OBITUARY NOTICES.

FREDERICK MOLLWO PERKIN.

BORN NOVEMBER 8TH, 1869; DIED MAY 24TH, 1928.

FREDERICK MOLLWO PERKIN, the son of Sir William Perkin by his second marriage, was born at Sudbury, Middlesex, on November 8th, 1869. He was educated at Amersham Hall School, Reading. On leaving school he studied at the Royal College of Science, at Edinburgh University, and also at the Heriot-Watt College, Edinburgh, and finally at the University of Würzburg, where he took the degree of Ph.D., studying chemistry under Professor Hantzsch.

In 1897 he became head of the Chemical Department of the Borough Polytechnic Institute, a position which he resigned in 1909 in order to enter into practice as a consulting chemist. This work he carried on in the laboratory of his late father, Sir William Perkin, at Sudbury, but he also had a laboratory in London, and in addition for some years he carried on a consulting practice in Bradford.

His first paper, " Some Derivatives of Piperonyl," was published in our Journal (1891, **59**, 150). The work done for his doctorate in Würzburg is to be found in the two joint papers with Hantzsch : " Zur Kentniss der Diazoamidoverbindungen " and " Zur Wander ung von Diazogruppen " (*Ber.*, 1897, **30**, 1394 and 1412). In addition to a number of subsidiary investigations, his chief con tributions to chemistry concerned the introduction and elaboration of electrolytic methods for the preparation of organic compounds. Bearing on this, reference may be made to his best-known book, " Practical Methods of Electrochemistry," which was soon recognised as the standard work in English on the subject. The papers describing the results of these investigations were published in part in our Journal, but mainly in the *Transactions* of the Faraday Society.

F. M. Perkin's technical work was concerned largely with the production of fuel oils from coal and from peat, and he was Technical Adviser to the Committee for the Production of Oil from Cannel Coal and Allied Minerals. He worked on the utilisation of peat, and on its conversion into briquettes, on the carbonisation of coal, and the production of smokeless fuels—he may be regarded as one of the pioneers of low-temperature carbonisation.

He took an active part in the foundation of the Faraday Society, was its first Treasurer (1903—1917), and frequently contributed to its *Transactions*. From 1908 to 1916 he was Honorary Secretary to the British Science Guild. He was active in the work of the Paint and Varnish Society, and for a time served as its President, and he was the first President of the Oil and Colour Chemists' Association (1918—1920).

Perkin helped to organise the Chemical Section of the Franco-British Exhibition (1908), and was a member of the juries of that exhibition and of the International Exhibitions held at Brussels (1910), Turin (1911), and Ghent (1913).

For his services to various Government departments during the war he was in 1920 appointed a Commander of the Order of the British Empire.

During the last year of his life his health failed, and he died on May 24th, 1928, in his 59th year.

Perkin married Elizabeth Margaret, daughter of Geo. Mackay of Edinburgh, who with their son and two daughters survives him.

