tioned above by Prof. Max Born, and which will be sure to give a new great impetus to cosmological discussion. Several decisive ideas of Hoyle's are in full harmony with my own theory; especially his very convincing arguments against oscillatory models, and concerning the irreversible conversion of hydrogen. But by far the greatest encouragement which I gain from his very interesting discussion is given by his hypothesis of creation of matter. When I put forward in 1939, following Dirac, the idea of an increasing mass M of the universe, I myself believed this to be a rather astonishing hypothesis. Surely this hypothesis will now be discussed earnestly. But there are also considerable differences between Hoyle's theory and my own. The principal point has already been emphasized by Prof. Born. Will Hoyle's thesis (F), namely, the existence of internebular matter, really be accepted by empirical astronomers? I learn from Dr. Baade that he does not believe it.

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FORESTRY AND HILL FARMING

IN the face of present economic difficulties, the right use of the limited area of productive land in Great Britain, shrinking through the demands of housing and industry and through diversion for use by the Services, becomes of prime importance. When the agricultural improver lifts his eyes to the hills in the hope of increasing food production, he finds that the forester has also marked the hills for the development of his forests. The case for increasing home-grown timber supplies is strong and finds expression in an afforestation policy that has been approved in principle by all parties. On the other hand, we must have more home-grown meat, and in this connexion the importance of hill lands is not simply in the actual mutton and lamb produced, but also in their value as a source of the foundation stocks of lowland sheep.

In view of the existence of these conflicting claims on hill land, the holding of a joint discussion by Sections K* (Forestry) and M (Agriculture) of the British Association was opportune, the more so as Newcastle upon Tyne lies on the verge of a great hill area where the issue of sheep versus trees has been actively joined.

In the opening paper, Lord Robinson surveyed the position mainly from the point of view of timber production. He pointed out that hill country forms about thirty per cent of the area of Britain and, except for the highest land, was originally mainly forest. At present it is mainly devoted to grazing. There has been a recession in this type of utilization; apart from the incursions of forestry, the hill areas are less populous, and sheep stocks are lower and less healthy than formerly. The industry supports about one family per 800 acres; the production is about 8 lb. of mutton and 1·9 lb. of wool annually per acre in England and Wales, with lower figures for Scotland. The industry is heavily subsidized, and Lord Robinson doubted if the expenditure on hill farming could be justified unless soil fertility is restored and maintained, and also whether this could be effected except by ploughing and re-seeding.

A conservative estimate of coniferous timber production is 1½ tons of air-dry timber per acre per annum. Employment at first is double that under sheep farming and rises until about one employee is required for 50 acres of forest. The present programme envisages the provision of at least ten thousand new houses and the establishment of new communities.

Lord Robinson held that there is a place both for forestry and grazing in the hills, and both must be planned as economic units. Dollars saved on imported timber can pay several times over for food displaced, but this displacement need not occur if the grazings unoccupied by the new forests are improved.

Prof. R. W. Wheldon, from the agricultural side, emphasized the importance of hill-sheep farming. At present, grassland types of sheep are dominant owing to the decay of arable-sheep farming. Type conservation and the release of lowland areas from rearing require an integration of hill and lowland, and the same applies to a certain degree to cattle. The possibilities of direct food production in hill areas have been enlarged in recent years. In estimating the contribution of the hill areas to our meat supplies, crude estimates of output may be misleading. The hills are important as providing the foundation stocks for lowland meat production. Private estates have successfully combined farming and forestry. The use of hill lands both for sheep and timber is a problem of practical integration.

Mr. A. P. Long dealt with some of the practical aspects of hill forestry in Britain. The ultimate objective of five million acres afforested by the end of fifty years is to be obtained by (1) the maintenance and replanting of existing woodlands, some cleared and some derelict, and (2) the planting of new areas. A proper balance must be maintained between these programmes. In the new plantings some displacement is inevitable; but much of the land is not fully productive, and we cannot afford to maintain land in an unproductive state.

Mr. Long did not consider that the displacement of food would be so great as often imagined. The number of sheep displaced in one year under the present programme is only 0·27 per cent of the total sheep population. The temporary loss could be repaired by a modest increase in production elsewhere. The need for timber is great, particularly for pitwood, which is a major problem in war-time. The general shortage of timber is likely to persist, and we cannot afford to postpone plans for improving our position.

Land for afforestation is acquired in close consultation with the Ministry of Agriculture, and every effort is made to ensure as little disturbance as possible. Planting may occur many years after acquisition, and only rarely is notice given to quit more than part of a farm. Particular attention is paid to the utilization of unplantable land. The main source of forest land is rough pasture, areas that are unproductive being first tackled; for example, bracken land and water catchment areas. Mr. Long also stressed the social implications of the afforestation programme. Employing about ten times as much labour as sheep farming per unit area, it offers a means of checking rural depopulation and building up a vigorous rural community life.

