In the second paper, R. I. Tanner, from the University of Manchester, presented a paper on some tests on 'Fluon' as a material for artificial animal joints in which results of artificial hip-joint friction and wear are given. They are based on the results obtained by means of simple pendulum apparatus which provides a reasonable approximation to the walking motion of a normal person.

A critical review of published work on the nature of lubrication in animal joints was given by John Charnley from the Department of Orthopaedics at Manchester. Further, some of the experiments which have been accepted in support of the theory of hydrodynamic lubrication have been repeated by him to show that the lubrication of animal joints is almost certainly a boundary phenomenon. Charnley emphasized that the coefficient of friction of animal joints reaches a very low figure and surpasses in slipperiness any combination of sliding surfaces known to engineering.

A paper on the provision of workable substitutes for missing or defective limbs was presented by D. S. McKenzie and Brig. N. A. M. Swettenham, from the Limb Fitting Centre, Ministry of Health, Roehampton.

Limb fitting has been essentially a craft until quite recently, and many ideas current in the last century exist materially unchanged to-day. This situation is now changing as a great deal of research work on artificial limbs with emphasis on fundamental studies is in progress. Some of the problems here are very complex. The prosthesis has to replace a human component but it does not necessarily follow that its mechanical design should copy that of the part it replaces. Amputation often changes the pattern of muscular control and weight bearing. The paper also described some of the features governing the construction of artificial limbs. Each case has to be treated individually and *ad hoc* modifications have to be made to suit individual needs. In a research field of this nature it is difficult to prove that a proposed change has merit, and evaluation techniques still require much development. Some devices evoke general acceptance, but more often individual responses vary and the type of case for which the new idea is best suited must be discovered. Only users can supply the final answer, but they cannot give up unlimited time to experimentation. Objective testing is therefore necessary to eliminate obvious flaws and shorten user trials.

Following the presentation of the papers, a film entitled "Late Results of Four Massive Internal Prosthesis" was shown by A. C. Bingold and W. G. France. Here the authors gave an excellent picture of how, through the co-operation of surgeons with engineers, instead of amputation, limbs can be saved and restored to their normal use.

The success of the symposium, I think, was reflected in the very interesting discussion which followed and well exceeded the time limit allocated for this purpose.

The Institution was honoured by the presence of Sir Harry Platt, of the Royal College of Surgeons, who, in opening the discussion, stressed the importance of interdisciplinary work between the medical men and engineers. He said that the symposium had clearly demonstrated that some of the surgical techniques now in use are so complex that it is impossible for one profession only to solve the problems involved.

Dr. F. C. Harper, of the Building Research Station, showed a film and some results obtained in the course of studying the forces exerted by the human foot in walking, the emphasis there being on the wear resistance of floor surfacing materials.

Dr. J. D. Moreland and Mr. S. J. Thurlow, of the Road Research Laboratory, discussed their investigations into the problems connected with road crash injuries.

Mr. E. H. J. Smyth, an orthopaedic surgeon from the Southampton and Isle of Wight Hospital Groups, presented in a very interesting manner his views on the functional significance of the formation of trabeculae in the neck of the femur.

Finally, because of shortage of time, after a number of speakers discussed a variety of subjects of their own interest, the authors of the papers answered various points raised in the discussion very briefly.

In conclusion, the large attendance and the discussion were an indication that the Institution of Mechanical Engineers had organized a successful symposium which from the 'mixed' audience indicated the growing affinity between engineering and medicine in the process of alleviating human suffering.

The Institution of Mechanical Engineers will shortly publish the proceedings of the symposium, which will include the discussion and communications.

J. M. ZAREK

INTERNATIONAL STARCH CONVENTION, 1959

THE ninth annual Starch Convention, which took place at the Cereal Research Station, Detmold, Germany, during April 21-23, was attended by 360 chemists from seventeen nations. The papers which were read to the meeting were divided into four sessions, on research and analysis, starch manufacture, starch fractions and derivatives and on industrial applications.

The opening address was delivered by T. J. Schoch (Argo, Illinois), whose theme was the application of modern methods of starch chemistry to characterizing its useful properties. Waxy sorghum starch, which is comprised wholly of amylopectin, can be given some of the characteristic properties of corn starch by

cross-linking the polysaccharide chains with phosphate, epichlorohydrin or fatty acid groups. The amount of cross-linking agent required to achieve this result is only 1 part per 1,000 parts of starch. Thus waxy starches, which normally give rise to fluid pastes, are deprived of this property and become 'short'. Simultaneously their resistance to shear increases greatly. Another result is that such starches lose the property of gelatinizing in water at a precise temperature, and instead show a gradual increase in solubility with rising temperature. Cross-linking also results in a marked improvement of resistance to freeze-thaw cycles, which has important implications for the food industry.

Improved freeze-thaw characteristics show as a lower rate of sedimentation after freezing, and better gloss and transparency of the paste.