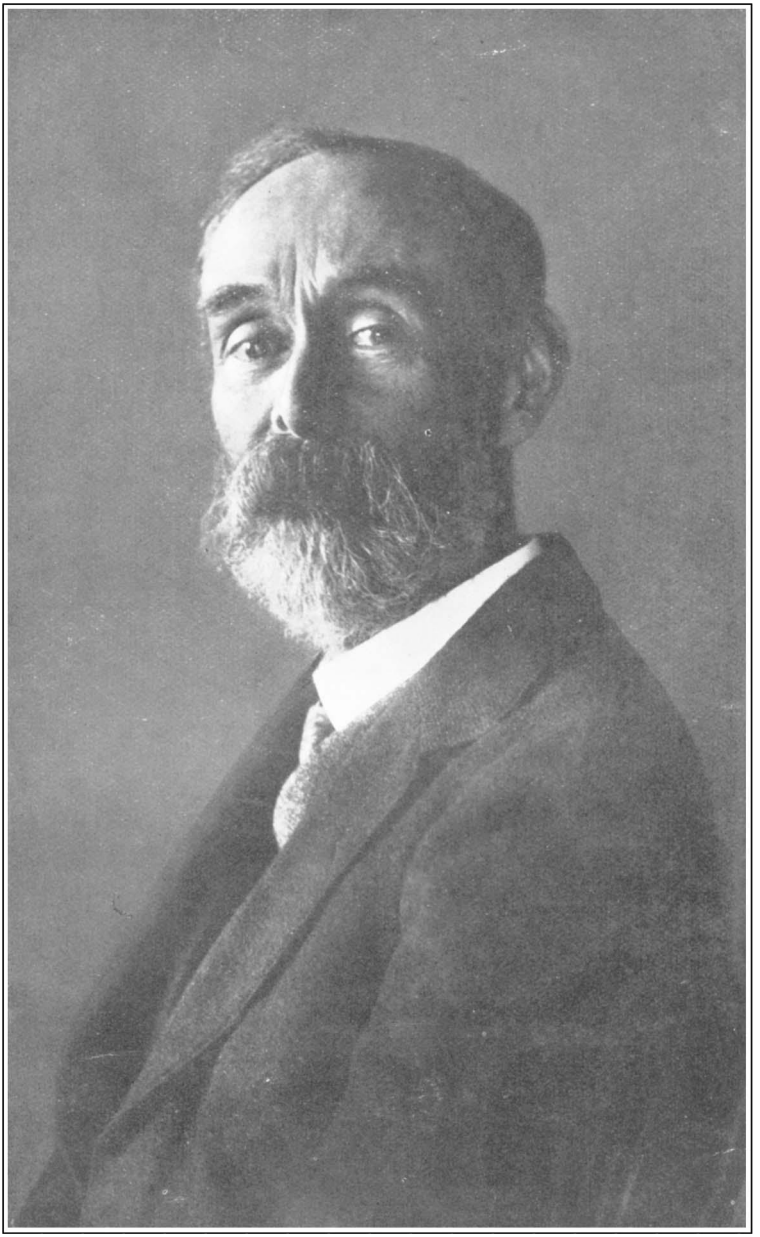
A. J. G.

HENRY RICHARDSON PROCTER.

BORN MAY 6th, 1848; DIED AUGUST 17th, 1927.

AMONG the men of science who have devoted themselves to the improvement of our manufacturing arts, the subject of this notice, Henry Richardson Procter, acclaimed on every side as the pioneer of a scientific leather industry, occupies a conspicuous place of honour. His death has evoked tributes from all parts of the world acknowledging his services to the industry and celebrating his qualities as a scientific investigator, a teacher, and a man rich in qualities of mind and heart.

Henry Richardson Procter was born on May 6th, 1848, at Low-lights, North Shields, his parents both being descendants of the Quaker and tanning family of Richardson. His father maintained the old tannery and designed that Henry, his elder son, should succeed him. At the age of 14 Procter went to Bootham School, York, where, according to an autobiographical note, he had more training in science, for which he already showed an aptitude, than was common in schools of that day. After leaving school he was apprenticed to his father's business and made some efforts to apply his chemical knowledge to tanning, carrying on his scientific studies in an attic laboratory. Having passed the Government "South Kensington" Chemistry Examination, and so become a qualified teacher, he taught a small chemistry class in the town and in con-



H. R. PROCTER.

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nexion therewith was invited to a week's summer course at the Royal College of Chemistry in Oxford Street, London. There his talents so impressed the authorities that they persuaded him to return to London at Christmas for the rest of the term. At the end of the course he was head of the lists and obtained the full certificate. During part of this time he acted as volunteer assistant to Edward Frankland and Norman Lockyer and so became interested in astronomy. He also published, in conjunction with his relative, T. H. Waller, a translation of Kohlrausch's " An Introduction to Physical Measurements," one of the earliest laboratory books of practical physics to be generally used in this country.

