

results of very great interest; they show that diamonds exist in two types differentiated by the condition of strain originating in their high-temperature formation.

During the present War Robertson has occupied very responsible positions in relation to the earlier field of his researches and has played a keen and active part in the contribution of chemistry to the national emergency.

#### Darwin Medal

The Darwin Medal is awarded to Prof. John Stanley Gardiner, lately professor of zoology and comparative anatomy in the University of Cambridge, in recognition of his life's work on coral reefs.

Gardiner is universally recognized as an authority on coral reefs and on the organisms associated with such habitats. His contributions to these fields of biological and geographical research began not long after his graduation, when he was a member of the coral reef boring expedition to the atoll of Funafuti, organized by the Royal Society in 1896. Since then he has himself organized and led two most important expeditions, the first to the Maldivé and Laccadive Archipelagoes in 1899 and the second to the Indian Ocean in 1905; the results of these expeditions are embodied in nine large quarto volumes and represent a most valuable contribution to a field of knowledge closely associated with the work of Charles Darwin. Within recent years Gardiner has organized and, to a large extent, directed the Cambridge Expedition to the Suez Canal, 1924; the Great Barrier Reef Expedition, 1928-31; the John Murray Expedition to the Indian Ocean, 1933-34; and the expedition to Lake Titicaca in Chile, 1937. He is an authority on the taxonomy and systematics of Alcyonarian and Zoantharian Corals, and has taken a keen interest in their ecology and geographical distribution.

Gardiner realized the great importance, in the study of corals, of the examination of the polyps themselves, as well as of their coralla, and he paid special attention to variations which may result from slight differences of habitat and are correlated with physical and other conditions, showing that in several instances so-called 'species' are merely variations. He also realized the immense value of an accurate knowledge of the coral fauna of any given locality in relation to its environment, in enabling one to deduce the conditions under which tertiary and earlier coralline deposits have been formed.

There is scarcely a branch of research on corals and coral reefs in which Gardiner's work is not of great importance. It was his observations on the Funafuti atoll and the atolls of the Maldivé and Laccadive Archipelagoes that caused him to realize that no one theory, such as the 'subsidence' theory of Darwin, or the 'solution' theory of Murray, can account for the formation of all such reefs and atolls though, when once formed, every reef has been moulded and modified by world-wide phenomena, such as a change in the relative levels of sea and land.

Stanley Gardiner has given us an admirable summary of this, his life's work, and of the conclusions that he has drawn from it, in his book "Coral Reefs and Atolls", a most valuable supplement to Darwin's own volume "On the Structure and Distribution of Coral Reefs". There is a special fitness in the award of the Darwin Medal for work of such "acknowledged distinction in the field in which Charles Darwin himself laboured".

#### Hughes Medal

The Hughes Medal is awarded to Prof. George Ingle Finch, professor of applied physical chemistry in the Imperial College of Science and Technology, in recognition of his fundamental contributions to the study of the structure and properties of surfaces; and for his important work on the electrical ignition of gases.

Finch has carried out two important bodies of research in different fields, both involving electrical considerations in a fundamental manner. The first was a detailed study of the electrical ignition of gases, the second the application of electron diffraction to a wide range of chemical and physical surface problems.

In his work on electrical ignition, Finch not only elucidated the chemistry of the ignition of simple gaseous systems, but also was the first to develop the theory of the sparking ignition coil. His inductance component control interrupter has been used by the Radio Research Board for the production of single electromagnetic pulses. In the course of his ignition work, Finch developed, as a pioneer in Great Britain, the high-speed cathode-ray oscillograph.

In the field of electron diffraction Finch has developed the electron diffraction camera into an equipment giving results of high accuracy with speed and ease of manipulation. The Finch camera has found wide application outside his laboratory, and examples made under his direction have been installed, among other places, at the National Physical Laboratory, University College, London, the University of Brussels (two), and in the laboratories of Messrs. Ferranti and of other industrial research centres. The pictures which he has obtained with it are outstanding in beauty of detail. He has contributed notably to the interpretation of the electron diffraction pattern and has applied his methods to many problems of theoretical and practical importance.

