In presenting this address, I should like to say at the outset how pleased I am at receiving the high honour of being invited to attend the Third Biennial Meeting of your Society. I express my deepest appreciation to Professor T. K. Ewer for this invitation and to the Fulbright Programme for their support. It is a pleasure also to bring greetings to all of you from the American Society of Animal Production.

At Cornell University, as in other American schools, teaching in animal husbandry is quite separate from the faculty of Veterinary Science and B.Sc. degrees are granted with training in animal husbandry. At the post-graduate level however, interchange in training between the two schools is available in the basic courses. Over the past 30 years or more, there has been effective co-operation in research and teaching between the staffs of animal husbandry and veterinary science at Cornell University.

Specially in the different areas of agriculture, including animal husbandry, Cornell University has contributed for many years to the training of students from other countries. In 1959/60 for example, there are among the 11,000 full-time students, 750 from 78 foreign countries, including 93 from India. At present many areas are contributing to international education of foreign students and are sending their senior faculty members to assist foreign governments, universities and research organisations. Many other American universities are also serving the cause of international education.

My main purpose is to review briefly some of the research in animal nutrition at Cornell University and to show you a few pictures of the campus and of our livestock. In doing this I acknowledge that contributions in this area from other Universities and experiment stations have been as important, and often more so, as those I will mention here.

Much of our research has been carried out by students working for advanced degrees, the primary objective of which has been to afford training in research principles and to provide facilities and stimuli for a degree of independent research. In all fields of animal husbandry we at Cornell University also provide an opportunity for graduate students to gain experience in teaching since many of our students are called upon to teach and all must be able to deliver reports on their scientific data.

Animal nutrition at Cornell University was started by L. A. Maynard before World War I. In the late 1920's C. M. McCay joined the staff and F. B. Morrison's coming as department head gave great stimulus to research and teaching in all phases of livestock feeding and nutrition. Throughout the years research has dealt with many aspects of the nutrient requirement of animals and of the comparative values of various feeds. Attention has been given to solving specific problems, which have occurred on livestock farms and at the same time to discover the basic nutritional principles involved. Only a few examples can be mentioned here.

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1. Nutrition and productive life

Early in the 1930’s C. M. McCay found that severe underfeeding of experimental rats greatly extended their life span. On the other extreme, overfeeding of energy and excessive fatness in the latter half of life was associated with earlier death in the animals.

Since 1948, a study has been in progress to test the influence of different planes of nutrition from birth to first calving on the productive lifespan of Holstein-Friesian cattle. Animals on the low plane (60 per cent. of Morrison’s TDN standard) were greatly retarded in growth and they were much older (2.5 mo.) at first oestrus than those fed at 100 or at 140 per cent. of the standard (11.3 and 9.3 mo., resp.). After first calving all heifers were well fed. Lactation performance to date has been poorest for the animals grown on the high plane. Fewer low-plane animals have been lost as a result of sterility or mastitis, but there is wide variation in performance among animals within groups. Clearly the high plane of nutrition is far too expensive. While the study is not yet complete the results appear to agree with Danish and Swedish work in showing that a nutrient level for dairy heifers lower than the Morrison standard may be desirable.

2. The white muscle disease

In the late 1920’s J. P. Willman of our department and W. A. Hagan and Peter Olafson of the Veterinary School began studies on the “stiff lamb disease” a muscular dystrophy which was causing heavy death loss of lambs in parts of New York State. It was soon found that a ration of alfalfa hay (lucerne) and cull kidney beans would cause a high incidence of the trouble, and that a ration of whole corn grain (maize), oats, wheat bran, linseed oil meal and grass hay would entirely prevent it.

At the same time L. L. Madsen working with Maynard found that purified diets containing cod liver oil to supply vitamin A and D caused death loss from muscle dystrophy in lambs, goats, guinea pigs and rabbits but no trouble was seen in rats fed the same diets. The heart muscle was often affected. When it was later shown by other researchers that alpha tocopherol would prevent the muscle dystrophy in rabbits our group demonstrated its effectiveness in preventing or curing the “stiff lamb disease”. Recently D. E. Hogul, in agreement with results at Oregon, has shown that selenium will prevent the disease. He has further found that cooking the beans will also prevent the disease without added alpha tocopherol or selenium, suggesting that a heat labile inhibitor may be involved.

3. Forage utilisation

During the past 15 years many studies have been carried out with forages by K. L. Turk, S. T. Slack, G. W. Trimberger and others. Forages cut at the early bloom or prebloom stage are more palatable and cattle or sheep make faster gains or give more milk when fed those cut early than on more mature forages. J. T. Reid has shown that in New York State the date at which a first-crop forage is cut is a useful index of its feeding value. Other tests have demonstrated that cows will produce more milk per unit of dry matter consumed as silage than as hay made from the same crop cut the same day and cured without weather damage, but cows will eat more dry matter as hay than as silage. With beef cattle J. I. Miller found weaners gained better on hay than on silage alone, but with mature cows there was less difference. The use of preservatives has not proved advantageous in making silage from forage crops at Cornell University, although some other states recommend their use with forages, but not with corn or sorghum silages.
4. **Urea utilisation**

We were able to demonstrate in the early 1940’s that calves only two months of age could make considerable use of urea for growth. Urea has proved to be almost equal to high protein oil meals for growing cattle or milking cows fed low protein hay or silage and adequate grain to supply needed energy. With poor quality grass hay a supplement of urea, molasses and minerals gave better growth of heifers than a basal ration without urea but considerably below a ration containing also a pound or two of corn grain daily or equal nitrogen as soybean oil meal. Urea is not as effectively utilised with sugar (molasses) as when starch is also available. In balance studies ethyl alcohol and starch (or corn grain) were about equally effective in increasing urea utilisation on a ration of poor quality roughage and molasses.

5. **Rumen development**

Recently R. G. Warner and his students have shown that papillary development of the rumen mucosa is stimulated by sodium propionate and butyrate, but much less or not at all by sodium acetate or sodium chloride. There was no stimulation by stiff nylon bristles or sponges which were not fermented. Epithelial and muscular development up to three months of age was stimulated as much by dry concentrate feeds as by hay, but the latter gave greater rumen volume expressed per unit of body weight. These measurements are being extended to animals of older ages to determine whether the types of ration fed early in life has any influence on capacity of roughage at maturity.

The question of how best to utilise Australia’s dried nature forages seems to be one of the major problems here. It is a pleasure to see that your research scientists are seeking answers to this problem along with the many questions that confront you. In closing let me again express my appreciation to you for the privilege of attending your outstanding meeting.