Reluctantly refusing Lockyer's invitation to join the Eclipse expedition, then proceeding to India, Procter returned to his father's tannery and set to work with success in improving and expanding the manufacture. He had little taste for the business side of the industry and as competition within it had become very acute by the time his father died in 1888, he abandoned the paternal tannery and took up the post of chemist to the tanning firm of his relatives, Messrs. S. and J. Richardson, of Elswick, Newcastle-on-Tyne. Here he remained until, in 1890, he was invited by the Yorkshire College, Leeds, to take direction of a new department of applied chemistry which it had been decided to establish for the benefit of the leather industries. The offer, from a worldly point of view, was meagre, but happily the possession of some private means enabled Procter to seize what was to him a tempting opportunity of living in the scientific world and of devoting himself unrestrictedly to scientific work. He took up his post at Leeds early in 1891 and began with very simple accommodation and appliances to devise a course of instruction in the applied science of leather manufacture. In 1898 his department was transferred to a new building provided by the generosity of the Worshipful Company of Skinners of London. These excellent premises were laid out after Procter's design for teaching and research, and they included manufacturing plant on a scale sufficient to afford demonstrations and trials on a valid working scale.

In setting up this new department of applied science, Procter was confronted with the usual difficulty of securing students of adequate preliminary education and intellectual quality. He would have been glad indeed if he could have insisted that students coming to him had previously been equipped fully in fundamental sciences. His own educational and scientific standards were very high, but he was no pedant; he had sympathy with people whose outlook was strongly practical, and his teaching afforded a striking example of the way in which an interest and schooling in scientific

theory and scientific method can be inculcated by an approach from the side of practical problems. It could often be seen how under his guidance and the stimulus of a visible practical end, students previously reluctant would awaken to a perception of the value of chemical theory and apply themselves with zeal to serious scientific study. He produced by his three years course a type of student well trained to address himself to the scientific control and development of the processes of leather manufacture. Students soon came to Procter from all parts of the world and returned to put to effective use the training which they had received.

Before taking up work at Leeds, Procter had gone far towards bringing science to play its due part in the leather industry. His "Text-Book of Tanning," published in 1885, was the first serious effort in the application of science in tannery practice, and is recognised as having inaugurated a scientific era in the industry. It embodies a great deal of original work which he had done since the first publication, in his twenties, of papers on tannin analysis. The difficulty of applying scientific methods to the leather industry came at the outset in the basic substance of the old tannery process—What is tannin and how is the tanning value of a substance to be estimated for the purpose of both manufacture and commerce? The first question can only be answered in the vaguest way. There are many tannins, but they present great chemical variety and not much is known about their constitution. They are all derivatives of the aromatic series of carbon compounds, and, so far as is known, all contain either pyrocatechol or pyrogallol, and sometimes phloroglucinol. The pyrogallol tannins yield gallic acid as a decomposition product and many of them glucose. The pyrocatechol tannins contain protocatechuic acid and seem to yield no glucose. The tannins have the one common property of converting skins into leather, and for any scientific control of leather manufacture a standard method of estimating the tanning efficacy, one which will give reproducible results in different hands, is indispensable.

It was to this end that Procter's first efforts were directed, and he devoted great labour to developing the method based on the use of hide powder. During fifty years he returned continually to the subject and he took the principal part as Chairman of the International Commission in drawing up the official method of tannin analysis, published by the International Association of Leather Trades' Chemists in 1907. In the new international method adopted last year, the essential principles of the earlier one are retained.

Apart from his work on tannin analysis, Procter concerned himself with devising simple methods of chemical control for the various

operations of the tan-yard and in his laboratory the biological as well as the chemical aspect of tanning problems was always the subject of study. He took a very active part in the establishment of chrome tanning. He gave to the trade his well-known formula for the making of single-bath chrome liquors and his teaching of the scientific principles of the new methods contributed in a very important way to their adoption and success.

