OBITUARY NOTICES.

GEORGE BARGER.

1878—1939.

By the sudden death on 6th January, 1939, at the age of 60 years, of Professor George Barger the Society has lost one of its most distinguished Fellows and Organic Chemistry one of its ablest workers.

George Barger was born in Manchester in 1878, his father, Gerrit Barger, being a Dutch engineer and his mother English. During his childhood the family lived in Utrecht, where he attended school until he was 16 years old. He then chose to complete his education in England and proceeded to University College, London, with a scholarship which he had obtained on the University Matriculation Examination. After commencing his studies for the London B.Sc. at University College, he won a scholarship to King's College, Cambridge, which he subsequently took up.

Barger's wide interests in later life were doubtless due in part to the fact that his early scientific training was on a broader basis than that of many organic chemists. As an undergraduate at Cambridge his interests were divided between Botany and Chemistry, and he was actually placed in the first class of Part II of the Natural Sciences Tripos in both Botany and Chemistry on the last occasion on which it was possible to offer two subjects for this examination. Although he never did any botanical research, Barger retained his interest in the plant throughout his life.

The first academic appointment which Barger held was a demonstratorship under the late Professor Errera in the Department of Botany of the University of Brussels; here he spent two years, and during this time he worked out the micro-method of molecular weight determination which bears his name. The method has not found very wide application, having been replaced by others which are more accurate and convenient; nevertheless, the ingenious application of the principle of isothermal distillation which it embodied showed a marked freshness of mind and an early appreciation of the importance of micro-methods in the study of biological chemistry.

On his return from Brussels Barger entered the Wellcome Physiological Research Laboratories as chemist. Although he only took this post after considerable hesitation, the appointment was of decisive importance for his future development; not only were the six years which he spent in the Wellcome Laboratories some of the most fruitful of his life, but the contacts which he made there with biological workers and particularly in his long collaboration with Dr. (now Sir Henry) Dale gave him a broadness of outlook which influenced the whole of his later work.

Barger remained in the Wellcome Laboratories until 1909, when he left to become Head of the Department of Chemistry at Goldsmiths' College in the University of London; in 1913 he was appointed to the Chair of Chemistry at the Royal Holloway College.

He had not held this appointment long before he joined the research staff of the recently formed Medical Research Committee, and he continued in this post throughout the War; during this period his energies, like those of most other chemists, were mainly diverted to work of immediate national importance, although even in these circumstances he published several papers of scientific interest.

In 1919 Barger was appointed to the newly constituted Chair of Chemistry in Relation to Medicine at Edinburgh, and in this position he found himself called upon to spend a much greater proportion of his time than had formerly been the case in duties of teaching and administration. The conditions at the time of his appointment were anything but favourable. The medical school at Edinburgh had received an enormous influx of new students, a large proportion of whom had little prospect of completing their course; some attempt had to be made, however, to teach them elementary chemistry and the present writer has a vivid recollection of assisting in the attempt to demonstrate to classes which had to be held in quadruplicate owing to insufficient accommodation. The shortage of accommodation, both for teaching and for research, persisted, indeed, for some years, until

the Department of Chemistry moved out to its new quarters in the King's Buildings at Liberton. In these circumstances it is not surprising that Barger's output of research should have suffered for a time, but he never allowed his interest to slacken, and even at the busiest periods he took every opportunity to snatch a few moments in the laboratory.

Barger remained at Edinburgh until, a little more than a year before his death, he was appointed to the Regius Professorship of Chemistry in the University of Glasgow. This important appointment was a fitting recognition of his distinguished position in the profession of Chemistry in this country. It brought with it heavy burdens, but he threw himself into the task of reorganising a large department with a freshness and enthusiasm which surprised even his friends. It is sad to think that this task, with which he had already made so much progress, should have had to be left unfinished.

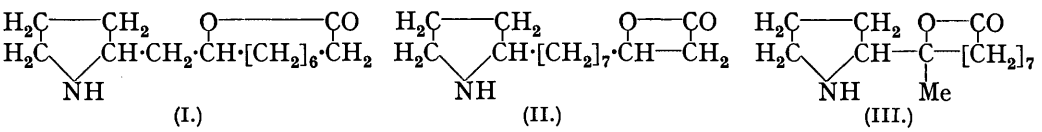
Barger's scientific work falls naturally into two main divisions, his studies of alkaloids and his investigations of simpler nitrogenous compounds of biological interest.

One of the first investigations which he undertook in the Wellcome Laboratories was a study of the alkaloids of ergot; the work which he did on this subject was the basis of his first publication in the field of alkaloid chemistry, and since this field remained a major interest throughout his whole life, occupying indeed the greater part of his attention in recent years, it has seemed better to give first a continuous account of his main contributions to the chemistry of alkaloids rather than to attempt to present the whole of his work in strictly chronological sequence.

Ergotoxine.—At the time when Barger and F. H. Carr took up the study of ergot considerable confusion existed concerning the physiologically active substance produced by this fungus. The only crystalline alkaloid known to be extractable from ergot was the ergotinine which had been discovered by Tanret, and this was physiologically inactive. Barger and Carr (J., 1907, **91**, 307) described the isolation of a new alkaloid, $C_{35}H_{41}O_6N_5$, the salts of which could be obtained crystalline, and which showed a high degree of physiological activity. They showed moreover that the new alkaloid, which they named ergotoxine, was convertible into ergotinine by treatment with acetic anhydride, the change being interpreted as due to the loss of the elements of water. This observation was the first example of what has since turned out to be a general characteristic of all ergot alkaloids, namely, that they occur in isomeric pairs, the members of which are interconvertible by simple means with large changes in specific rotation and physiological action.

With Ewins (J., 1910, **97**, 284) Barger later studied the degradation of ergotoxine and observed the production of *iso*butyrylformamide on pyrolysis of the alkaloid. The significance of this observation was not appreciated until, many years later, the brilliant work of Jacobs (following on the observations of Smith and Timmis) revealed the general nature of the ergot alkaloids as compounds of lysergic acid with amino-acids or substances derived therefrom; it then became clear that *iso*butyrylformamide must represent a link between the components in ergotoxine.

Carpaine.—The next alkaloid to attract Barger's attention was carpaine. He observed (J., 1910, **97**, 466) that this compound, $C_{14}H_{25}O_2N$, could be hydrolysed to a substance, $C_{14}H_{27}O_3N$, which he named carpamic acid, thus indicating the presence of a lactone group in carpaine; carpamic acid, on oxidation, gave a dicarboxylic acid, $C_8H_{14}O_4$, at that time supposed to be αδ-dimethyladipic acid. More than twenty years later he resumed the study of carpaine and was then able (Barger, Girardet, and Robinson, *Helv. Chim. Acta*, 1933, **16**, 90) to prove the presence in it of a pyrrolidine ring, since dehydrogenation under



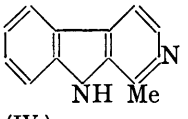
(I.) (II.) (III.)

mild conditions with selenium yielded a pyrrole derivative, $C_{14}H_{21}O_2N$, which could be re-hydrogenated to a compound isomeric with the original alkaloid. Further investigation of the oxidation products of carpamic acid revealed the presence among them of azelaic and

suberic acids, the latter being the acid $C_8H_{14}O_4$ already mentioned. The formation of azelaic acid proved the existence of a continuous chain of at least 9 carbon atoms in carpamic acid and the facts available at this stage led to the suggestion of the two alternative formulæ (I) and (II), of which (I) with the large lactone ring was favoured. Later (Barger, Robinson, and Work, J., 1937, 711) came the recognition of the presence of a *C*-methyl group; this, together with the consideration that carpamic acid is a tertiary alcohol, led to formula (III), which is at present accepted as representing the structure of carpaine.

