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

breeding, moderate levels of protein feeding are indicated, since birds on moderate planes of nutrition attain similar weights at 33 weeks of age to those reared on high planes of nutrition. For egg production, maintenance of layers at a low plane of nutrition, whether induced by the use of inferior feeding-stuffs, restriction of food consumption, or by the use of bulky or fibrous foods, results in a diminution or cessation of egg production and is consequently uneconomic and wasteful of food.

On the problem of making the most efficient use of available resources, Prof. M. M. Cooper expressed the view that there is considerable room for improvement in the use of grassland, particularly the so-called rough grazings, and estimated that no less than nine million acres of land are capable of improvement. The difficulty of dealing with the hill country, particularly some areas in Scotland, was emphasized during the discussion, in which it transpired that on some hill farms the annual lamb production is 60–70 per cent, and it takes two years for a cow to produce a calf.

With regard to sheep, Mr. Pomeroy suggested that the future of the sheep industry appears to lie in concentrating on the production of fat lamb from cheap grass in the spring and summer, and reserving the more expensive winter feeding-stuffs, hay and roots, for carrying the breeding flock through the winter. In the case of pigs, assuming that the era of cheap imported feeding-stuffs is unlikely to return in the near future, it would be better to spread the breeding-sow population thinly over as many farms as possible, the basic idea behind this policy of 'two sows on every farm' being that, with the provision of the requisite minimum of concentrated food in the form, say, of fish meal, the average farm should be able to supply sufficient food in the form of grass, chat potatoes, tail corn, crop surpluses and the like to support two sows and their progeny.

With regard to milk production, Dr. S. Bartlett suggested that the most hopeful method of increased production in existing circumstances is in the direction of increasing the average yield per cow rather than in attempting to increase the number of cows. A better use of roots in the ration gives some hope of achieving this; in an experiment the daily starch equivalent intake of a cow on a diet of hay and roots was raised from 14·5 lb. to 18·4 lb. starch equivalent by increasing the roots fed from 33 to 99 lb. The kind of roots fed is important, and Dr. Bartlett said that he had been impressed with the dependence placed by the Danes in their dairy production on the use of 'fodder beet', a root crop which in addition to being palatable has a high dry-matter content (approximately 21 per cent). By this increased use of suitable root crops, coupled with the practice of 'steaming up' prior to calving, there is no reason why increased yields of milk should not be obtained on home-grown foods and with present resources.

On poultry meat and egg production in Britain, the future appears to rest, in Mr. Halnan's opinion, on the provision of adequate supplies of cereal grains and cereal by-products. War-time experience on the use of substitutes has shown the very limited capacity of poultry to deal with bulky or fibrous foods, except geese, which considerably increased in number throughout the War. The only feeding-stuff capable of acting as a cereal substitute is potatoes, and these are capable of replacing one-half of the daily food requirements. The use of potatoes is, however, wasteful of fuel and labour, and the suggestion was made that from the national point of view it would be more economical to make available for poultry feeding the 700,000 tons of wheat offal that would arise from a reduction of milling extraction-rate from its present 82 per cent to 70 per cent, rather than to ask poultry producers to increase egg production by using the calculated 2,800,000 tons of potatoes required as a substitute. E. T. HALNAN

FLUORINE AND ITS COMPOUNDS

A SHORT symposium on "Fluorine: the Element and Some of its New Compounds" was held by Section B (Chemistry) of the British Association at the recent Newcastle meeting. Sir Alfred Egerton presided, and in a few opening remarks commented on the rapid progress made in recent years in the chemistry of fluorine compounds.

The first speaker, Mr. H. R. Leech (Imperial Chemical Industries, Ltd., Runcorn), gave a lucid account of the production and techniques of handling elementary fluorine. After dealing briefly with Moissan's original isolation of the element in 1886, he gave an account of the development of different types of cells in Germany, Great Britain and the United States during the past few years. These all involve the electrolysis of a potassium and hydrogen fluoride mixture at high, medium or low temperatures. In most cases, the cells have steel cathodes and either nickel or carbon anodes. In Germany during the War, a fluorine installation built for chlorine trifluoride production had a potential output of 700 tons of fluorine per annum, and the cells running at 250° C. used silver for the electrode material. A good deal of attention was necessary for the successful running of such cells. Fluorine was produced in America in very large amounts for the Manhattan atomic energy project. Modern British and American cells use medium temperatures (up to 90°), and in the British cells polarization troubles have been largely overcome by use of a special form of carbon for the anodes. Mr. Leech outlined the work done in his laboratories on fluorine bubble growth and formation during electrolysis of the molten potassium hydrogen fluoride (KF.2HF), and a striking illustration was given of the 'non-wetting' effect of the electrolyte at the carbon anode. Reference was made to the importance of electrode–electrolyte contact angles. Although it has taken sixty years to achieve, it is quite clear that there are now no important technical problems to be solved in the production and handling of fluorine on the largest scale.

Prof. H. J. Emeléus (Cambridge) dealt with some recent advances in the chemistry of certain inorganic fluorides. He outlined the reactions of fluorine with the other halogens, making special mention of chlorine and bromine trifluorides and of iodine pentafluoride, and dealt briefly with some of their chemical properties.

Chlorine trifluoride is a gas, boiling at 11·3° C., which can readily be prepared by burning chlorine and fluorine together under appropriate conditions. It is already available in cylinders from Mr. Leech's laboratories. It behaves as a powerful fluorinating agent and is probably the best means of storing and transporting fluorine. Chlorine trifluoride in the pure state is a non-conductor, though both bromine trifluoride and iodine pentafluoride do conduct. In bromine trifluoride the existence of the ions, BrF_2^+