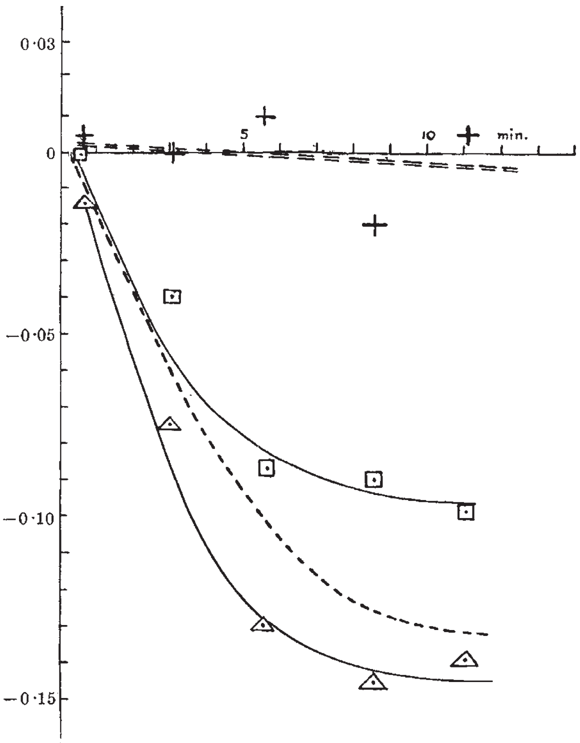

Fig. 3. Diagram of a combined experiment, illustrating the interaction of the cytochrome system and the active absorption of salt anions. The abscissa represents the height of the partly reduced bands in roots pretreated with distilled water for 48 hr. ⊡ cytochrome oxidase 443 mμ, △ cytochrome *b* 430 mμ, + cytochrome *c* 415 mμ. The height was automatically recorded in intervals of 2·5 min. At 0 min. the medium was changed from distilled water to 0·05 *M* potassium chloride. The subsequent oxidation of the cytochromes is reflected in the decreasing height of the bands of *a* and *c*, whereas *c* behaves more indifferently, probably owing to its linkage to side-reactions (cf. ref. 1). The absorption of chloride was recorded and its time-course (- - - - -) closely follows the decreasing reduction of the cytochromes *a* and *b*

The experimental results show that a fragmentary cytochrome system, including only *a* and *c*, can operate without salt accumulation. The anions required for compensation of the valency changes are here probably only circulating. It is even possible that cytochrome *c* is movable between the oxidase and the postulated second dehydrogenase system (cf. ref. 14). The more independent oxidation-reduction situation of cytochrome *c*, as compared with *a* and *b* (see Fig. 3; also ref. 1), supports the idea of its ambulatory character and its participation in enzyme systems outside the structurally anchored cytochromes. The barrier function of cytochrome *b* postulates a fixed linkage to a membrane structure.

A cytochrome system which is not anchored to a diffusion barrier will, of course, not accumulate salts; it will only contribute to a common stirring of the solutes around the structures. This may possibly be the case with systems located in mitochondria, etc. (cf. ref. 7). On the other hand, any oxidation-reduction system operating by means of electron transferences may be capable of transporting electrolytes, or absorbing and excreting ions, if it is combined with a barrier mechanism. So far no such system in addition to the cytochrome system has been closely studied. In respect of plants, our present knowledge points to the cytochrome system as the main salt-transporting mechanism.

A detailed report of the investigations will be published in *Ark. f. Kemi* (Swed. Acad. Sci., Stockholm).

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FUTURE OF HIGHER TECHNOLOGICAL EDUCATION IN BRITAIN

THE second of a series of meetings organized by the Staff Association of the Royal Technical College, Glasgow, to discuss the future of higher technological education was held in the College on May 27 and addressed by Prof. J. F. Baker, head of the Department of Engineering, University of Cambridge.

Prof. Baker, who was speaking on higher technological education from the point of view of the universities, began with a short historical review. Throughout the nineteenth century, a handful of professors of engineering struggled to convince employers that the subject was a science requiring specialized teaching, and was not merely a craft which could be taught best during an apprenticeship. Although hampered by lack of funds, engineering laboratories began to be established about 1870, and did much to bridge the gap between theory and practice. The value of the application of science to industrial problems was more fully realized during the First World War, although even in the 'thirties some firms employing graduate engineers had little idea how to make the best use of them. The universities themselves were not free from blame in this matter, the courses being often too narrow and specialized.

Contending that education for the various branches of technology is an essential function of the universities, Prof. Baker instanced the medical faculties. Medicine, an old and well-organized profession, long ago established its rights in the universities, although it is essentially a technology.

Prof. Baker continued by pointing out the difficulties of teaching a subject the application of which is essentially practical: "while the fundamentals must be sound, practice can never be ignored". With such a vast and ever-expanding field as that covered by engineering, it must be decided what parts must be played by the university and what by industry in the education and training of the student. He was convinced that the intellectual discipline involved in technological education is second to none.