Yohimbine.—In 1915 (Barger and Field, J., 1915, **107**, 1025) Barger made a preliminary study of the degradation of yohimbine, in the course of which he observed the formation of indole derivatives during alkaline fusion of yohimbic acid. Many years later, with Scholz (J., 1933, 614), he identified among these degradation products 3-ethylindole, indole-2-carboxylic acid and, most significantly, harman (IV).

In the intervening years much information had been forthcoming from the work of others concerning the structure of yohimbine, and in 1933 Barger and Scholz (*Helv. Chim. Acta*, 1933, **16**, 1343) published a valuable paper in which cogent reasons are given for regarding the structure of yobyrine (a selenium dehydrogenation product of yohimbine obtained by Wibaut) as being represented by (V). Yobyrine is regarded in turn as repre-



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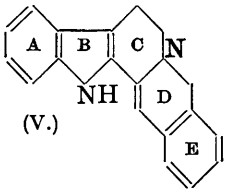

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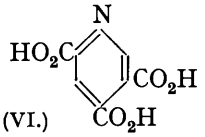
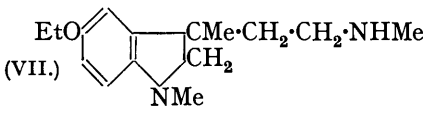


(VI.)

senting the essential skeleton of yohimbine, in which ring E is fully hydrogenated. Two major arguments for the proposed structure rest on observations for which Barger was himself responsible, namely, the isolation of harman, which fixes the arrangement of rings A, B, and C, and the detection of berberonic acid (VI) among the oxidation products, which must represent ring D.

Physostigmine (*Eserine*).—With his pupil Stedman (J., 1923, **123**, 758) Barger published a detailed study of the complicated series of products obtained in the exhaustive methylation of eseroline (the phenolic compound obtained by removal of the methylcarbamido-group from eserine), and of eserethole (eseroline ethyl ether). In the course of this it was recognised that eseretholemethine, produced by the action of alkali on eserethole methiodide, was a ψ-base, reconvertible into eserethole methiodide by treatment with hydriodic acid. It was also confirmed that the final Hofmann degradation product of eserethole, physostigmol ethyl ether, was an indole derivative. The synthesis of the latter compound by Stedman (J., 1924, **125**, 1373) proved physostigmol to be 5-hydroxy-1 : 3-dimethylindole and thus fixed the orientation of the indole portion of the eserine molecule. The remainder of the structure was elucidated by Stedman and Barger (J., 1925, **127**, 247), who showed that reduction of eserethole led to the formation of a secondary base which they



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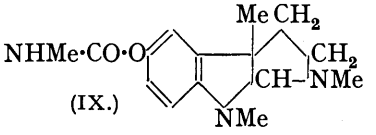
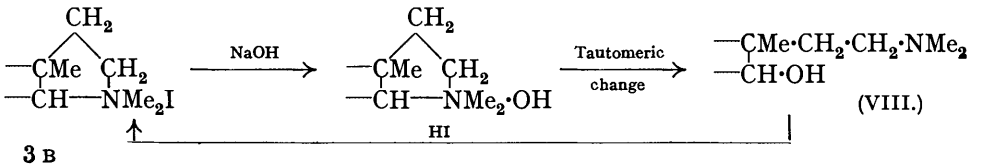


(IX.)

regarded as having the structure (VII). The pseudo-basic character of eseretholemethine already referred to was explained by supposing it to be an α-hydroxyindoline formed as follows :

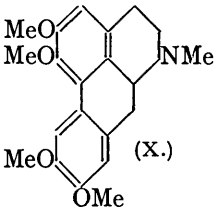


(VIII.)

Confirmation of this hypothesis by the formation of indolinones on oxidation and considerations of the probable biogenesis of the alkaloid led the authors to propose (IX) as the formula of eserine. As is well known, this formula has since been shown to be correct by the synthetic studies of other workers.

The investigation of eserine is of importance not only in itself but as the foundation of the later well-known work of Stedman on the physiological action of simpler but analogous urethanes, among which at least one substance (the prostigmine prepared by Aeschlimann) has proved to be of great pharmacological and therapeutic value.

Aporphine Alkaloids.—During the years 1928 to 1933, Barger made a number of investigations of a group of related alkaloids, namely, laurotetanine from *Litsea citrata*, Bl., and the pukateine–laureline–lauropukine group from *Laurelia Novae Zealandiae*. The first of these to be studied was laurotetanine. This alkaloid was already known to be closely related to glaucine (X), from which it differs only in having no *N*-methyl group and one less *O*-methyl. Earlier work by Gorter had appeared to show that *ON*-dimethyllaurotetanine was not identical with glaucine; Barger and Silberschmidt (J., 1928, 2919), however, by subjecting laurotetanine and glaucine in turn to Hofmann degradation, obtained identical series of (phenanthrene) derivatives; it thus followed that laurotetanine and glaucine had the same fundamental structure and the former could be formulated as (X*a*). The doubt as to the relative positions of the hydroxyl and methoxyl groups was



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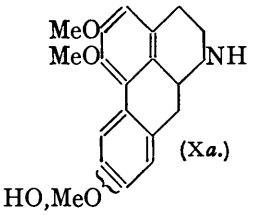
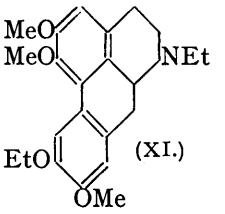
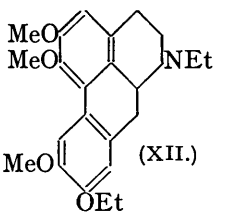


(X*a*.)



(XI.)

settled by Barger, Eisenbrand, Eisenbrand, and Schlittler (*Ber.*, 1933, **66**, 450) in an indirect manner. The compounds (XI) and (XII) were synthesised and the products obtained from them by Hofmann degradation were compared with those similarly obtained from *ON*-diethyl-laurotetanine. By this means ethylated laurotetanine was proved to be identical with (XII), whence the constitution of the alkaloid follows.



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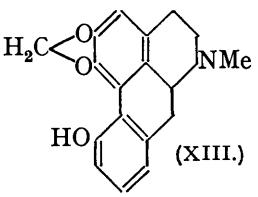

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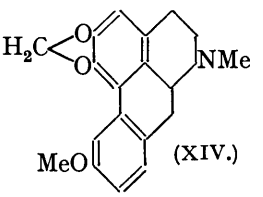


(XIV.)

Similarly complete information was obtained regarding pukateine (XIII) and laureline (XIV), the formulæ being proposed on the basis of Hofmann degradation and oxidation experiments by Barger and Girardet (*Helv. Chim. Acta*, 1931, **14**, 481) and subsequently confirmed by the synthesis of *O*-methylpukateine (Barger and Schlittler, *ibid.*, 1932, **15**, 381) and of laureline itself (Schlittler, *ibid.*, 1932, **15**, 394).