Behind all Procter's active work of the kind just described was the constant occupation of his mind with the fundamental science of colloids. He showed in relation to the newer physical chemistry his remarkable power of bringing himself fully abreast of the times in any special part of theoretical science that he wanted to use, and so equipped he entered upon his *magnum opus*. This was a very complete investigation of the conditions determining the state of equilibrium which is established when gelatin jellies are brought into contact with solutions of acids.* The attainment of equilibrium in such systems is usually associated with swelling or contraction effects which depend on the nature and concentration of the acid solution and are also affected by the presence of neutral salts.

Procter recognised clearly that such a system is one to which the Donnan theory of membrane equilibria can be applied. In virtue of its basic properties, gelatin combines with acids to form gelatin salts; on ionisation these yield a gelatin kation which is of relatively very large dimensions and consequently unable to pass through membranes which are readily permeable to ionic or molecular entities of smaller size. The interface between a gelatin jelly and its aqueous environment may be regarded as the equivalent of an actual membrane, for the gelatin ions are necessarily confined to the jelly side of the interface, whereas the anions associated with the gelatin kations may pass freely from one side to the other under the influence of osmotic forces, subject, of course, to such restrictions as are attributable to the intervention of electrical forces between the charged ions.

When a gelatin jelly is immersed, for instance, in a solution of hydrochloric acid, the latter passes through the interface, forming the salt gelatin hydrochloride, and ultimately a state of equilibrium is established in which we have gelatin ions, hydrogen ions, and chlorine ions on the jelly side of the interface, whilst hydrogen ions and chlorine ions are in the outer solution. In accordance with Donnan's theory, this equilibrium satisfies the relation

$$[H^+]_1 \cdot [Cl^-]_1 = [H^+]_2 \cdot [Cl^-]_2$$

* The writer has to thank Professor H. M. Dawson for summarising this work. He is also indebted to Mr. J. R. Atkin and Mr. F. C. Thompson of the Leather Industries Department of Leeds University for valuable assistance.

where $[H^+]_1$ and $[Cl^-]_1$ are the concentrations of the hydrogen and chlorine ions in the inner solution and $[H^+]_2$ and $[Cl^-]_2$ are the corresponding quantities for the outer solution. Since both solutions must be electrically neutral, we may also write

$$[G^+] + [H^+]_1 = [Cl^-]_1$$

where $[G^+]$ is the concentration of the gelatin ion. From these relations, it follows as a mathematical consequence that the concentration of the hydrochloric acid when in the jelly must always be less than that in the external solution, and Procter's numerous experiments showed this was actually the case. It follows further that the total ion concentration within the jelly must be greater than that of the external solution. This means that the osmotic pressure within the jelly must be greater than that of the outer solution, and Procter recognised in this inequality the cause of the swelling which, according to his views, proceeds until the difference in the osmotic pressures is counterbalanced by the forces of cohesion in the gel.

This theory, elaborated subsequently in conjunction with J. A. Wilson, has been found to give a satisfactory account of the phenomena associated with the swelling of gelatin. In particular, experiments have shown that there is a close parallelism between the degree of swelling and the difference in the ionic concentrations of the inner and outer solutions in that both pass through a maximum as the acidity of the solution, measured by the p_H value, increases. The maxima occur, in fact, at the same p_H value (compare Atkin, *J. Soc. Leather Trades' Chemists*, 1920, **4**, 248). The theory also affords a simple account of the repression of the swelling which takes place when a salt of the corresponding acid is added to the outer solution.

Procter's work on gelatin thus affords a very notable example of the successful application of the theory of membrane equilibria. The significance of his work from a purely scientific point of view is to be found in the highly satisfactory issue of this attempt to deal with a problem which, even in its essential outlines, had previously been quite obscure. As a result of his investigations, this type of problem was brought within the range of application of modern physico-chemical principles, and in this way he provided a rational basis for the further investigation of colloid systems which is recognised to be of the greatest importance from the purely scientific as well as from the technical point of view. The late Jacques Loeb wrote of Procter's theory of protein swelling as "one of the most ingenious and original contributions to modern science."