The new properties of amylopectin obtained by cross-linking can be explained by a greatly reduced rate of retrogradation and greater internal rigidity of the starch molecule. The technique of cross-linking can be extended to dextrines, which are used as re-moistening gums on envelope flaps and labels. The deterioration of such gums on ageing has been shown to be due to retrogradation of the dextrine in the presence of small amounts of water. By using the hydroxyethyl derivative of dextrines for gumming purposes, the ageing characteristics of flap gums can be largely avoided. Finally, Dr. Schoch explained how starch films, which have been laid down by slow evaporation of water, have a greatly increased resistance to water when compared to quickly dried films. This again can be shown to be due to retrogradation taking place during the slow drying of films.

Prof. M. Samec (Ljubljana, Yugoslavia) described how the bursting and tear strength of paper can be markedly improved by using a starch size which has been previously irradiated with cobalt-60. This process might become of great importance if the cost of the radioactive material would be reduced in the future.

The use of starch as sizing agent in the paper industry was described by J. Seaman (Slough, Bucks). A beater size should preferably be a potato starch soluble in cold water, of which 5 per cent w/w is added to the paper pulp. Such starches are manufactured by passing a slurry containing starch and borax over steam-heated drying rolls. The product when re-dissolved has pH 8.5 at 5 per cent concentration. For surface sizing it is advantageous to use an oxidized starch, which is manufactured by treating potato starch with sodium hypochlorite. The material has to be cooked with water before use to give a size having pH 7.5 at 15 per cent solid-content. For paper coating, white potato dextrine (1 part) is added to china clay (5-6 parts) and the mixture made up with water to a slurry having a solid content of 50 per cent.

When selecting dextrines for coating purposes, it is essential to choose one with a maximum rate of set back to enable the coating to set on the surface of the paper as rapidly as possible.

Prof. M. Mautner (Zagreb, Yugoslavia) described a new method for the continuous production of

glucose by the acid hydrolysis of starch. The starch slurry is first treated with hydrochloric acid and is then passed into a conical chamber, which rotates very quickly about its long axis. The chamber is heated externally by steam and is provided with an inlet at the wide end and an outlet at its apex. Ungelatinized starch particles are forced by centrifugal force to the walls of the chamber, where they gelatinize instantly. In so doing their specific gravity is reduced and they are replaced by further ungelatinized granules. The chamber has a peripheral speed of 30 m./sec. and it can deal with $2\frac{1}{2}$ tons of raw starch per hr. After leaving the chamber the starch paste is fed into a series of flat, box-like heat exchangers, where the final conversion of starch to glucose takes place. It is estimated that the total time required for conversion is only 18 min.

At the Convention a total of twenty-two papers was read and they will be reprinted in full in the journal *Die Stärke*.

The actual Convention was followed during April 24-25 by the first meeting of the International Standards Organization Technical Committee No. 93, which has been set up to establish international recommendations for analysis of starch, including its derivatives and by-products. There were 65 delegates present from Czechoslovakia, Denmark, Eire, Finland, France, Germany, Hungary, Italy, India, The Netherlands, Norway, Switzerland and the United Kingdom. The chair was taken by Prof. K. Heyns (Hamburg), the secretariat being held by the German Standards Association. The British side of the work is in the hands of the British Standards Institute Committee on Analysis and Testing of Starch Products; ten members of this committee—representing manufacturers and users of starch and associated products, research interests and Government departments—were present. The work already done by the British Standards Institute Committee enabled the British delegation to give a strong lead at these inaugural discussions of the International Standards Organization and many of the United Kingdom proposals were adopted.

It was agreed that the scope of the new International Standards Organization committee should cover: terminology, methods of sampling, methods of analysis and examination of starch, its derivatives (including hydrolysis products and dextrines) and its by-products.

E. DUX

THE EDUCATION OF TECHNOLOGISTS

THE presidential address to the Institution of Metallurgists, delivered by Prof. A. J. Murphy on May 12, covered a field involving not only the metallurgist but also the technologist in general, and in no small measure the pure scientist as well.

After dealing with matters of a more or less domestic nature, Prof. Murphy turned his attention to the general background desirable in the training of the technologist. From this the following has been extracted.

Sooner or later in any discussion on the education of scientists and technologists the remark will be made: "What a pity it is that you cannot give your bright young technical men some sense of cultural

values". Often this can be recognized as the defensive manoeuvre of a dyed-in-the-wool classicist, who, in an age of automation, atomic energy and satellites, sighs for the day when he could with impunity, and publicly, dismiss science as something they used to call "stinks" at school.

But there is more in it than that. It must be admitted that far too many technically competent men are distressingly inept in communication by speech and writing. This is very regrettable. The blame rests primarily on the schools—of that I do not have the slightest doubt. I do not believe that any reasonably intelligent boy who had been properly taught the elements of English grammar and syntax could perpetrate the mangled compositions which