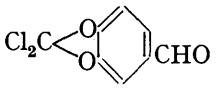
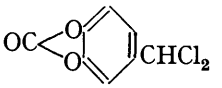
During the past few years Barger had been engaged with J. J. Blackie on a systematic study of the *Senecio* alkaloids, and at the time of his death one of his main interests lay in work which he was doing on the difficult problem of the constitution of calycanthine.

Important as were Barger's contributions to alkaloid chemistry he will perhaps be remembered even more for his work in the field of what he himself called the " simpler natural bases." This work was largely done while he was in the Wellcome Laboratories.

At the time when he took up his post there the active principle of the suprarenal gland, adrenaline, had recently been isolated and its constitution had been determined. The chemistry of this substance naturally attracted much attention and Barger, in collaboration with H. A. D. Jowett took up the attempt to synthesise it. In this he was not completely

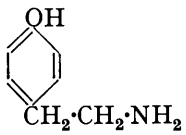
successful, but his efforts were embodied in an interesting paper (Barger and Jowett, J., 1905, **87**, 967) on the synthesis of compounds closely related to adrenaline.

These experiments led first to an observation of some chemical interest. An obvious starting material for the synthesis of adrenaline would be piperonal, provided that the methylenedioxy-group could be converted into the corresponding catechol. In studying the possibilities in this direction, Barger (J., 1908, **93**, 563) examined the action of phosphorus pentachloride and thionyl chloride on piperonal; the former reagent was already known to yield a tetrachloro-derivative which lost two chlorine atoms on treatment with water to give what was supposed to be the compound (A). Barger found, however, that an

(A.)  (B.) 

identical dichloro-compound could be prepared from piperonal directly by the action of thionyl chloride and that it actually had the structure of a cyclic carbonate (B). This reaction was subsequently shown by Barger to be generally applicable to methylenedioxybenzenes.

The much more important outcome of the experiments towards the synthesis of adrenaline was, however, the interest which they aroused in Barger's mind in the physiological action of relatively simple basic compounds. This phase of his work, throughout which he collaborated with Dale, began with a return to the study of ergot. The isolation of ergotoxine had done something to explain the physiological activity of extracts of ergot, but still left much unaccounted for; Barger first showed (J., 1909, **95**, 1123) that a part of the unidentified activity was due to the presence of tyramine (XV), which compound he also synthesised; later (Barger and Dale, J., 1910, **97**, 2592), he isolated the still more active substance histamine (XVI) from the same source.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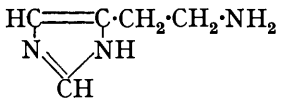
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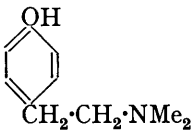
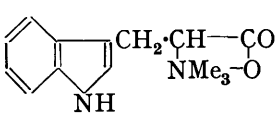

(XVII.)

In 1911 (Barger and Dale, *J. Physiol.*, 1911, **41**, 499) Barger demonstrated for the first time the occurrence of histamine in an animal tissue (gut); later developments in physiology and pathology have given this observation an importance which could not at the time be appreciated. In connection with this it may be mentioned that in continuation of Barger's work his pupil Ewins was subsequently able to isolate acetylcholine from a particular ergot extract, and this compound also has since proved to have a profound physiological importance. The physiological implications of one aspect of this work as they were then apparent were treated in the classical paper of Barger and Dale (*J. Physiol.*, 1911, **41**, 19) in which the general conception of sympathomimetic amines was developed.

During this period Barger published several other papers dealing with compounds allied to those under discussion; among these may be mentioned the syntheses of hordenine (XVII), the alkaloid of barley (J., 1909, **95**, 2193), and of hypaphorine (XVIII), the betaine of tryptophan (Van Romburgh and Barger, J., 1911, **99**, 2068), which occurs in the seeds of *Erythrina hypaphorus*.

With Ewins (J., 1911, **99**, 2336) he showed that ergothioneine, a sulphur-containing substance which had been isolated by Tanret from ergot, was the betaine of thiolhistidine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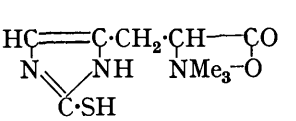
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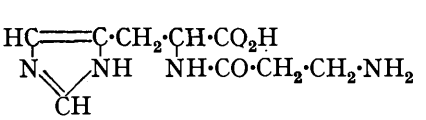
(XX.)

(XIX), and with Tutin (*Biochem. J.*, 1918, **12**, 403) he was able to prove by synthesis that the muscle extractive carnosine had the structure of β-alanylhistidine (XX).

Barger made another contribution in the field of amino-acid chemistry when he proved

the constitution of the amino-acid methionine, $CH_3 \cdot S \cdot CH_2 \cdot CH_2 \cdot CH(NH_2) \cdot CO_2H$, which had been discovered by Mueller in 1923. He synthesised this compound first in 1928 (Barger and Coyne, *Biochem. J.*, 1928, **22**, 1417) and later by an improved method (Barger and Weichselbaum, *ibid.*, 1931, **25**, 997).

Reference should be made to one other piece of work which Barger did, not because it led to any results of importance, but because at one time it exercised a peculiar fascination over his mind. At the time when he was in Brussels he studied a glucoside, saponarin (actually the subject of his first published paper); this substance had the unusual property of giving a blue compound with iodine similar to that given by starch. The observation attracted Barger's interest and he returned to the subject on several occasions in later years; he found that the property of forming such blue complexes with iodine was generally associated with the γ-pyrone group, and he published several papers (Barger and Field, J., 1912, **101**, 1394; Barger and Starling, J., 1915, **107**, 411; Barger and Eaton, J., 1924, **125**, 2407) dealing with the theory of the reaction and with constitutional factors affecting it.

Finally, mention must be made of two researches in which Barger played a less direct but nevertheless important part, namely, the work of the present writer on thyroxine and that of A. R. Todd on vitamin B_1 (aneurin). At the time when the writer started to work on thyroxine he had already left Barger's laboratory several years. This did not, however, prevent consultation by correspondence, and the keenness of Barger's interest and the freedom with which he gave of his experience did much to further the progress of the work. Incidentally it is typical of Barger that, in spite of this, he so far belittled the value of his own contribution as only with difficulty to be persuaded to agree to joint publication of the final stage.

The recent distinguished work of A. R. Todd and his collaborators on the constitution and synthesis of aneurin was begun and largely carried through in Barger's laboratory in Edinburgh. In the early stages of this work, particularly, his contribution was of great value.

Apart from his original papers in scientific journals Barger published several books; in his monograph on "The Simpler Natural Bases," which appeared in 1914, he collected a large amount of chemical and physiological information which was otherwise not easily accessible. In 1930 he published "Some Applications of Organic Chemistry to Biology and Medicine," and in 1932 a textbook entitled "Organic Chemistry for Medical Students"; the book by which he will chiefly be remembered, however, is the monograph "Ergot and Ergotism," which appeared in 1931. The writing of this masterly book was a labour of love extending over many years; in it every aspect of the subject is treated with a sureness of touch and a scholarly finish which make the work a model of its kind.

Barger's work was recognised by many distinctions in this and other countries. He was elected a Fellow of King's College, Cambridge, in 1904. In 1919 he was admitted to the Fellowship of the Royal Society; he served on the Council in 1930—1932, and a few weeks before his death he was awarded the Davy Medal. He was a member of the Council of the Chemical Society in 1913—1917 and a Vice-President at the time of his death; in 1936 he was Longstaff Medallist. In 1934 he received the Hanbury Medal from the Pharmaceutical Society. In 1928 he held the Baker visiting Professorship of Chemistry at Cornell University, and during the same year he delivered the Dohme lectures at the Johns Hopkins University, Baltimore. The British Association elected him President of Section B (Chemistry) for their meeting in South Africa in 1929. He received honorary degrees from the Universities of Liverpool, Padua, Heidelberg, Michigan and Utrecht, and he was an honorary or corresponding member of many foreign academies.

