some extent as a test for auxins. Thus the initiation of roots is stimulated, but their growth retarded, by the substances.

All this work shows that the same compounds are responsible for a large number of activities in higher plants, involving cell extension, cell division, and processes of differentiation and inhibition. Are all these phenomena due to the same primary process? *A priori*, it seems unlikely that one cause could start so many processes. Nevertheless, the evidence indicates that it is so. The writer has shown that those other substances IV and V, which partially imitate the action of the auxins I, II and III, also cause initiation of roots, inhibition of root growth and inhibition of bud development. They are limited in their action by being poorly transported, but the activity is there. Other substances are under study. Thus it is probable that any compound which brings about one of these effects has the power to bring about all of them, provided only that it is not prevented from doing so by failure to be transported, or by other limiting factors, such as water for cell extension or sugar for root formation. Thus we reach the view-point that the auxins and the other related active compounds (all of them unsaturated organic acids or easily hydrolyzable esters) exert some kind of general stimulation on the cell. The subsequent observed response depends on the condition, nature and anatomical position of the cell. The cells in young tissues may increase in size; older cells may not do this, but some of them respond by division, those in the parenchyma between bundles giving rise to cambium, those in the pericycle giving rise to root initials. The inhibition of bud development and of root growth, however, are not explained by this or any other satisfactory view at present. The rôle of other factors together with the above hormones may prove of great importance.

In conclusion it may be said that not only has knowledge of hormones thrown much light on some aspects of plant physiology, but it has also given us a new set of tools for the study of genetics, morphology and problems of development.

References to literature will be found in the recent documented reviews of Snow,[1] F. A. F. C. Went,[2] F. W. Went,[3] Jost[4] and Thimann.[5]

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[1] *New Phytologist*, **1932**, **31**, 336.
[2] *Biol. Rev.*, 1935, **10**.
[3] *Botan. Rev.*, 1935, **1**, 162.
[4] *Zeit. f Botanik*, 1935, **28**, 260.
[5] *Ann. Rev. of Biochem.*, 1935, **4**, 545.

Animal Husbandry in India—Retrospect and Prospect.

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ANIMAL Husbandry may be defined as the art of producing, maintaining and disposing of the different species of domestic animals and poultry in the best possible manner for those uses which man requires of them, and, in the same way as the scientific method is now considered essential for progress in most other walks of life, so in this subject it is necessary to remember that any contemplated development should be based on the three sciences of veterinary medicine, animal nutrition and animal genetics. The analogy of Animal Husbandry amongst the livestock population to Public Health amongst the human population will thus be seen.

As Indian Agriculture is so dependent on its cattle throughout its activities, there has been a tendency to think only of these animals when talking of Animal Husbandry and to look upon this art as being connected only with the processes of crop and milk production, but, as will be seen from the definition above and from what follows, Animal Husbandry work covers a much wider field. For this reason it is suggested that India could not do better than follow the lead of other progressive agricultural countries, which make a point of using the word "Agriculture" in its widest sense in official correspondence, and adopt the terms Plant Industry and Animal Industry to describe the two great divisions into which the subject can be divided.

To ascertain the value of India's major livestock industries a survey was carried out by Colonel Olver, Animal Husbandry Expert, and Rao Bahadur Vaidyanathan, Statistician to the Imperial Council of Agricultural Research, and we are now able to allot them an approximate figure. It will probably surprise many to learn that this figure,

even at a very conservative estimate, slightly exceeds the value of her cash crops. The original estimations were based on prices ruling in September 1929, and assuming that there has been a drop in prices of 33% since that date, we arrive at the following figures for the different items which go to make up the enormous total :—

	Crores of rupees
1. Milk and milk products ..	540
2. Cattle labour in agriculture ..	408
3. Manures	180
4. Labour for purposes other than agriculture	107
5. Other products such as hides and skins, meat, wool, etc.	30
6. Live animals exported ..	0·12
	1,265·12

It will be seen that such items as the inland trade in livestock and profits from horse, poultry and pig breeding and other minor industries, have been excluded from the calculations, owing to the difficulty of obtaining even approximate figures of their value at the present time, but there is no doubt whatever that if they were included the total would exceed Rs. 1,300 crores *per annum*, a sum sufficiently large to justify the plea that is being made for the exploitation of this industry on more scientific lines.