Of Procter's contributions to the literature of his subject the "Text-Book of Tanning" has already been mentioned. This was followed in 1898 by the publication of the "Leather Industries

Laboratory Book " and in 1903 by the " Principles of Leather Manufacture." The " Principles " at once took the position which it has retained, that of a standard masterpiece of applied science literature. It has been translated into many languages, including Japanese.

For a full account of Procter's work and the testimony of those who profited from it, the reader is referred to the " Procter Memorial Issue " of the *Journal of the International Society of Leather Trades' Chemists*. Typical of this testimony may be quoted the words of Professor V. Kubelka of Brünn, who, after expressing his own indebtedness, says : " Je suis certain qu'il y a dans tous les pays du monde des centaines de chemistes de cuir qui se rappelleront avec reconnaissance que pour eux aussi les libres de H. Procter étaient les premiers phares qui les ont conduit dans l'étude de la chimie de cuir." A list of 121 publications gives some idea of the variety of Procter's scientific work and the range of his technical services. Among these services was the foundation in 1897 of the Society just mentioned, which from small beginnings grew to include all the leather chemists of Europe and in other and more remote countries. Procter was its first President and always its central influence.

Procter held his professorship at Leeds until, in 1913, he reached the age of retirement. In anticipation of this event steps had been taken by the leather industry to mark the event by some suitable memorial of the man and his services. The story may perhaps be best expressed in Procter's words : " On my retirement in 1913 a considerable sum, over £1800, was subscribed by my friends as an acknowledgment of what I had done for the chemistry of the trade, and as I have fortunately a modest independent income, I thought that this (the fund) could be most usefully devoted to the establishment of a special laboratory to investigate the underlying scientific problems, which, though not likely to be of immediate commercial value, are yet the materials on which sound advance can be based. The money sufficed to erect the laboratory, but unfortunately not to endow it, but it is now open to qualified students of all nations at fees calculated merely to cover their actual cost, and the University, which acts as a Trustee under a Deed-poll, has so far generously borne a good part of the actual working expenses. With more money and more research students, its usefulness might be greatly increased."

Procter's successor, in the person of Dr. E. Stiasny, had already been chosen and had been acting for some time with great success as assistant professor. He now took the vacant Chair and Procter passed into the new Research Laboratory, where with J. A. Wilson

he completed his work on gelatin. The formal opening of the Laboratory by Sir William Ramsay and the attendance of representatives of the industry from all parts of the world was to have taken place in October, 1914. To this plan the outbreak of war put an end. Not only so, but in August Professor Stiasny was in Austria, his native country. In this emergency Professor Procter resumed his old position and busied himself with important work for the War Office, remaining in office till 1918. He was then succeeded by his old pupil, Professor McCandlish, but he continued to work a good deal in his laboratory. In 1923 he sold his house at Ilkley and retired to Newlyn, Cornwall, where, in proximity to his artist son, Ernest, he spent the evening of his life in comfort and content, pursuing old hobbies of handicraft and art and enjoying the society of friends. Towards the end of 1926 he was compelled to take to his bed and he died on August 17, 1927. He was buried at St. Hilary, some miles from Penzance.

Procter had married in 1874 Emma Watson of Newcastle, who died in 1901. He has left a daughter and two sons, the elder, Mr. J. W. Procter, a distinguished architect, the younger the well-known artist, Mr. Ernest Procter.

Procter's success and the sway which he acquired were largely bound up with his remarkable personality. Though he found himself obliged to withdraw from the Society of Friends, he retained in high degree the most admired characteristics of that community. The gentleness of his nature, his single-heartedness and companionableness endeared him to all who knew him and, as Sir Michael Sadler has said most truly, "no Indian guru had disciples more devoted, more respectful." His tastes and talents were of the widest range. In the country he was naturalist, rock-climber, and artist; he was a much travelled man and a good linguist. In leisure hours at home he was a gardener and a craftsman in mechanical and decorative arts and a great reader.

