thought we should be careful not to over-capitalize the upland farms, and pointed out that expenditure on the scale suggested by Prof. Ellison might add £2–£3 per cwt. to the cost of production of a weaned suckled calf. There is great need, he said, for a new building technique to cheapen the costs of rehabilitation. A self-feeding pit silo, as used in America, would be a boon. Above all, greater attention should be given to advisory work, directed more to the economy of the whole farm than to details of land improvement.

Mr. Phillips Price and Mr. Gorrie (Ceylon) took up and supported Dr. Duncan's plea for afforestation. As Mr. Price pointed out, Nature abhors continuous cropping, and lack of balance is just as detrimental in the case of livestock as in cultivation. Mr. Gorrie spoke of the benefits derived from the shelter belts established in the eighteenth century, and suggested that progress in the upland areas is dependent on the supply of labour and machinery.

Three or four farmers, from both sides of the Border, made useful contributions to the debate, in which varying views were expressed as to the economics of the business. Mr. J. A. Symon, formerly chief inspector of the Scottish Department, thought that too much attention is paid to that aspect and referred to the go-ahead enterprise of some farmers in the reclamation of land in Orkney and elsewhere.

Perhaps the question still remains: What exactly is marginal land? I am tempted to quote from a delightful little 'essay' written in the early 'forties by a member of a war-time executive committee in the Border country:

"Marginal land was discovered by the Farmers' Union in 1940. Prior to that date there was none of it: to-day there is little else but. The Department, later, recognized its existence. They have regretted their action ever since. Nobody quite knows where it is except the man who farms it. But Members should be suspicious of any land situated near a margin. Such land is almost certain to be marginal land.

"Sub-marginal land is found under marginal land. Sub-soil is not the same thing. Super-marginal land was also discovered on the same day by the same explorer. All land situated above marginal land is super-marginal. These sub and super discoveries should greatly simplify the work of Members."

However, this member and his colleagues, and those of other executive committees in Scotland, have done a good and conscientious job during the past eight years in the administration of the Marginal Agricultural Production Scheme. There are undoubtedly long-term problems still to be solved, but at least these upland farmers, contributing some 10 per cent of the total agricultural output of the country, have been enabled with State assistance to keep going and to make a reasonable contribution to the nation's food supplies.

HIGHER TECHNOLOGICAL EDUCATION IN GREAT BRITAIN

At a discussion on higher technological education on August 13 before Section L (Education) at the British Association meeting at Edinburgh, over which Sir Hector Hetherington presided, Mr. H. J. Cull gave a well-balanced and concise review of the technical colleges and their development and an appreciation of the contribution they could make in this field. He claimed that higher technological work is a natural part of the development of these institutions, as is indicated by the growth and success of their work in providing courses for Ordinary and Higher National Certificates and for external University of London degrees, as well as, in the larger colleges, for general science degrees, special science degrees and engineering degrees. A technological course of degree standard is a natural development if the needs of industry are to be met, and such a course should include more fundamental science than is usual in National Certificate and diploma courses, and more applied science and technology than finds a place in the external degree syllabuses. If liaison with industry is maintained and developed, the colleges consider that they could provide courses which, with the freedom of an internal examining system, could well be different from the external degree.

Mr. Cull emphasized here that periods of full-time study would be necessary, but that with the co-operation and goodwill of industry there should be no major problem in planning the association of study with experience as a vital part of the course. On the question of the award to be received by the successful student, Mr. Cull indicated the alternative proposals, but urged that early decision is imperative and that any award should carry national recognition. Postgraduate training, he thought, would present less formidable problems if such schemes were allowed to develop, and particularly if the postgraduate courses were developed in association with neighbouring universities. Here, particularly, questions of accommodation and of staff, in his opinion, are important, and equipment and apparatus are expensive items; on the staff side, quality is as important as numbers, and to obtain staff of the requisite quality with real experience of industry and its needs is not easy. He thought that, if properly used, the scales of the recent Burnham report give scope for such appointments to be made. Solution of the problems of accommodation of staff would, moreover, permit the gradual establishment of real centres of research, with teams of research workers, including staff and students, and possibly, in some problems, some workers on a part-time basis from industry. Many of the problems investigated might conceivably come from industry itself, and just as some industrial firms find themselves touching the field of fundamental science, so some investigations in the technical colleges might be concerned with direct industrial problems.

Mr. Cull recognized that not every technical college could or should be called on to provide higher technological courses, and that some regional planning would be necessary. He recognized, too, the critical importance of finance, though he passed over the question of local administration in relation to the academic freedom of the teacher and investigator. He was confident, however, that the technical colleges could provide not only the technicians but also the technologists needed in Great Britain, and that there is in the colleges the enthusiasm to do this work once it is given direction and the student the necessary incentive.