Dealing with the teaching of technology, Prof. Baker said that ideally the product of such education should be a man who by the age of thirty is master of the theory and practice of his particular branch, with a wide knowledge of science equipping him to break new ground, and also a man of culture and character able to deal with men and administrative problems. This is obviously an impossible specification for all but the rare genius. To produce the results required to-day, industry must employ a partnership of different types. Two approaches to teaching are possible: first, to work from the particular to the general, illuminating practice by theory and maintaining a strong practical engineering emphasis; second, to concentrate on theory, with the main approach from mathematics and physics, leaving the junction of theory and practice to be worked out in industry. Each university must recognize the limitations of these two approaches and choose its own course accordingly.

In spite of the demand from some quarters for more advanced technical courses, Prof. Baker was emphatic that the universities would be wise to concentrate on the fundamentals. He is opposed to any extension of the length of undergraduate courses and believes that the proper time for specialized technological studies is in a postgraduate course.

In the important matter of training engineers in the universities, the teaching staff must, above all, be engineers, who would be concerned with the application of scientific principles, instil the idea of precision and help to develop a creative attitude. The staff must keep in touch with practice either by engaging in applied research or in a high standard of consulting work.

Prof. Baker then strongly recommended the foundation of postgraduate courses to meet the needs of those graduates who, after about five years experience in industry, are eager to pursue the study of their particular line of work to a higher level. Their maturity in the practice of their profession would enable them to appreciate to the full advanced knowledge. In addition, the presence of these men in the university would be of great value in stimulating the teaching staff to new vigour and enthusiasm, which would in turn influence the undergraduate courses.

A wide general scientific education should be the aim for the undergraduates, while the postgraduate courses would complete the training of the best technologists, so providing for the needs of an expanding industry and stimulating progress.

A contribution from Dr. James Taylor, managing director of the Nobel Division of Imperial Chemical Industries, Ltd., was read in his absence by Dr. David Traill, research manager of the Division. In his opening remarks, Dr. Taylor, who dealt with the relation of higher technological education to industry, defined the technologist as "one who engages in the scientific study of the practical or industrial arts, and in the practical application of scientific principles and discussions to the arts and industry", and emphasized the collective importance of the technician, the technologist and the pure scientist in the growth of any healthy and progressive industry. He next examined the American thesis that, while Britain is abreast and in some cases ahead of the Americans in many branches of research, technical stagnation has ensued due to a failure of technical re-equipment and tardiness in technical innovation. In assessing how far the present training of chemists contributes to this reluctance in technical innovation, he said that the intellectual atmosphere of the training which regards research as an end in itself has two effects: "it tends to make the chemist non-critical of problems which are given to him for experimental study and too little concerned with the outcome when he has completed his investigation". Considering the training aspect generally, he felt that the first requisite is a sound grounding in the basic principles followed by a period of research in a university school if the student plans to take up the fundamental exploratory aspect of industrial research, or by a chemical engineering course (as, for example, that given by the Massachusetts Institute of Technology) if his interests lie in the development and plant-operational aspects. In the latter case the essential 'clinical' experience can only be provided by industry.

In conclusion, Dr. Taylor supported a recent statement by Sir Arthur Smout that more attention should be paid to the liberal side of scientific education, "to promote the inquiring mind and develop original thought".

A written contribution received from Mr. A. S. Danchev, lecturer in mechanical engineering in the New South Wales University of Technology, Australia, referred to the direct connexion which exists between an efficient technology and the right kind of technological education. He submitted that there is a need for a university of technology which would provide a broad educational background coupled with an enlightened professional training. In its courses, such a university would recognize that its primary aim is to produce "thinking men, men of judgment and initiative" capable of formulating and implementing an industrial policy. To that end it would institute a blend of theoretical and practical courses so that the practical operations within a technology would always be presented in relation one to the other and to the integrated whole. In conclusion, Mr. Danchev pointed out that universities of the type referred to are favoured in Europe, in the United States, and have recently been introduced in Australia.

In the varied discussion which followed, many contributions were based on personal experiences in the United States and Europe.

Criticism of the present British university system was mainly founded on the agreed view that sufficient technologists suitably trained to be effective in industry are not being produced. This led several speakers to advocate the establishment of universities of technology.

One cited the close co-operation existing in Switzerland between the research laboratories of firms and local colleges. This followed from frequent interchanges of staffs between them, many of the professors in the colleges having held high positions in the industries. Such exchanges led to a rapid diffusion of new knowledge into industry and also allowed local industries to have a strong influence on the development of theoretical work in the colleges. Now that technology has become internationally competitive, such co-operation is becoming a necessity for Britain. But such 'double harness' conflicts with the traditional freedom of British universities to develop in their own way and time.