The character of Procter's mind was as markedly philosophical as scientific. The setting up of a "professor of leather" gave scope for a good deal of jest and indeed for some indignation in more austere academic circles. It was a constant delight to his colleagues to witness the effect of Procter's conversation in the University refectory with guests from such circles. He revelled in dialectic and could have excelled any of his colleagues in the arts of casuistry. He exercised a strong quiet influence on University affairs, most of all perhaps by demonstrating in himself and his work the way in which applied science may justify itself among university studies.

The establishment of the unique personal memorial of an inter-

national Research Laboratory and the bestowal of the Fellowship of the Royal Society came towards the end of Procter's life and gave him deep gratification, but he had done his work and given all his discoveries to the industry, seeking neither honours nor rewards.

A. S.

MADYAR GOPAL RAU.

BORN JUNE 17th, 1891; DIED MAY 21ST, 1928.

MADYAR GOPAL RAU, who died of enteric fever at Amritsar on the 21st May, 1928, was born at Mangalore on the 17th June, 1891. His father, Manjunathayya, was a landholder and his mother, Chandravati, was the daughter of a judicial officer in the employ of the East India Company and later of the Madras Government. He received his early education at the Ganapati High School and the Canara High School, matriculating from the latter in 1909 and then entering the Government College, Mangalore (University of Madras). After passing the Intermediate Examination in 1911, he left Mangalore for the Presidency College, Madras. Here his ability was early recognised and he qualified for the B.A. degree in 1913, being at the top of the class list. Two years later he took an Honours degree in chemistry, being once more at the head of the list. He was awarded a University Research Studentship and for the following three years he worked at research in organic chemistry under the direction of the writer. During part of this period he was called upon to take complete charge of the teaching of organic chemistry at the Presidency College and he thus had an early opportunity of showing his aptitude for teaching. He was in 1918 appointed a lecturer in the College. In 1920 he moved to the Forest Research Institute and College, Dehra Dun, as Assistant to the Forest Chemist and he remained there until, in 1925, he was appointed Professor of Chemistry at the Khalsa College, Amritsar. He held this post at the time of his death and in addition he had for the last year been Principal of the College.

Nearly all Gopal Rau's research work had been carried out in collaboration with the writer. His early work was concerned with the nitration and bromination of acetamidomethoxybenzoic acids (J., 1917, **111**, 70, 221; 1918, **113**, 22, 783) and with an attempt to synthesise morindone (J., 1921, **119**, 1339), but after proceeding to Dehra Dun he worked mainly on natural products. He published a number of papers on essential oils and fats which appeared in the Journal and in the Indian Forest Records (J., 1922, **121**, 876; 1923, **123**, 550; *Ind. For. Rec.*, 1922, **9**, 95, 111; 1925, **11**, 197, 207; *J. Ind. Inst. Sci.*, 1926, **9**, *A*, 111). His most important work

was on the oxidation of Δ^3-carene, the constituents of the essential oil from *Blumea Malcomii*, and on the effect of anti-catalysts on the rate of oxidation of some dicyclic terpenes. He also collaborated in two papers on the constitution of abietic acid. After his appointment to Amritsar he had little time for original work, as he was much occupied with teaching and administrative duties and the facilities for laboratory work were not good. Although he never ceased to work in the laboratory, he only published one paper on "The essential oil from the flower-heads of *Perovskia atriplicifolia*, Benth." (*J. Ind. Chem. Soc.*, 1926, **3**, 141). He felt very keenly his lack of opportunity for work and he had arranged to visit England in September in order to work with Prof. Robinson at University College, but this was not to be. Though physically never very strong, he was a keen cricketer and tennis player and by his premature death at the age of 37 India loses an organic chemist of a type all too rare in that country, a loss which she can ill afford. Although not possessing great originality, Gopal Rau was a fine experimentalist and an inspiring teacher. In May, 1912, he married Miss Giriji Bai of Honavar (Bombay), who survives him.

J. L. SIMONSEN.