to have a specific effect in bringing about irreversible changes; on precipitation of the nucleic acid with ethyl alcohol in the presence of magnesium ions, large artificial aggregates are formed.

The behaviour of nucleic acids as polymeric electrolytes was discussed by Dr. D. O. Jordan (Nottingham). The nucleic acid polymer contains both strong and weak electrolytic groups, and the presence of the former and the ionization of the latter affect the viscosity of its solutions and the shape of the titration curve. The viscosity of deoxypentose nucleic acid shows considerable structural character, and the viscosity at low pressures is high. The addition of electrolyte reduces the viscosity considerably, as has also been described for simpler systems, for example, polymethacrylic acid and poly *N*-butyl-4-vinyl pyridonium bromide. This process is explained by the repulsion of the charged groups (PO^- at $\text{pH } 7$) maintaining a stretched polymer in aqueous solution. The addition of electrolyte reduces this repulsion, thereby permitting the molecule to coil, thus producing a more symmetrical molecule and reducing the viscosity, the structural character of the viscosity and the streaming birefringence. The analogy between nucleic acids and synthetic polymeric electrolytes cannot be carried too far, since the number of *gegenions* absorbed into the micelle is large, as indicated by the value of 550e for the charge per molecule in a solution of ionic strength 0.005, compared with the calculated value of 2664e for a molecule of molecular weight 8.2×10^6 . The presence of the *gegenions* in the micelle will reduce the number of effective ionized groups, thereby decreasing the repulsion. The dissociation constants are all found to be weaker than in the monomer. Calculation of the pK values at different degrees of ionization for the $-\text{NH}-\text{CO}-$ dissociations shows a decrease in acid strength as ionization increases; the initial value, however, is weaker than that for the nucleoside. This is presumably due to the presence of the PO^- groups. The case of the amino groups is more complicated, the field effect produced by the ionization to NH_3^+ and by the PO^- groups operating in opposite senses.

The degradation of deoxypentose nucleic acids by chemical agents was outlined by Dr. J. A. V. Butler (London). The extent of degradation was followed by measurement of viscosity. The action of X-rays had been shown previously to produce degradation during the irradiation and to give an after-effect in which the degradation continued after the source of radiation had been removed. This after-effect has now been shown not to occur in the absence of oxygen and is probably due to the presence of hydrogen peroxide or HO_2 radicals in solution. A similar degradation to that produced by X-rays may be obtained from the action of free hydroxyl radicals formed by the irradiation of hydrogen peroxide by ultra-violet light or by the reaction between the ferrous ion and hydrogen peroxide. Similar degradation is observed by the action of sulphur and nitrogen mustards. Ultracentrifugal analysis of the degradation products, by Dr. B. E. Conway and Dr. L. Gilbert (London), has shown that there is a considerable reduction of the molecular weight from 1×10^6 to about 1×10^5 , the products being very heterogeneous and containing some low molecular-weight fractions which diffuse very rapidly. These degradations, however, are not nearly so extensive as that produced by the action of deoxyribonuclease.

D. O. JORDAN

BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

By DR. HENRY PHILLIPS
Director

INCORPORATED in 1920 and starting with a modest income, the British Leather Manufacturers' Research Association at first rented laboratory space for its small staff in London at the Battersea Polytechnic, the Lister Institute and the Imperial College of Science and Technology. Largely the child of the heavy leather industry, the Association rejected the late Prof. A. Smithells's suggestion that its headquarters should be near the Leather Industries Department of the University of Leeds, then guided by Prof. H. R. Procter, because the tanneries in the Leeds area mainly produce light leathers; although scientifically similar, there are fundamental differences between the processes of these two sides of the industry. The Association therefore went to London, where it was near the headquarters of the United Tanners' Federation and the Federation of Light Leather Tanners and Dressers, and also the heavy and light leather industries of Bermondsey.

When Dr. Dorothy Jordan Lloyd succeeded the first director, Dr. R. H. (later Sir Robert) Pickard, the staff was gathered together in laboratories set up in St. Thomas Street, London, S.E.1. Industrial support for the Association grew steadily, and by 1938 sufficient reserve funds had accumulated to enable more commodious laboratories to be furnished in Nelson Square, Blackfriars Road, London. These laboratories were carefully planned and provided a compact and convenient research centre. Occupied in 1939, they were not destined to survive very long, for they were badly damaged in the bombing of 1940, fortunately at night during the absence of the staff. Space for about half the staff was improvised on the ground floor and in the basement of the bombed building; the remainder found accommodation first at Rothamsted Experimental Station and the Leathersellers' Technical College, and later in a large laboratory above the Royal Institute of Chemistry.

At the end of the War, permission to reinstate the laboratories in Nelson Square was refused. The industry was reluctant to move the Association from Bermondsey; but, after the death of Dr. Jordan Lloyd in 1946, a review of the circumstances suggested that the prospects of rehousing within the London area were slight. The Association therefore decided that a search should be made to find a country mansion suitable for conversion and within a radius of twenty miles of London. The final choice fell on Milton Park, a large Georgian-type mansion, situated in thirteen and a half acres of grounds and within walking distance of Egham Station. After a public inquiry, opposition to the conversion was withdrawn. Fairly extensive repairs and modifications to drainage and supply services had to be made; but in a little more than a year the conversion was completed, and the new laboratories were opened by H.R.H. the Duchess of Kent on May 22.