Referring to Prof. Baker's view that, until a man has been into industry, research should not form part of his training as an engineer, another speaker maintained that, without the attraction of research and the opportunity of gaining a higher degree, even fewer of the best brains in Britain than at present would train in technology. To attract men, technology must therefore have full university status as in

Europe and the United States, where the prestige of technologists is high. One argument used against a technological university is that it would deprive technological students of valuable social contacts with other students; but, in fact, the opposite is true. In the normal British university to-day, the demands of laboratory work keep students of technology from many student activities, whereas in institutions such as the Royal Technical College, Glasgow, which closely resembles a technological university college, all students are similarly placed and social activities easily arranged.

Another speaker observed that the idea of specialized technological institutions conflicts with an accepted definition of a university as a centre of general learning.

It was also pointed out that until greater administrative responsibility is given by industry to technologists, their status and numbers would remain unsatisfactory.

The value of postgraduate courses for young men from industry was stressed, and the popularity of such courses in the United States was mentioned. Among other matters raised was the function of the small technical college apparently threatened from below by the trades school and from above by the university.

In his replies, Prof. Baker agreed that on the Continent and in the United States public esteem for technology is high. That it is not so in Britain makes him doubt if lasting prestige would be gained by new 'technological universities'. On the present shortage of technologists, he maintained that the solution lies with industry to offer better opportunities to technologists and so induce more good entrants into the universities. While Cambridge-trained engineers are much sought after, many of them in the past had left the technical side of industry by the age of thirty. Speaking from recent experience in Cambridge, where a postgraduate course on "Structures and Materials" is available, he held that postgraduate courses for men back from industry are of great value. Advanced new knowledge can be applied to practical problems, and the results of research, which go unnoticed when published by learned societies, become available to industry without the distressing delay common in the past.

NEW BUILDINGS FOR THE DURHAM COLLEGES

At a ceremony on May 15, at which the Warden of the Durham Colleges, Sir James Duff, presided, Prof. G. R. Goldsbrough, emeritus professor of mathematics in King's College, Newcastle upon Tyne (University of Durham), formally opened the West Building and the adjoining Applebey Lecture Theatre of the Durham Colleges. These buildings have been recently completed by the firm of Messrs. Leslie and Co., Ltd., to the designs of the architect, Prof. J. S. Allen, professor of town and country planning in King's College, Newcastle, and the consulting engineers, Dr. Oscar Faber and Partners. They form, with St. Mary's College, the first instalment of the plan for developing a new university centre on the south side of the city of Durham.

Already, some thirty years ago, the science laboratories had been erected in that neighbourhood; and when pressure upon the 'peninsula' site between the Castle and Cathedral became intolerable, it was decided to transfer the teaching of mathematics and geography to a new building adjacent to the laboratories which should contain also additional lecture rooms for all the sciences. Of this building, the Applebey Lecture Theatre (so named in honour of Dr. M. P. Applebey, sometime fellow and tutor of St. John's College, Oxford, and for the past fifteen years chairman of the Durham Colleges Council) forms the western wing. It accommodates an audience of 350 and is fully equipped with cinema projectors and all bench services; ventilation and lighting, which is entirely artificial, are under the lecturer's control. The demonstration bench and dais are removable to permit the use of the theatre for meetings, concerts and the less elaborately staged plays. Here, as in the smaller theatres, the walls are panelled with sound-absorbing material and the acoustics are excellent. By taking advantage of the slope of the ground on which the theatre stands, it has been found possible to provide beneath its gallery a large and lofty reading room with ample natural light and stack-room for some fifty thousand volumes.

At the opposite end of the building the eastern wing, adjacent to the existing laboratories, contains two lecture theatres, three lecture rooms of varying size, and private rooms for the staff of the Mathematics and Geography Departments. It is surmounted by a flat-topped tower with arrangements for mounting surveying instruments and a small telescope. The varied character of the rooms in this wing has needed careful planning; but by the use of mezzanines it has been possible to give each room its appropriate height. The wings are connected by a three-storied central range in which are seminar rooms for both mathematics and geography, a computing room, two laboratories for practical work in geography, a drawing office equipped for cartographical research, and a map library. The ground floor is occupied by a workshop, stores and ample cloak-room accommodation, while in the basement space is reserved for the installation of a wave tank.

Heating throughout is by concealed ceiling panels, connected to calorifiers which in turn receive heat from a central plant some two hundred yards away, recently erected to serve all University buildings in the area. All wires and pipes for the various services are concealed in a system of horizontal and vertical ducts which are readily accessible at a number of points in the building. There are no external rain-pipes, the roof water, when collected, passing down the vertical ducts.

The resulting 'tidiness' assists that simplicity of line which is perhaps the building's most pleasing characteristic. Except in the main entrance and staircase, where there is some elaboration of design and ornament, architectural decoration is almost entirely absent. Colour of great variety and richness has, however, been freely used. The predominant light grey of corridors and lecture rooms is relieved by the bright colourings of doors and windows. These vary from floor to floor: while geographers are plum-coloured, mathematicians are merely yellow! Some interesting experiments in colour have been made: the general hue of the Applebey Theatre is a mustard-yellow, while in the smaller theatres the deep indigo of the sound absorbers is in harmonious contrast with the subdued red of the ceilings. Colour is but one element in the prevailing impression of