Of special interest are Finch's studies of the relation between crystal size and lattice dimensions and, in the more practical field, his investigations into the effect of the substrate on adhesion of electro deposits, into the nature of polish and into the mechanism of boundary lubrication and the wear of sliding surfaces. In all these he has materially advanced our knowledge, and his work on sliding surfaces, in particular, has found important applications in engineering practice.

His work during the War has covered a variety of fields, some involving the application of electron diffraction. That which he has carried out as scientific adviser to the Ministry of Home Security, while less closely related to his normal lines of research, has been of the greatest value.

## ANIMAL PRODUCTION AND ANIMAL BEHAVIOUR

ON Tuesday, October 24, the British Society of Animal Production held a discussion on the British sheep industry; on the morning of October 25, a joint meeting with the Institute for the Study of Animal Behaviour was held to consider the grazing behaviour of sheep and cattle; the Institute, on the afternoon of October 25, discussed the food preferences of dairy cows and the importance of the study of behaviour from the veterinary aspect.

The familiar classification of British sheep into hill,

lowland and Down types tends to split the industry into distinct sections, although it implies separation on ecological grounds or according to conditions of husbandry. In fact, as Prof. R. G. White clearly demonstrated in his opening general survey, the sections of the sheep industry in Great Britain are closely interrelated and interdependent, so that the industry must be considered as a whole, with that whole in turn forming an appreciable factor in the complex pattern of British agriculture. Although war-time food production policy has tended to relegate the sheep to a lowly place in the British livestock industry and to distract popular attention from its important role in British agriculture, we, as a nation, like mutton and lamb. Sheep consume home-produced grass, fodder crops and foods not suitable for human consumption, and are thus quite different from pigs and poultry. We have large areas of hill and mountain lands which under present conditions can only be exploited economically by sheep-grazing. The sheep of these areas are important not only in themselves but also because they are the basis on which the great majority of the 'flying flocks' of the lowland pastures are founded, and these in turn depend largely upon the arable flocks for the supply of rams for mating to the hill ewes and their crosses to produce fat lamb. If, after the War, we have to increase our home meat production, this will be done mainly by the sheep, and the sheep industry as a whole will be involved.

Mr. D. H. Dinsdale showed, from the economic point of view, that although there is a complementary relationship between hill and lowland sections of sheep farming, and recent trends have emphasized the importance of the foundation nature of the hill flocks, there is also a competitive relationship, as both tend to cater for the same market for meat. To this end the changes in the industry have been of character rather than extent. Most hill farms are small economic units and receive only a small proportion of their income from sheep and wool; the problems of a broad policy for improvement and rehabilitation would, therefore, affect many people. There are physical limits (soil, climate) to improvement as well as economic limits (price, capital expenditure); also, in the sheep enterprise on hill farms, questions of fluctuations in the annual lamb crop, of replacement of stocks (most hill flocks being self-maintained), and of selection for characters of hardiness and mothering ability, raise important biological considerations on which more data are needed. He concluded that no "single-track solution can be expected, of itself, to restore hill sheep to the place they should hold in a balanced farm economy".

In the ensuing discussion, the prime necessity was emphasized of a co-ordinated programme in Britain for improvement of stock and of land, for social betterment and co-ordination between forestry and agriculture in land use; knowledge is required of the efficiency of both sheep and grazing, of suitable ratios of cattle and sheep for successful grazing management, and of losses of efficiency due to inappropriate selection, to subclinical parasitism, and to low nutritional levels of pregnant ewes during winter.