Barger's bilingual upbringing was the foundation of the exceptional linguistic capacity which he developed in later life and which reached its climax when he was able to address the International Physiological Congress in Moscow in 1935 in eight different tongues. This facility for acquiring foreign languages was combined with a great enthusiasm for travel, and enabled him to make many contacts with colleagues in other countries. These contacts, which developed in several cases into close friendships, were of great value not only to himself but to the cause of mutual understanding between scientific workers which he had so much at heart. He was truly recognised as an international figure in Science, and

the many honours which he received from foreign Universities and Academies indicate the high regard in which he was held by his colleagues abroad; this regard was shown in another way, however, which meant even more to him, namely, by the constant flow of foreign students who passed through his laboratory.

Barger's death will be felt not only as a loss to Science but as a personal grief to his many friends. Those who were but slightly acquainted with him may not easily realise to what an extent he possessed the gift of true friendship. He was not the most patient of men and his manner at times made him seem far less patient than he really was, so that the first stages of acquaintanceship with him were the most difficult and there were even some who never succeeded in surmounting the initial barrier. Those who were admitted to his friendship, however, found it difficult to remember that any such barrier had ever existed; there can, indeed, have been few men who were willing to do so much in any way and at any time for their friends, or who were capable of showing so true a human sympathy.

To his pupils he gave without stint, both of his thought to their problems, and of his time in the laboratory to their practical difficulties. At the same time he did all in his power to encourage independence of thought and was at pains never to dissuade a student from testing a new idea experimentally even though he might himself feel sure from his own experience that the reaction would not " go."

It was indeed this love for experiment which was the keynote of Barger's attitude towards his work; he was instinctively mistrustful of hypotheses which were allowed far to outrun experimental support and this habit of mind coloured his whole outlook. It caused him to have strong leanings towards a mechanistic philosophy, departure from which, as he said in a discussion on the nature of life at the meeting of the British Association in 1929, he could not but regard as treachery to Science.

He himself possessed a high degree of experimental skill and had been at particular pains to perfect himself in the technique of working with small amounts of material, long before such technique came to be generally regarded as a part of the equipment of an expert organic chemist. This capacity for the fine handling of small quantities was somewhat paradoxically combined with unsystematic, not to say untidy, habits in ordinary laboratory work.

Barger remained always a fundamentally simple-minded man; completely honest and straight-forward in his outlook, he never hesitated to express his views on any subject on which he felt strongly. He had little patience with formality and little respect for conventions, although he would not willingly disregard conventions in such a manner as to offend others who might feel differently. It was inevitable that he should at times have irritated less outspoken people, and thus have made things more difficult for himself, but he was not easily deterred by the thought of such consequences if what he had to say was a matter of conviction. This essential sincerity made it impossible for him effectively to conceal his true feelings, even on those occasions when he judged that such concealment would facilitate the attainment of his object.

Fundamentally non-political in outlook, Barger was a man of liberal views with whom it was a ruling desire to break down all barriers, such as those of nationality, which interfere with the free intercourse of men of science; enough has already been said to indicate how great were his services in the pursuit of this idea, and in these times particularly the measure of success which he achieved remains an encouragement.

No account of Barger would be complete without reference to the warm hospitality of himself and Mrs. Barger, not only to friends and colleagues, but to students who were working with him; for many who have passed through his laboratory the remembrance of this will be one of their happiest recollections.

Barger has died as he would have wished while still in full activity; he leaves to his friends the memory of a beloved personality whose loss is a grievous blow, and to his pupils an inspiration which will endure throughout their lives.

I am indebted to Sir Henry Dale, F.R.S., and Dr. H. King, F.R.S., both of whom have read the manuscript of this Notice and have made helpful suggestions.

C. R. HARINGTON.

EDWARD RICHARDS BOLTON.

1879—1939.

EDWARD RICHARDS BOLTON, who died suddenly on February 10th in his 61st year, had been a Fellow of the Society since 1901.

He was the only son of J. A. Bolton of Blackrock in the County of Dublin, and received his school education at Bedford (Elstow), whence he proceeded to King's College, London (of which last year he was elected a Fellow), and later to the laboratory of Fresenius at Wiesbaden. On the conclusion of his chemical studies there he returned to England and after a short period of technical work in Newcastle became chemist to the Albert (East India Products) Oil Mills at Hammersmith, thus entering on the special branch of applied chemistry in which he was destined later to become regarded as a leading authority.

Apart from his proficiency and ingenuity as a chemist, Bolton had acquired some fundamental knowledge of physics, and as he was naturally possessed of the instincts and aptitudes which go towards the making of a good mechanical engineer, he made rapid headway in the solution of important problems in connection with oil refining, notably in connection with coconut oil. After a few years spent in the Albert Mills he entered into general consulting practice, but continued directive work with his original company, which became later incorporated as Loders and Nucoline Ltd. It was under his direction and largely by his inventive skill that crude coconut oil proved to be economically convertible into the highly finished food product which has now long been familiar. Coconut oil in its crude commercial state contains large quantities of free fatty acids. At first these were removed by soda saponification. Later, direct glycerol saponification was introduced, but was not wholly successful, since it tended to produce mono- and di-glycerides instead of triglycerides. Bolton made an advance in this direction by first producing mono- or di-glycerides by the action of glycerol on free fatty acids already separated from the parent fat and then using these mono- or di-glycerides for the direct neutralisation of the raw oil. The technique of the process is described in Patent Specification No. 159,587, 1921.

Finding his consulting work rapidly growing, Bolton, with the aid of some of his clients, formed a small organisation under the name of " Technical Research Works Ltd.," acquiring a convenient building in Milner Street, Chelsea, in which he was able to erect engineering plant sufficiently large to deal with oils and fats on a practical working scale, and thither he removed his analytical laboratory and consulting office. It was here that he worked out the principal achievement by which he is probably best known in the technical world, namely, his notable practical advance in the method of hydrogenisation of unsaturated oils—fat hardening, as it is more familiarly called. His improvements consisted in using the nickel catalyst required in this operation in the form of fine metallic wool in a " continuous flow " plant in which the oil and the hydrogen flowed in opposite directions, and in a special mode of restoring the activity of the nickel, as it waned, *in situ*. Bolton's patent in which the method is described is No. 162,370, 1921, and this may be regarded as memorable, seeing that Bolton's technique has been widely adopted not only at home, but in many other parts of the world to which have been exported the necessary plant made under his direction.

In 1913, in conjunction with Cecil Revis, Bolton published a remarkably useful book under the title of " Fatty Foods," in which was brought together a great deal of technical information relating not only to the better known fats, but to various less known tropical or sub-tropical products which had come within the range of the investigation of the authors; and a later edition of this book, with many additions and records of later investigations, was produced by Bolton in 1928 under the extended title of " Oils, Fats and Fatty Foods." This book is generally regarded as one of the most useful and informative of the many treatises on the subject.

The results of Bolton's analytical investigations over many years were, for the most part, communicated to the Society of Public Analysts, of which Society he was Honorary Secretary from 1915 to 1925, and President during 1926 and 1927. His earlier papers were on work done in association with C. Revis, and those in later years with K. A. Williams.

