking of our soil, plant and animal resources and potentialities as the only sound basis of agricultural development". Our soil men today have a comprehensive knowledge of our soil types, characteristics and distribution; plant men have a comparable knowledge of plant types; our animal men, a more limited though increasing knowledge of animal capabilities and needs. Highly coloured soil and plant maps, while a source of satisfaction to their creators, are of little value unless the information obtained is made use of. Cannot we dig these people out from their industrious collection of data and persuade them to produce a composite story embracing all three media, no one of which in any case exists separately, and all of which acting in concert are involved in the business of food production. It would not be difficult to do this for animal production, were a simplified synthesis attempted on the basis suggested by Hammond. He advocates plane of nutrition, as the most important environment variant operating, for such a general analysis. Classification could be on the broad basis of three main classes; poor nutrition - poor mutton, fine wool, inferior beef; medium nutrition - good mutton, medium wool, good beef; good nutrition - fat lamb, baby beef, strong wool, milk and butterfat. Such a basis fits the main facts of environmental stratification of animal production and would represent a start. It could at least be of considerable assistance to current problems of land settlement and rehabilitation.

Finally, I wish to emphasise that if we accept the general thesis here outlined of animal environmental relationships and the facts of animal adaptation arising therefrom, we, who are engaged in research work must see that the study of the animal in the field dominates our interests. This view advanced by several of our leaders in the animal world, must receive our endorsement. While the laboratory type of experiment is indispensable to the development of new ideas and theories, and to the evolution of principles, the final test must be the animal in relation to its environment. Might I conclude by reminding you that our first Presidential address was entitled 'Should a Breeder Tell', and by remarking that this laborious effort of mine might equally aptly be termed "Should Scientists Practice what They Preach".

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