The leather industry is often referred to as a traditional industry, with the implication that the tanner is conservative and reluctant to adopt new methods. This is a superficial view: industries remain traditional so long as scientific knowledge lags behind empirical knowledge. Fibre science and

the fibre scientist are relative newcomers to research laboratories: the tanner from time immemorial has been modifying collagen fibres, and until recent times his control over his empirical processes was necessarily precarious. Realizing this, he was naturally reluctant to experiment.

Unlike the textile manufacturer, the tanner obtains his fabrics—hides and skins—already woven; he is essentially a finisher of these fabrics, not only in the sense that he makes the fibres more resistant to water and micro-organisms, but also because he may modify profoundly the physical properties of the fibres. In the manufacture of sole leather, for example, where solidity and firmness are required, the collagen fibres become impregnated with as much as seventy per cent of their weight of vegetable tannins. This transformation is accomplished without serious disturbance of the original fibre weave and pattern. In light leather manufacture, where flexibility is the main consideration, the tanner alters the fibre far less; he is more concerned with decreasing their reactivity by sealing off their amorphous regions and by cross-linking the polypeptide chains.

Such a brief review in terms of modern fibre science could not have been made in 1920. Yet it explains how the past work of the Research Association has followed certain paths to satisfy the tanner's needs. The British tanner has searched the world for hides and skins with fibre structures suitable for specific leathers; thus, a Sudanese sheepskin will yield a gloving leather far superior to that obtained from a merino sheepskin. Methods of preserving hides and skins for transport became, therefore, an early subject for research. So also did the histological examination of all animal hides and skins in order to correlate their fibrous structures with the physical properties of the leathers they gave. Microscopical examination of hides and skins during their conversion into leather was and is still widely studied, so that to-day, for example, the wearing qualities of a sole leather can be assessed from the microscopical examination of a thin cross-section.

The classical work of Procter on the combination of gelatin with acids and alkalis, and the interpretation of the resulting swelling by the membrane equilibrium theory of Donnan, has obvious applications in the leather industry. Investigations in heavy leather tanneries, along the lines now known as operational research, showed that control of the swelling of the fibres in the acid vegetable tan liquors is necessary in order to facilitate the penetration of the tannins into the interfibrillary spaces in the hides. Later investigations revealed the importance of the concentration of acids and salts in the tan liquors as factors controlling the rate at which the collagen fibre structure is loosened to enable tannins to penetrate and become fixed in the fibres themselves. Empirically the tanner had found that, by using blends of extracts of tannin materials from different parts of the world, he could modify the fibres and facilitate the fixation of tannin, although he was unaware that blending gave him the requisite concentrations of acids and salts he required.

Using pH control, the tanner can regenerate the weak acids of his tan liquors by the addition of sulphuric acid. The use of strong acids in tanneries was blamed for the tendency of some bookbinding and upholstery leathers to rot and become powdery. Many years of investigation were necessary to prove that the sulphuric acid found in rotted leathers originated from the sulphur dioxide in town atmo-

spheres which was absorbed by leather and oxidized to sulphuric acid under the catalytic action of iron impurities. Treatment of the leather with oxalates or pyrophosphates which sequester the iron makes the leather inert towards sulphur dioxide and hence capable of withstanding polluted atmospheres.

In more recent years the demand for specification of imported manufactured goods in countries anxious to build up secondary industries has caused increased attention to be paid to methods for measuring the physical properties of leather, and this development was taken into account when planning the laboratories at Milton Park: adequate facilities have been installed for the comprehensive study of the physical properties of collagen and leather fibres and of leather in bulk. One of the aims of the Physics Department is to strengthen the morale of the industry, which under the impact of the extensive publicizing of synthetic products has forgotten why it adopted the slogan "There is nothing like leather". This is not surprising, since many men of science are woefully ignorant of the unique properties of the natural fibres and fibrous materials.

Some people have assumed that a model tannery will be erected at Milton Park: nothing could be further from the truth. The liaison department of the Association has many tanneries in which to make extra-mural experiments on existing processes. Radical departures from present methods of leather making which may come in the future will have to be developed before the industry will consider their adoption. For such development work, space is necessary and is now available. Lastly, the recent extension of the work of the Association to include the study of the engineering problems of the industry is not without bearing on future development work.

There are many indications that the Association has moved to its new laboratories at a stage in the development of fibre science which will enable existing processes to be placed under even more rigid control and may lead to the development of new and probably less arduous tanning processes.

OBITUARY

Dr. A. J. Bull

DR. ALFRED JOSEPH BULL, who died on April 15 in his seventy-fifth year, made notable contributions to both photography and geology. From 1903 until 1946 he was associated with the School of Photo-Engraving and Lithography, having been principal since 1912. The advancement in photo-engraving during this period owes much to the research work carried out by Dr. Bull and his colleagues at Bolt Court, Fleet Street. During the Second World War, Dr. Bull and his staff were engaged, among other activities, on a number of special investigations for government departments. Particularly noteworthy was the work leading to the production, on a large scale, of gratitudes of extremely high precision for a wide range of purposes. Dr. Bull was also a pioneer in colour photography, and enjoyed international reputation as an expert in currency and security printing. He was a founder member of the Institute of Physics, and was president of the Royal Photographic Society in 1933 and 1934, the latter the year of the Fox Talbot Centenary celebrations.

Geology was Dr. Bull's other chief interest. With characteristic thoroughness he attended the full