Some of the most recent of the latter related to colour measurement, first of oils or other transparent liquids, and later of opaque surfaces by means of the ingenious photo-electric instrument designed by the joint authors (*Analyst*, 1935, **59**, 447; 1937, **62**, 3).

Bolton's special knowledge and experience in relation to oils and fats led to the requisition of his services on many committees. He served on the Advisory Council of the Imperial Institute on Plant and Animal Products and as Chairman of its Oils and Oilseeds Committee and Tung Oil Sub-Committee; on various Committees of the British Standards Institution; and on the Panel of Analysts of the London Oil and Tallow Trades Association; and he was chosen as British representative on the International Commission on Fats over which he presided during the Congress held in London in 1935. He also rendered much good service over many years in connection with the Analytical Methods Committee of the Society of Public Analysts; and he was also a member of the Standing Advisory Committee appointed by the Minister of Agriculture under the Fertilisers and Feeding Stuffs Act, 1926. In 1927—30 he served on the Council of the Chemical Society, and in 1925—28 as Vice-President of the Institute of Chemistry, of the London Section of which he was a former Chairman. He was also a Member of the British National Committee (of the Royal Society) for Chemistry.

He took an active interest in the work of the Royal Institution, of which he was on the Panel of "Visitors," and as an instance of the versatility of his interests it may be added that at the time of his death he was a Vice-President of the Medico Legal Society. Notwithstanding his many serious preoccupations, he found time to cultivate as a hobby the art of photography, in which he developed a degree of artistic skill that was a frequent source of pleasure to his friends.

Bolton had a happy gift of speech, fluent and well spiced with the wit of his country of origin, and although sometimes trenchant in debate he was therein never otherwise than pleasant and courteous, and his genial personality made his presence unfailingly welcome in the many gatherings he attended, whether formal or informal. His encyclopaedic knowledge of his own special subject, together with his well-known good nature, led to his being constantly besieged for help and advice by his professional colleagues, and he never failed to give cheerful and effective response, grudging neither time nor trouble. His sudden and tragically premature passing must be widely mourned.

He was married in 1902 to Norah, daughter of Robert Binning of Glasgow, who survives him without family.

BERNARD DYER.

JOHN THOMAS DUNN.*

1859—1939.

DR. J. T. DUNN died, in his 81st year, in Newcastle upon Tyne, on January 3rd.

The service at the West End Crematorium, Newcastle, on January 6th, was attended by a numerous congregation, representative of his scientific, public, social, cultural and other activities. It was conducted by the Rev. Herbert Barnes of the Church of the Divine Unity, who gave a short address of consolation and an appreciation of Dr. Dunn's attainments and services and of his many-sided character.

A memorial service was held on Sunday, January 8th, in the Church of the Divine Unity, Newcastle, where Dr. Dunn attended after he came to live in Newcastle. An eloquent address was delivered by Lord Eustace Percy, Rector of King's College, Newcastle, in which he referred to the long and valuable services of Dr. Dunn to the Council of the College.

Dunn was educated at Dr. Bruce's School and at Durham College of Science, later Armstrong College (now King's College), Newcastle. He graduated B.Sc. in 1877 and proceeded to M.Sc. and D.Sc. At Armstrong College he was Demonstrator in Chemistry and Physics and, later, Acting Professor of Chemistry (1882). He then turned to scholastic work, becoming science master at Gateshead School in 1884, and Head Master in 1887. In 1894 he became Head of the Technical School, Plymouth, and in 1895 Principal of the Northern Polytechnic Institute, London, where he was also Head of the Chemistry Depart-

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ment. In 1901 he joined John Pattinson in partnership in the firm of J. & H. S. Pattinson, Analytical and Consulting Chemists, Newcastle upon Tyne, of which he was the senior partner at the time of his death. On Pattinson's death Dunn became Public Analyst for the City and County of Newcastle upon Tyne, the County of Northumberland, the County Boroughs of Gateshead, South Shields, Sunderland, and Tynemouth, and the Borough of Berwick-upon-Tweed; these appointments he held until 1937, when, owing to his illness, his partner was appointed to them.

Dunn was elected a Member of the Society of Public Analysts in 1905, served three periods as Member of Council, was Vice-President in 1917—1918, and was elected President in 1930. He was President of the Society of Chemical Industry in 1933—1934, and was a Member of Council of the Institute of Chemistry, 1918—1921, and Examiner from 1921 to 1925 and from 1927 to 1932.

An eminent man has gone from us, but his example remains, and fortunately the many who came in contact with him during his early scholastic and university life, and later in his numerous public and professional activities, have had the opportunity to profit by it. A cultured and scholarly man, of a quiet and kindly disposition, tolerant of the views of others, yet ever ready stoutly to defend his own opinions with a vigour that surprised those who were unacquainted with the depths of his character. He was a fluent extempore speaker, but nevertheless he wrote all important speeches, which he committed to memory and delivered with scarcely a reference to his notes. Of his own language he was a perfect master, and he derived much entertainment from journalese; he possessed an intimate knowledge of French and German, a working acquaintance with Italian, and for business purposes he even made a study of Russian.

As might be expected, he was a scholarly writer, and his manuscript and letters will long be remembered for his choice of words, beauty of handwriting and neat arrangement. Dunn accomplished so much because of his great powers of endurance (he was only once known to admit feeling tired) and because he permitted himself no idle moments; having a few minutes to spare before keeping an appointment or catching a train, he would employ them by writing a short letter, or in making a microscope examination, arriving without hurry, to catch the train almost at the due time for departure. He was never bored, nor did he feel the need of hobbies. Habitually he acted upon the injunction " do it now," rarely delaying or postponing, and no sooner was he asked to do something than he at once set about doing it, if he approved of the request. This characteristic sometimes led to wild searches in the waste-paper basket for a document or letter which, having been at once attended to, had been thrown away, but which, on second thoughts, he wished to file or to refer to again.

Dunn took a deep interest in Rotary, regularly attending the Friday lunches of the Newcastle Club, of which he was a Past President, and he often visited the Rotary Clubs in the neighbourhood of Newcastle; in 1928 he represented Newcastle Rotarians at the International Conference at Minneapolis, U.S.A. He never used the much-hackneyed word " service," yet he was ever ready to do a service for those who needed it; though charitable, he preferred to act through some organisation whose business it was to investigate cases of need. He had a great love of animals, particularly of dogs, and was Secretary and Treasurer of the Newcastle Dog and Cat Shelter, and a member of the Committee of the Newcastle Branch of the R.S.P.C.A. A lover of music, and no mean performer on the pianoforte, he was an active supporter of local music societies, and acted as Local Representative of the Associated Board of the Royal Schools of Music, London.

Dunn was a Justice of the Peace for Gateshead, a Freeman of the City of Newcastle, a member of the Freemen's Guild, and a member of the Ancient Company of House Carpenters, of which he was Senior Steward.

His was a crowded life, yet nothing appeared too great or too trivial to merit his attention, and in all he undertook he gave of his best. Although he passed the normal span of life, he never went through the period of old age, and thus we shall continue to remember him—a man of great activity and usefulness.

He leaves a widow and an only child, Mrs. V. A. Mundella.

H. CHARLES L. BLOXAM.

WILLIAM SETTEN GILLES.

1876—1938.