The Government of India early recognised that the welfare of India's livestock largely depends on the control of contagious disease and set up as long ago as 1890 what is now the Imperial Institute of Veterinary Research, Muktesar, for the investigation of these ailments and the preparation of agents for their control. That it has more than justified the money that has been spent on it cannot be refuted, for a number of those conditions with which it was originally charged to deal, notably Rinderpest in cattle and Surra in horses, are now well under control, provided that the requisite amount of field staff can be made available. The cause of a large number of other conditions has also been elucidated, and in this connection it is noteworthy that the Royal Commission on Agriculture in 1927 observed that scientific research into these matters appeared to be progressing at a quicker rate than executive staffs were able to take advantage of it, and the position has not improved greatly in this respect since that report was written. One realizes that the provision of more fully trained veterinary field staff by the Provinces and States is a matter of considerable difficulty in these days of restricted revenues, and the only solution appears to be the training of a cheaper agency. In other countries stockmen are employed in Animal Husbandry departments to carry out the duties of vaccinator, castrator, etc., under veterinary supervision. It is particularly desirable that protection on a large scale should be made available for the control of Rinderpest, *by far the most destructive cattle plague in* India, for in the recently adapted goat virus, which can be used alone as a vaccine on all country cattle and even on cross-bred calves up to the age of 18 months, we have a simple, efficient and cheap product, which should prove a most powerful weapon, if properly used, not only for the control of the disease, but also for the automatic improvement of cattle by using it to save the valuable animals, when time and money will not permit of its application to the worthless ones.

Next in importance in Animal Husbandry *work to the control of contagious disease* is the question of Animal Nutrition, and we have had small sections working for some years on this subject at the Imperial Institute of Animal Husbandry and Dairying, Bangalore, and the Agricultural Colleges at Coimbatore and Lyallpur. More recently, a small staff has been financed by the Imperial Council of Agricultural Research and attached to the Agricultural Chemist's Laboratory at Dacca, so that local investigations are now being carried on in several typical parts of the country. These include the analysis with digestibility trials of a number of grains and fodders in common use in India, and it is important that this work should be continued. In addition, more fundamental work connected with the maintenance of animals in India in the optimum state of health requisite for the duties they have to perform, whether this be work, production of milk, wool or other articles of trade, and to increase their resistance to disease, is required and as a result of a grant from Government facilities for this will be provided at the new Animal Nutrition Section which is being added to the central organisation for Veterinary and Animal Husbandry Research at Izatnagar, a sub-station of Muktesar.

Undoubtedly the outstanding scientific

problem in India to-day is one of nutrition and it is one for the solution of which the best brains amongst workers in crop production, human nutrition and animal nutrition will be required. India's human population is increasing by leaps and bounds, her animal population is much larger than it should be, and in both cases there is already a vast amount of mal-nutrition prevailing. The ideal state would be for the plant breeder to show the ryot how he can produce larger and better crops for his own consumption, so releasing some of the land for the production of fodder crops for his animals, which in turn should produce more milk and other products for his household or for sale, and better manure for his land. It will be a very long time, however, before such an ideal is attained in India and in the meantime animal husbandmen must endeavour to alleviate the situation in other ways. The most promising line appears to be the better utilisation of forest grazing areas for the rearing of young stock, and this, of course, is a matter which cannot be dealt with satisfactorily without the co-operation of the Forest Department, but given this and the closest possible cohesion between Livestock and Veterinary officers, it should be possible to arrange for these areas to be more effectively used and for them to rear better cattle, which should find their way to those parts of India which are unable to provide the fodder necessary for young growing cattle.

The Governments of India, both central and provincial, and their advisers took action many years ago to remedy some of the most obvious causes of the degeneration of cattle in India by establishing cattle farms for the production of breeding bulls of known pedigree and in some cases to preserve a breed from extinction. Some of the best examples of these are the Hissar farm in the Punjab for the Hariana breed, the Chharodi farm in Gujerat for the Kankrej breed and until lately the Madras Government maintained the Chintaladevi farm for the Ongole breed, the animals of which are in great demand for export to other tropical countries. Unfortunately, during the recent financial depression, this latter farm was closed as a measure of retrenchment.

The Central Government in this matter have devoted themselves mainly to the question of maintaining and improving some of the best milch breeds in India, and the Sahiwal herd at Pusa, the Scindi herd of the Imperial Dairy Institute at Bangalore and the Tharparkar herd at the Imperial Cattle Breeding farm at Karnal will ever remain a testimony to their foresight.

It cannot be expected, however, that the different Governments will always be prepared to undertake the whole of the work that is necessary for the maintenance of pedigree herds of India's many breeds of cattle, to which buyers both from inside and outside the country can go for their requirements, and it is to be hoped that more land-owners will follow the good example of the Pattakar of Palayakottai, who keeps a pedigree herd of Kangayam cattle near Coimbatore in the Madras Presidency, and maintain similar herds of the breed indigenous to the tract in which they live. These should, if required, prove a source of profit to the owner, and they can be used for the production and distribution of breeding bulls to the surrounding villages.