Mr. D. H. Dinsdale dealt with the economic aspects of the problem. Both hill farming and forestry must exist, and the question is, how much of each ? The decisive choice must be made not solely on economic, but also on social and other grounds. In the decision, the State, rather than landowners and farmers, will take a decisive role. Since forestry requires the lower and better slopes, the direct conflict cannot always be avoided. Mr. Dinsdale explained the difficulties in trying to determine at what level of effort the marginal net return from farming and forestry would be approximately equal. All large-scale enterprises bear risks, and in his view farming would appear to be safer because it is more flexible. Food shortage appears likely to become more acute against increasing population and, in Britain, a shrinking agricultural acreage. The withdrawal of land that produces food should not be lightly undertaken. Mr. Dinsdale pointed out that the production of meat by the hills by no means measures their contribution to meat supplies. They play a vital part in maintaining our total sheep stocks. Further, the potentialities of hill-sheep farming have been considerably increased by advances in technical skill. With the expansion of arable in the lowlands, more is demanded of the hills.

Although stressing the importance of the hills for meat production, Mr. Dinsdale was hopeful that forestry could be integrated with sheep farming in the hill areas through mutual co-operation.

Prof. G. W. Robinson referred to the 'three story' structure of hill farms, with (1) lowland, (2) 'inby', 'intake', or 'ffridd', and (3) open grazing, representing decreasing intensity of utilization and decreasing natural fertility. Forestry is chiefly interested in the middle story, the total planting of which would make sheep farming impossible by removing most of the winter keep.

Although the economics of sheep farming and forestry need more investigation, economics alone cannot give a solution on account of the insecurity of the fundamental data ; for example, future interest rates and relative prices of sheep and timber. Other considerations must be taken into account, notably the present state of sheep farming in a locality and the effect of afforestation on existing patterns of rural society. In some areas the decay of sheep farming may justify the predominance of forestry ; elsewhere sheep farming should be the first consideration. In those areas where there is no clear case for the predominance of either, it should be possible to fit forestry to sheep farming on the lines of good estate management. Part of the 'second story' might be taken for forestry, and the remainder might be improved in compensation. This would be possible only if the Forestry Commission is willing to do its planting in smaller blocks. More mutual understanding is necessary. It should be possible to do for the hills what the great eighteenth-century improvers did for the lowlands.

The discussion added little to what was said in the papers. The vigour with which some speakers attacked the Forestry Commission reflected the difference in approach to the problem. While the forester is mainly concerned with executing a Government policy, the sheep farmer is naturally anxious for his livelihood and cannot view it dispassionately as an economic problem. The exchange of views was, however, valuable, and encouraged the hope that in future the problem will be tackled with greater co-operation.

NUTRITION LEVELS FOR LIVESTOCK

AS part of its contribution to the central theme of "World Population and World Supplies" outlined by the president, Sir John Russell, to members of the British Association at the Newcastle upon Tyne meeting, Section M (Agriculture) devoted a morning session to consideration of the plane of nutrition of livestock in relation to resources.

The resources now available for the feeding of livestock in Britain are very different from those available before the War, and present the farmer with problems of a complex nature. Up to 1939, with easy access to cheap and abundant supplies of imported feeding-stuffs, the rearing and feeding of livestock, in particular pigs and poultry, presented no difficulty ; now, however, the need to conserve foreign exchange, coupled with the pressure to devote a considerable proportion of farm land to the cultivation of food for direct use by man, have not only severely limited the extent to which the farmer can rely on imported feeding-stuffs for the use of his livestock, but has also forced him to look to the farm itself as a main source of his feeding-stuffs.

In these circumstances, not only is there a tendency to keep livestock production to a minimum, but in addition there is also a natural inclination to maintain such livestock as are kept at a low plane of nutrition. The need, from the national point of view, to avoid keeping livestock on such low planes of nutrition was clearly brought out in the papers and discussion. Thus, Mr. R. W. Pomeroy showed that both the birth weights of lambs and the subsequent milk yields of the ewes are affected by the plane of nutrition of the ewe during pregnancy, a high plane of nutrition in the latter part of pregnancy resulting in a higher birth weight of lamb and an increased milk yield. The experimental results show that it is preferable to maintain a high plane of nutrition during the last two weeks of pregnancy rather than maintain a moderate plane of nutrition throughout the pregnancy period. Under conditions of limited supply of concentrates, the practical importance of these findings in the economical production of fat lambs needs no emphasis. In the case of pigs, the emphasis of the effect of planes of nutrition lies on the treatment of the young pigs rather than on treatment of the sow, the experimental evidence indicating that the best results for pigs reared to 200 lb. live weight are obtained by rearing the pigling for the first sixteen weeks on a high plane of nutrition followed by a low plane thereafter. Similarly, in the case of milk production, Dr. S. Bartlett gave evidence to show that increasing the plane of nutrition of the dairy cow beyond the accepted standards results in reduced efficiency of conversion of food to milk, and that lowering the plane of nutrition below the accepted standard not only reduces the milk yield, but also results in a change in the normal milk composition, the solids-not-fat being reduced below normal.

In the case of fowls, Mr. E. T. Halnan showed that where birds are intended for early slaughter as meat, a high plane of nutrition results in increased growth-rate and consequently a greater efficiency of conversion of food protein to meat protein ; high-level protein diets are therefore more economical where slaughter at weights approaching $1\frac{1}{4}$–$1\frac{1}{2}$ lb. are concerned. If, however, the birds are intended for laying or for