Prof. J. C. Prescott, dealing with the university aspect of the problem, distinguished at the outset between two schools of thought: one regards higher technological courses as providing an opportunity of treating specific advances in technology; the other advocates courses in which the emphasis is upon fundamentals and in which recent technological developments appear as illustrations of the more

general theory. In the universities, the mode of study is to approach the particular example by way of the most general principle, to consider specific phenomena in terms of, and by the light of, fundamental theory. This method is in general followed in their schools of applied science, and accordingly, Prof. Prescott suggested, universities could provide the proper environment only for the second type of course. If they attempted to do more they would forsake their legitimate function.

Prof. Prescott pointed out in passing that the rapid advances in technology have created teaching difficulties for the universities, where reorganization to allow greater attention being given to the study of the fundamental sciences has left less time available for the study of their application in technology. Nevertheless, he thought that university courses which first of all establish the fundamental principles upon which technology is created and then show their application by examples selected from among modern developments would provide a satisfactory solution. While a better medium of education from the point of view of technology, they could not be so comprehensive as regards new advances as the courses which they replace. Advanced courses in technology should be regarded by the universities as the natural continuation of their undergraduate courses. Even here, however, the university should be circumspect and insist that the courses approach the particular through the general, and seek to educate rather than to instruct. He did not believe that a university could usefully conduct courses containing little more than an isolated description of recent developments in technology.

Prof. Prescott said that the results of postgraduate courses of the type he advocated, so far as he has seen them, have been excellent. He thought there is no evidence that the courses have had any narrowing effect, because a systematic study of the sciences involved is as essential as their informed and logical application in the technology. Moreover, the increasingly sympathetic understanding of the engineer's outlook by the scientific worker, strengthened by the latter's growing reliance on the engineer for the design of special apparatus, has largely dissipated fears that such courses might turn promising engineers into indifferent physicists or chemists. Indeed, this clear understanding between the engineer and the scientific worker is fostering happier relations between pure and applied science departments in the universities. Higher technological education, in fact, offers the universities, and particularly their faculties of applied science, a great opportunity of giving systematic education to an advanced standard in subjects which in the past they have only been able to treat sporadically, or at a comparatively elementary level.

Neither of these papers gave any attention to the quantitative aspect of the question, on which clearly a decision as to where the expansion of facilities for higher technological education should take place must partly depend; nor did the ensuing discussion, which was opened by Sir Arthur Fleming, give any clearer lead there, or as to the desirability of any new award. Sir Arthur, commenting on industry's need for the technologist as well as the technician, observed that the number of corporate members of the great engineering institutions who have qualified through National Certificate courses is about the same as the number from university degrees. He endorsed what had been said as to the necessity of teaching of the highest order and the value of postgraduate courses, but added that the chief anxiety in recruitment is as to whether we are securing men of the right type for industry. Sir Arthur urged that the personal qualities of courage, powers of decision, judgment, leadership and the ability to mix well with others should count as much or more than technical or scientific ability. These personal qualities are formed before the young men reach industry, and he knew of firms which for this reason are turning to the public schools, because the technical knowledge could be imparted.

The importance of personal qualities was equally stressed by Wing-Comdr. T. R. Cave-Browne-Cave, who commented that the same qualities of leadership and decision which the Fighting Services seek are needed in industry. The syllabuses of courses should not be so full as to require a concentration on academic work which hinders the development of personal qualities. He thought, too, that it is important for higher technological education to develop independently of the universities, and that the technical colleges should not depend on the universities for their higher award.

The discussion, on the whole, was disappointing in that, although attention was directed to the main factors on which the expansion of technological education in Great Britain turns, no clear lead was given as to their relative importance or the form in which that expansion should immediately proceed. The need for early decision was rightly stressed; but even in the emphasis on the importance of personal qualities, no suggestions were advanced as to whether these would be better fostered in the universities or in the technical colleges. Sir Arthur Fleming's suggestion regarding travelling fellowships relates to the postgraduate stage and the acquiring of the experience and outlook required to fill the highest positions in industry.

CATALYTIC CONVERSION OF A DIENE INTO DEEPLY COLOURED POLYENES

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PROPERTIES indicating the presence of conjugated double bonds. *Cyclo*pentadiene can be converted catalytically into a deep red poly*cyclo*pentadiene-trichloroacetic acid adduct (I), the yield under suitable conditions being more than 90 per cent of the theoretical amount. Analyses, molecular weight determinations and fractional precipitation tests make it probable that a mixture of polymer homologues, of composition $(C_5H_6)_r(XY)$ and a number average degree of polymerization $r = 18 \pm 2$, is formed, (XY) being here and later the symbol for trichloroacetic acid. The unsaturated nature of (I) is shown by its large consumption of potassium permanganate, under relatively mild conditions; and the interaction with molecular oxygen, ozone, nitric acid, perbenzoic acid and hydrogen, in presence of