When all is said and done about cattle farms, however, we are still faced with the position that they can do only a small part to help in the general improvement of the cattle of this great sub-continent, for which more intensive work in the villages by those qualified to give advice is the only solution. The most important items are the introduction of controlled breeding with specially selected or herd-book sires, in the manner recently initiated in the Punjab and the Bombay Presidency, the castration of all unsuitable males, and propaganda work on the general feeding and care of animals, particularly the young.

In addition, India should now consider the desirability of following the example of other progressive agricultural countries which have set up organisations for the study of applied animal genetics, where investigations can be carried out into such subjects as the inheritance of milking and working qualities, wool and egg production, disease resistance factors, etc., technical breeding processes like artificial insemination, and sterility, particularly the partial sterility from which so many Indian cows suffer and which has to be removed before the cattle population can be reduced to figures more commensurate with the available food supply.

There still remain the side-lines of Animal Husbandry such as commercial dairying, poultry keeping, sheep and goat breeding, horse-breeding and the cottage industries of silkworm-rearing and bee-keeping, which

to-day are usually included under this head. Of these, the Dairy industry is by far the most important to India, even judged by figures alone, but apart from this is the fact that milk and its products will supply the animal protein and fat which are so necessary for the proper nutrition of a human race whose diet is predominantly vegetarian. It is a matter for gratification, therefore, that at the instigation of the Imperial Council of Agricultural Research, the Government of India have recently allotted a sum of Rs. 6 lakhs, which is to be devoted to improvements to the Imperial Institute of Dairying at Bangalore and the re-opening of the Anand Research Creamery, which will be staffed and equipped with the primary object of devising the best methods for the collection, preservation and transportation of village milk to the big cities of India. This work, if successful, should at one and the same time improve the lot of the villager, provide the town dweller with more of the food he requires at cheaper rates, and save from slaughter many specimens of India's best milch breeds, which to-day are brought into the cities in large numbers and destroyed after one lactation.

In order to help the Poultry industry, it has also recently been decided by Government to add a Poultry Research Section to Izatnagar, where investigation into Poultry diseases and different industrial processes will be undertaken side by side.

This new movement for the better development of Animal Husbandry in India has been set in motion chiefly through the efforts of the Imperial Council of Agricultural Research and should act as a great stimulus to workers in veterinary, dairy and their ancillary sciences. Very little work connected with domestic animals has been undertaken at the Indian Universities up to the present, but they are admirably suited for the investigation of some zoological subjects, such as the identification and life-history of ecto- and endo-parasites, certain physiological problems, the analysis of local fodders and grasses, etc. It is to the Veterinary profession in India, however, that the prospect should make the greatest appeal and it is to be hoped that its members, and particularly those responsible for devising the curriculum for the Veterinary graduates of the future, will see that the profession is fit to take its proper place in this new campaign.

So far the main object of Veterinary courses in India has been to teach the control of disease, but the endeavour of Veterinary Colleges in all other parts of the world to-day is to turn out, not merely a man well-versed in that subject, but one who also understands animals at all stages of their existence and is able to get the best out of them, *i.e.*, the complete animal husbandman. When the Royal Commission on Agriculture was discussing the best type of officer to employ on cattle breeding farms it remarked that "when the knowledge and instincts of the farmer and cattle breeder are combined with the professional training of the Veterinary Surgeon the position is ideal".

Another great authority, Sir Daniel Hall, late Scientific Adviser to the Ministry of Agriculture in England, in a recent lecture stated "I see the task of the people who are dealing with the health side of animals to be, in future, very much more hygienic and the maintenance of health than the cure of disease. What I would like to see is a class of Veterinarians who are officers of animal health rather than practitioners. There must always be practitioners who are concerned with surgical cases and with specific illnesses of valuable animals, but it seems to me that the great efforts of the profession should be rather of a public nature. Instead of being called in to this ailing cow, or that fretting horse, we want to see a class of men who have charge of a district, who are thinking about the horses, the cattle, the sheep and the pigs and how to keep disease away from them. Naturally, they will have to know about the endemic diseases, but breeding, environment, nutrition, and other factors in hygiene will be equally important. I think that is going to be the direction in which the Veterinary profession itself will eventually move, and that the veterinarian of the future will be the kind of public officer who is taking prophylactic and preventive measures and who is studying problems like nutrition and so forth, so as to ensure a greater amount of health amongst the animal population."

If the teachings of these authorities are followed, then there should be evolved a class of livestock officer for service in India who is able to take full advantage of the encouragement and help now being given by Government and we may look forward to a great future for Animal Husbandry in India.