IT is with much regret that we record the death on December 2nd last of William Setten Gilles, who was elected a Fellow of this Society on February 17th, 1898. He was born on October 9th, 1876, and was educated first at St. Dunstan's College, Catford, and then entered the Central Technical College of the City and Guilds of London Institute, South Kensington, in 1893 as a student in the Chemical Department under H. E. Armstrong, F.R.S., and F. S. Kipping, F.R.S. After obtaining the College Diploma, A.C.G.I., in 1896, he was awarded a Leathersellers' Research Fellowship and was engaged in researches on the terpenes till early in 1898. He then joined Courtaulds Limited at their Bocking factory in Essex, and rapidly became an expert on real silk and its dyeing and finishing.

In the early days of viscose and cuprammonium rayons he made considerable studies of the physical and chemical properties of these materials and their behaviour in dyeing and finishing.

In 1910 he became Manager of the Black Crepe Department, and for the next fifteen years was responsible for the whole art of production of this very difficult type of crepe silk fabric, the production of which was for many years regarded as a trade secret.

When he retired in 1925 from active works research and production, he remained closely associated with the industry as a consultant, and as a member of the Executive Committees of the Silk Research Association and of the Council of the British Cotton Research Association.

He was a Fellow of the Institute of Chemistry, and in 1937 he was awarded the Fellowship of the City and Guilds Institute.

Throughout his life he was keenly interested in several branches of natural history and became a recognised authority on British moths. His extensive entomological collection he bequeathed to the Cambridge Natural History Museum.

Of an extremely retiring disposition, he nevertheless gave much disinterested service and support to local and other charities, and his numerous acts of private generosity will long be remembered by his friends.

F. F. RENWICK.

FRANCIS WOOD HARDY.

1892—1939.

FRANCIS WOOD HARDY was born at Allerton, a suburb of Bradford, in 1892. He received his general education at Carlton Street Secondary School, Bradford, and then entered Westminster Training College, graduating as B.Sc., of London, in 1914. In 1916, after a course of research work at Leeds University, he joined the staff of the Leeds Modern School as Senior Chemistry Master and continued in this capacity until the time of his death, which took place with tragic suddenness in January while he was on his way to school.

Though a martyr to rheumatism, he fought steadfastly against his disability. A man of lovable personality, he never bore ill-will, invariably confronting petulance with severity and anger with good humour. He had the gift of inspiring enthusiasm in his pupils, many of whom have won high distinctions both at school and the University, and no earnest student looked to him in vain for help and encouragement. He was strong in the belief that the aim of the whole staff was to make the " Modern " the first school in the City, and the records he kept of the achievements of his boys showed how deeply he accepted the tradition of the school that only the best was good enough. For several years he had been collecting mineral and chemical specimens from all quarters of the globe. This collection, which includes many rare specimens of great interest to students, stands as a permanent memorial to his work, " monumentum aere perennius." A man of many parts, Hardy was a great lover of music, and the school orchestra, which he brought into being, provided

another channel for his activities. He was also a shining light in the Allerton Methodist Church, and a keen gardener. His was a fine record of service; a workman " who needeth not to be ashamed," and a host of friends will hold him in thankful remembrance.

Hardy was a member of the Faraday Society, and was elected a Fellow of the Chemical Society in December, 1923. G. W. KENDALL.

WILLIAM EDWARD KAY.

1855—1938.

KAY, who was 83 years of age at the time of his death on November 7th, 1938, was a brilliant pupil and for years personal assistant of Sir Henry Roscoe during the formative period of Owens College and the Victoria University, Manchester. He was invited by Walter Crum, F.R.S., an intimate of Roscoe, to seek a career in calico printing as chemist to the Thornliebank Works, near Glasgow, then one of the largest and most important in the world. He rapidly became a recognised authority on the science and technology of textiles, dyeing and printing.

The industry was in transition from the period of " natural " dyewares and traditional processes, still of the greatest importance, to that of artificial dyestuffs, many classes of which were already in use alone and in association with the older materials and methods. Kay disclosed exceptional gifts of administration, and many were surprised to find in this mild-mannered professional gentleman a man of firm will, ripe judgment, and keen appreciation of character who could deal suitably with men of all types.

At the formation of the Calico Printers Association he was selected as its chief chemist and established its original central laboratory. In later years he was mainly responsible for the buying activities of the Association, and the organisation for central buying was built up by him.

In spite of his partial dissociation from the technical side of the industry Kay always felt strongly about the professional status and interests of scientific workers, and in post-war years lent his influence and services to the establishment of the British Association of Chemists, which owes its survival through the difficult early years largely to his persistent efforts.

Kay was elected a Fellow of the Chemical Society on February 17th, 1881.

F. O. ASHMORE.

ARTHUR WILLIAM KNAPP.

1881—1939.

IT is with great regret that we have to record the death of Arthur William Knapp, who passed away in the General Hospital, Birmingham, on Friday, January 6th, 1939, in his 59th year.

Knapp was born at Handsworth and educated at the King Edward VI Grammar School, Aston, and at Birmingham University. He graduated B.Sc. London and Birmingham in 1901, and M.Sc. Birmingham in 1928. He passed in 1903 the examination for the Associateship of the Institute of Chemistry, and proceeded to the Fellowship in 1906. He was a member of the Institution of Chemical Engineers, of the Society of Public Analysts, of the Society of Chemical Industry, and of the British Association of Chemists, and he was a Fellow of the Chemical Society and of the Institute of Hygiene.

From 1923 to the time of his death Knapp was Chief Chemist to Messrs. Cadbury Brothers, Ltd., Bournville. He joined the Cadbury organisation as the firm's first research chemist in 1911, and he had previously held appointments in Public Analysts' Laboratories in London, Belfast and Birmingham, and in the Research Laboratory of Messrs. Lever Brothers, Ltd., Port Sunlight.

A fairly frequent contributor to the chemical and technical press, Knapp was also the author of a number of standard works on the cocoa and chocolate industry. His book on

" Cacao Fermentation," which was published in 1937, seems likely for many years to come to remain one of the best text-books on this subject. The research work which he carried out was of great importance to the cocoa and chocolate industry, and its value was officially recognised in 1935 when he was awarded the *Médaille de Mérite de l'Office International du Cacao et du Chocolat.*

Knapp's interest in and devotion to his profession were wholehearted and unswerving, and his concern for the less fortunate of its members was a constant example to us all. He served on the Council of the Institute of Chemistry, of the Society of Chemical Industry, of the British Association of Chemists and of the Society of Public Analysts. He had also been Chairman of the Local Sections of the first three bodies and of the Midland Chemists' Committee.

As a chief he was kindly, courteous and considerate, and his zeal for truth was an inspiration. In the most difficult circumstances he would retain his calm and balanced judgment and perfect self-control; temper played no part in his make-up. An old colleague wrote of him: " I have always envied him his gifts, his quiet yet so forceful manner of speaking and writing, his comprehensive knowledge of everything connected with cocoa and chocolate; but his unassuming manner and the invariable friendliness with which he greeted me made me feel as if I had been his brother."

Another of his colleagues has said: " In so far as such a nature could hate anything, he hated humbug and insincerity, whether in commerce, literature, religion or any other department of life. It was perhaps his downright sincerity which kept him from orthodox religious expression, but if purity of thought and action, unflinching integrity, kindliness, and generosity with his time, talent and money—if these are Christian virtues, then he was the Christian of us all."