The general lack of adequate data for framing policies was neatly exposed by Mr. T. L. Bywater, who presented a summary of the results of the University of Leeds crossbreeding trials. These have been carried out since 1898, first at Garforth and later at Askham Bryan, and bear upon the question of the most suitable kinds of stock for the flying flocks on

long leys. Many different breeds and crosses of ewes were used, mated to different breeds of rams; records of fertility and of weight and age of lamb when sold have enabled a general comparison of the results of the various crosses to be made on a basis of the total live weight of lambs produced per ewe put to the ram. A significant feature is that smaller differences in results occur from different breeds of rams as compared with different types of ewes—in flying flocks the ewe is more important than the ram; moreover, the results from individual rams of the same breed vary more than between rams of different breeds. For desirability in a flying flock, the ewe should be thrifty, able to rear on the average about 1½ lambs per year, have a sufficient milk yield to produce not less than 120 lb. live weight of lambs at six months or less, and be capable of bearing at least five lamb crops in her life-time. Under the conditions represented in these trials, such characters were found to be most fully expressed in 'North' (Border Leicester × Cheviot) and Masham (Wensleydale × Swaledale) ewes, while for general conditions such types as the Clun, Kerry Hill, Greyface (Border Leicester × Blackface), and Welsh crosses could be relied upon. For mating to such ewes the ram should be able to grow quickly and to fatten readily and be well developed in loin and leg; Suffolk, Oxford and Hampshire rams had been satisfactory, with Suffolks giving the most consistent results.

Mr. Bywater contended, and other speakers supported him, that it is necessary to have similar trials carried out in other localities before an enlightened policy can properly be devised. Among the allied problems to be taken into account are the quality of the lamb product, the most suitable methods of measuring productivity, profitability and depreciation, as well as the source of supply of ewes. In any event, the possibility of different combinations of ewes and rams gives advantages in adjusting production to the various local circumstances; fresh combinations of breeds may be well worthy of study.

The complexities of management of arable flocks were discussed by Mr. J. F. H. Thomas. This section of the industry has declined for economic reasons—lower grain prices, expansion of dairy cow production, high costs of labour and of cultivations. But in spite of these, arable flocks in the south of England enable the large areas of unfenced, unwatered land on the chalk formations to be utilized and the fertility of the ploughland to be maintained. So far as the sheep themselves are concerned, the important questions are those of the suitable types or breeds for commercial production, the standard of which is affected by the present low fertility. Over-specialization on high carcass quality has neglected the factors of high fertility and milking ability of the ewe. Mr. Thomas does not believe, although some of the subsequent speakers did, that the only future for a able flocks is to produce rams for crossing purposes. He sees a favourable prospect for the commercial meat-producing flock, provided that all conceivable sources of loss can be reduced, whether they are due to defects of management, to parasitism (to which the intensive system predisposes but which can be controlled largely by good husbandry), or to other diseases that are favoured by heavily stocked land. He considers that this most complicated branch of the livestock industry has as yet received little help at the practical level from the agricultural scientific worker—and the general trend of the subsequent discussion admitted this by implication, although the

advantages of phenothiazine in control of parasitic worm infestation were stressed.

The second day's proceedings indicated some of the ways in which scientific inquiry is throwing light upon practical problems, and in some cases leading to a reconsideration of attitude towards them.

Mr. John Hammond, jun., summarized the results of observations on the breeding season in sheep and its extension by treatment with pituitary extracts and pregnant mare serum, which induce ovulation in anoestrous ewes, but without heat at the first ovulation. This year it was found that stilboestrol administration, following injection of mare serum hormone, failed to accelerate onset of heat, and that treatment with pregnant mare serum alone, followed by artificial insemination, did not lead to fertilization. The maximum lamb crop under practical conditions would be produced, without treatment, by mating in mid-October and again in February or March, when a second crop could be expected from about 25 per cent of the ewes; with successful hormone treatment, a natural mating in October could be followed by a second service in June.

Experiments at Cambridge on the feeding of pregnant ewes were described by Mr. L. R. Wallace, who showed that lambs from ewes allowed to lose weight during the last six weeks of pregnancy were significantly lighter at birth than those from well-fed ewes. Further, the milk yield of the former ewes was, both at the peak and throughout a sixteen-week suckling period, materially less than that of the second group. This greatly affected the growth of the lambs, which at sixteen weeks averaged 56 lb. and 72 lb. for the two groups respectively. The importance of the level of nutrition during late pregnancy was emphasized by the spectacular differences in size at birth of the lambs from groups of ewes which had been well fed either throughout or during the last two months of pregnancy, as compared with those which had been poorly fed throughout or for the last two months. The ewe's udder remains small, and little affected by feeding level, until ninety-one days of pregnancy; after this the degree of its development is markedly influenced by the nutritional level of the ewe.