Knapp's gifts and interests were not confined to science. He was a ready and able writer on artistic, literary and philosophical subjects, he had a skilful pencil, with a special aptitude for caricature, and he was both a very keen student of the drama and a most gifted amateur actor. He was a member of the Fabian Society, and in his early days at Belfast he frequently spoke at open-air meetings, sometimes at grave personal risk. He combined shyness and reserve with the highest moral courage, and his considerateness for others reflected his own extremely sensitive nature.

Despite his many outside interests, he was devoted to family life, and it was an inspiration to visit his home and to see the happiness which he shared with his wife and children. The writer once spoke to A. W. Knapp about happiness in life, and he replied: " I don't know that I should call myself happy—I would rather describe it as ' blessed.' " To have known such a man was a privilege. We, his friends, rejoice in his memory and mourn his loss.

J. R. JOHNSON.

CYRIL ALEC LAWRENCE.

1912—1938.

A PROMISING chemical career was cut short almost at its outset by the sudden death on December 20th, 1938, of Cyril Alec Lawrence. He was born in 1912, educated at the Coopers' Company's School at Bow, and later became a laboratory assistant at St. Olave's Grammar School, where he was given facilities for higher study. At a very early age he developed an enthusiasm for organic chemistry which amounted almost to a passion. He attended the evening classes of the Sir John Cass Technical Institute, graduating in London University with honours in Chemistry in 1933. In collaboration with Dr. E. de Barry Barnett he studied the application of the Diels–Alder reaction to conjugated dienes obtained by dehydration of cyclic pinacols and thereby synthesised a number of interesting polycyclic compounds. For this work he obtained the degree of M.Sc. in London University. As a grantee of the Medical Research Council, Lawrence worked in the Research Institute of the Royal Cancer Hospital from 1935 to 1937, where he obtained his Ph.D. degree with a thesis describing the synthesis of various hydronaphthalene derivatives by an internal Darzens reaction, and also by the use of vinyl*cyclo*hexenes in the diene reaction. In

January, 1938, Lawrence began work at the Courtauld Institute of Biochemistry of the Middlesex Hospital, where he undertook an investigation of problems relating to synthetic oestrogenic compounds. Never robust, his health began to fail, but he appeared to be gaining strength towards the end of the year and his death, which took place in a sudden spell of severe weather in December, was quite unexpected.

Lawrence was a devotee of motor-cycling and on several occasions attended the Tourist Trophy races in the Isle of Man. He was unmarried, and is survived by a widowed mother and a brother and a sister.

He was elected a Fellow of the Society on June 1st, 1933. J. W. Cook.

ALFRED COURTENAY LUCK.

1866—1938.

Alfred Courtenay Luck, whose death took place on June 21st, 1938, in Buenos Aires, was born on December 21st, 1866, in England, and received his education at private schools and at King's College, London.

He studied chemistry under the late W. E. Halse, who specialised in sugars, starches, etc. Later Luck was appointed chemist and afterwards a chief chemist to the explosive works of Pigou, Wilks and Laurence at Dartford, this firm being subsequently absorbed in that of Curtis and Harvey which now belongs to Imperial Chemical Industries, Ltd. He was with this firm for 12 years, and resigned to take over the managing directorship of Luck's Explosives, where he remained until in 1904 he accepted the position of Director of the Explosives Laboratory of the Navy, at the Ministry of Marine of the Argentine Government. He resigned from this position in 1934 to become chief chemist to the Buenos Aires and Pacific Railway. He remained there for six years and left it to devote his time to private practice, working almost exclusively for English firms established in Argentine. During the early part of his life in England, Luck was connected with Cross and Bevan, working with them on the stability of nitrocellulose, and being joint author of works dealing with this subject.

He was an original member of the Society of Chemical Industry, a Fellow of the Institute of Chemistry from 1918, and was a member of the Committee appointed to represent the Argentine at the Seventh International Congress of Applied Chemistry held in London in 1907.

Luck married as his second wife Margaret Ryle, an Argentine of Irish descent, and left two sons by his first marriage and three by his second. He was a keen sportsman and a collector of old paintings.

He was elected a Fellow of the Chemical Society on February 15th, 1905.

STEVENSON JOHN CHARLES GEORGE MACADAM.

1865—1939.

Stevenson J. C. G. Macadam, who died on January 26th at the age of 73, was the younger son of Prof. Stevenson Macadam. He assisted his father, and subsequently worked with his brother, Prof. W. Ivison Macadam, in the chemical laboratories of the Edinburgh College of Surgeons. On the death of his brother in 1902 he left the College and established himself as a consultant, holding many positions as public analyst. He retired from practice a number of years ago and devoted himself to country pursuits and to the cultivation of cacti at his house at Lasswade, Midlothian. He was unmarried.

He was elected a Fellow of the Chemical Society on February 2nd, 1888.

C. H. Desch.

KENDALL MORGAN MADIGAN.

1909—1938.

KENDALL MORGAN MADIGAN obtained his Doctorate of Dental Surgery at the University of Alberta, Canada. On his return to Australia he practised in Macquarie Street for two years. He was then appointed Oral Surgeon to the Bathurst Hospital. Here he exhibited exceptional technique in this department of dental work. Later he commenced private practice in West Maitland, combining oral surgery with general dental work. He was selected as Honorary Dental Surgeon to the Maitland General Hospital.

Madigan was passionately attached to his profession, and possessed a distinctly comprehensive view of dental science. He was one of the few who had enough imagination to realise that standards of human nutrition played the greatest part in dental prophylaxis, and that the biochemist was the greatest friend of the dentist. He was intensely interested in the biochemical factors involved in tooth nutrition, and followed with great enthusiasm all the vast array of chemical research bound up with this great problem.

At the time of his demise he was planning some research work in dental materia medica in which chemical research was to be the foundation. But destiny determined otherwise, and harshly extinguished a promising career at the age of 29 years. Madigan had a bright and breezy personality and was blessed with a keen sense of humour. He was fond of outdoor pursuits, particularly in the athletic and sports arenas. GEORGE Z. DUPAIN.

EMILE MOND.

1865—1938.

TREASURER, 1931—1938.

EMILE MOND spent his early years in Paris and was educated at the Collège de Sainte Barbe and at the Lycée Condorcet. From there he went to Zürich for his specialised training in chemistry at the Polytechnicum under Lunge and Alfred Werner. He pursued his studies diligently and already took a lively interest in literature and the arts and his imagination was stirred by the rapid advances then taking place in many branches of natural science. He knew his teachers intimately and was immensely popular with and respected by his fellow students. It was during this time that one of the writers (E. B.) came to know him and to be a life-long friend and collaborator.

Like many parents at that period, Emile Mond's father did not believe in pampering his children. One story of his Zürich days Emile Mond has related with his characteristic appreciation of delicate humour. Always abstemious, he nevertheless found it trying at times to be deprived of an occasional glass of wine to accompany his boarding-house fare. Then came an opportunity and after some hesitation he wrote to his father suggesting a small supplement to his allowance in order to purchase a little wine which would render the dubious liquid from the municipal water tap more safe during the prevailing epidemic of typhoid in Zürich. Replying immediately, his father pointed out that a few drops of vinegar would be at least as effective if not more so for the purpose ! On one occasion when a student at the Polytechnicum had grossly misbehaved, rather than report the matter to the authorities the general body chose Emile Mond to take charge of a court of honour to consider the matter and the culprit was dealt with summarily and effectively; and so at this stage his qualities as an arbitrator and as a man of honour were recognised by his fellows who realised something of his fine personality and character.