Detailed observations on an inbred Romney flock enabled Dr. Nancy Palmer to present a general picture of wool-growth on a unit area of skin; the length of fibres is determined by follicle density at birth, the subsequent rate of skin expansion, and the weight of wool produced. The last factor is found to be the same every summer for all sheep, of any age, in this particular flock.

The practical importance of Mr. Wallace's findings is patent; those of Dr. Palmer were shown by several speakers to throw light upon some of the factors which have to be taken into account in selecting for density of fleece-covering on one hand and increased body-size on the other.

The succeeding papers were concerned with an aspect of livestock management which has received relatively little direct attention. Though conditions of animal behaviour have long been tacitly recognized as affecting experimentation and practical procedures, apparently only in recent years have they been subjected to scientific study, interpretation, and even deliberate exploitation. For example, Dr. J. E. Nichols referred to one of a series of investigations on the problem of drought-feeding in Western Australia, in which the preferential grazing of the sheep and their habits of necessary and unnecessary

movement were studied parallel with observations on the food values and ecology of different forms of *Acacia aneura*. As a result, it proved possible to devise, in the particular circumstances, a practical, and economical, procedure for maintaining the condition of the stock and preventing losses by exploiting the highly developed discriminatory sense of the sheep for the most nutritious shrubs and conserving their expenditure of energy by restricting their travelling as much as possible.

This evoked instances of how similar behaviour patterns could be examined in relation to preferential grazing in Britain, and consequently to the selection of more highly utilisable fodder plants and grasses, and to increasing the efficiency of food utilization under hill conditions as well as in folded flocks.

Mr. A. N. Worden communicated a résumé of Prof. Johnstone-Wallace's studies at Cornell on the grazing habits of beef cattle. From observations on the time taken in grazing and travelling, on the mechanics, methods, and selectivity of grazing, and on the frequency of defaecation, principles of rotational use and management of the pastures can be formulated. While the idea and practice of rotational grazing are not new, it has become clear that detailed investigations on these lines are necessary to enable the most efficient utilization of the various patterns of pasture-growth to be made, if only to overcome the loss of efficiency due to the rapid reduction of herbage consumed as the amount available for consumption is reduced by grazing. Our present ideas of what constitutes good pasture and good management of stock and pasture may require modification.

A similar view in relation to byre feeding emerges from Mr. K. L. Blaxter's observations on the habits and food preferences of dairy cows; refusals of food may occur before the mechanical satiation of the digestive tract, which places an upper limit on appetite, is reached. Broadly, food preferences are in the order; young grass, excellent quality hay, certain protein cakes and cubes, green fodders and roots, certain cereal and protein meals, average hay, then cereal chaff and straw. Moreover, the rates at which different foods are eaten, and at which different cows eat, vary greatly, the differences being most noticeable with bulky foods. Since the most nutritious foods are taken first and eaten most rapidly, these considerations must certainly affect herd rationing, where individual feeding is impossible through lack of adequate housing and facilities.

Some of the variables in this field are easily recognizable, others are as yet less obvious; examples of both kinds were suggested in the discussions which followed these papers. Thus a fertile ground was prepared for Dr. J. T. Edwards' analysis of the development of the study of animal behaviour and its general importance from the aspects of natural history and psychology, as well as in its didactic and economic considerations. In respect of the last, he instanced the work at Cornell, that of Stapledon (see *Vet. Rec.*, June 3, 1944), and Walton's observations on artificial insemination. Other speakers gave further examples of the necessary extension of the general approach, especially with regard to questions of degree and spread of parasitism in relation to grazing and other habits; these served to strengthen Dr. Edwards' plea for provision for systematic research on animal behaviour at institutes dealing with problems of animal husbandry and agronomy, and for the incorporation of appropriate courses at least into the veterinary curriculum.

J. E. NICHOLS.