After taking his diploma, Emile Mond in collaboration with his friend made his first venture into industrial chemistry and technical production. The story is an interesting one. During a discussion after the course of Lunge's lectures on dyes and dyeing processes one student, also from Paris, remarked on the stupidity of importing to Europe the bulky dyewoods from the tropics and carrying out the extraction here; if the extraction were carried out at the plantations and the extract shipped to Europe, the saving on freights

alone would ensure adequate profits. The originator of the idea did nothing further in the matter, eventually becoming a successful manufacturer of synthetic perfumes; but Emile Mond and his friend were greatly interested. A little later and with the consent of his uncle, Dr. Ludwig Mond, they designed and ordered a small experimental plant for extracting logwood, logwood extract then still being one of the most important dyes. They rented a small shed in Manchester, buying steam from an adjoining factory. The work went on continuously day and night, the two friends relieving each other in two shifts and changing turns weekly. They had to work hard and live economically, but they made the extract and reports of the technical trials were so satisfactory that plans for the large-scale plant to be erected in the West Indies were quickly made. These plans had to be submitted to Dr. Mond, whom they approached with some trepidation. They found a propitious moment, one o'clock in the morning, when it so happened they caught the great man after a successful game of billiards. " My poor boys," he exclaimed, " it's all wrong, no thought for the future, no provision for expansion, you would have to pull down everything." Dr. Mond had never seen a dyewood extract plant, but seizing a billiard chalk he rapidly drew on the green cloth what became the final plan of the works, exclaiming, " Here is the line of boilers, here the diffusion battery with room for expansion to the right and left, here the row of cutting machines, here the row of vacuum pans " and so on to the last detail.

Still the two friends had to struggle, capital had to be found. Dr. Ludwig Mond was appealed to, but he was obdurate, having decided, probably wisely, that it would do the young men no harm to realise at this stage that difficulties should be surmounted by their own efforts. But they did find the capital and ultimately year after year the shareholders received a dividend of 50%. One day, they received a request from a lady desirous of investing money with the West Indies Chemical Works Limited. She was Dr. Mond's faithful old French cook, who, on retiring, had asked her employer's advice concerning a sound investment. Emile Mond has said that that was the proudest moment of his industrial career. When the Jamaica enterprise was in full swing he ceased to take active share in the management; for him it had been a useful experience in organisation and in the surmounting of difficulties and it brought out that tenacity of purpose which characterised his work.

On returning to London, Emile Mond became technical assistant to his uncle, specialising in patent work. Later, he joined the board of Brunner, Mond and Company, Limited, and also became vice-chairman of the Mond Nickel Company, Limited. In addition, he held the chairmanships of the South Staffordshire Mond Gas company, the Power Gas Corporation, Limited, and Ashmore, Benson, Pease and Company, Limited.

Emile Mond married Angela, youngest child of the late James Henry Goetze, who has been so closely identified with his many benefactions and scientific and social activities. Ever since its foundation by Madame Marie Bohn, he was intensely interested in the Institut Français du Royaume Uni and, being greatly concerned at the lack of educational facilities for French and Belgian refugee children, he provided for the establishment of the Lycées de Londres in May, 1915. These institutions became so important that the British Government provided a house for them and the Lycées became part of the Institut Français. Later, in 1921, they were formally recognised by the French Government and affiliated to the Université de Lille. In recognition of this important work, with which he continued to be actively identified, Emile Mond was made Officier de la Légion d'Honneur by the French Government and Officier de l'Ordre de Léopold by the King of the Belgians. In 1919, he established the " Francis Mond " Professorship of aeronautical engineering—the first chair in that subject in a British University—at Cambridge in memory of his son, who was killed while flying in France in May, 1918.

Although he always underestimated his own ability and attainments in the science, Emile Mond was keenly interested in the advancement of chemical knowledge. He delighted to visit laboratories where original investigations were in progress and frequently contributed materially to the discussion of results. It was this interest in the subject and his desire to assist in the publication of new knowledge which led him to accept the Honorary Treasurership of the Faraday Society in 1930, succeeding his cousin, the late Sir Robert

Jours Sincères
Emile Mond

[*To face p.* 730.

Mond, and in 1931 he also became Treasurer of our Society. He was elected a Fellow of the Society in May, 1899, and was Vice-President from 1929 to 1931.

The records bear witness to the meticulous care and foresight with which he looked after the financial side of the Chemical Society's work. His work as Treasurer began during a time of severe financial stress. Emile Mond quickly realised that, if the Society was to continue its publication work on a scale in any way commensurate with its function as the oldest and leading society devoted to the extension of chemical knowledge and with the needs of the science, active support, apart from what the Fellows could contribute, must be obtained from chemical industry for its work. He supported financially and actively all the efforts which have resulted in the establishment of the Chemical Council. He always preferred to give rather than ask for money, but when he did appeal for money for the Society, and this had to be often, he was invariably successful. During Emile Mond's Treasurership the Society, in spite of passing through a difficult time, has made outstanding progress and the publication of new knowledge in chemistry has been greatly extended.

Emile Mond was a man of rare discernment, great modesty and charm. Severely critical of his own efforts, he was always appreciative of those made by others. Only a few have any idea of his great generosity during many years and this generosity was guided by his intense desire to help the younger generation, to advance science and other branches of knowledge and to extend international good will. For many years, Mr. and Mrs. Emile Mond made their houses delightful centres of refinement, culture and recreation for their numerous friends in this and many other countries.

Emile Mond was a type of man unfortunately too rare in these days. His greatest happiness was in helping others towards a fuller appreciation of things that are worth while. He will be greatly missed and to Mrs. Mond and the family all who came to know him tender their deepest sympathy.

He died on December 30th, 1938, at his residence, 22 Hyde Park Square, London, W.2, and is buried at Sullington, Sussex.

The Society has a permanent and visible memorial of its late Treasurer. Mrs. Emile Mond has presented to the Society a beautifully designed Presidential Badge in gold and enamel which she and her husband had had made some little time ago.

This notice has been written by two personal friends, one who has known Emile Mond intimately during 54 years and the other who has been privileged to be particularly closely associated with him during recent years. They with many others will continue to revere his memory.

EMILE BUCHER.
CHARLES S. GIBSON.

CHARLES EDWARD MUNROE.

1849—1938.

CHARLES EDWARD MUNROE, Ph.D., LL.D., was born at Cambridge, Mass., U.S.A. on May 24th, 1849, and died on December 7th, 1938. He graduated in 1871 from Harvard University, where he became assistant lecturer in chemistry and founded what was probably the first course in technological chemistry. From 1874 to 1886, Munroe was professor of chemistry at the United States Naval Academy, which he left to enter the Naval Torpedo Station. Thereafter, he became professor of chemistry at George Washington University (1892—1917), where he acted also as consultant on explosives at first to the Technological Branch of the Geological Survey and later to the Bureau of Mines from its inception in 1910. In 1919 he became chief explosives chemist to the Bureau of Mines, a post which he held until his retirement in 1933.

From amongst Munroe's many achievements in the study of explosives, perhaps the best known are his invention of a smokeless powder, " indurite," the first smokeless powder used by the United States navy; his discovery of the so-called " Munroe effect," whereby, for example, a design impressed in the face of a cube of guncotton is indented in a steel

plate on which the cube is detonated; and his development of " permissible " explosives for use in coal-mines.

All those who knew him had a high respect for Munroe and regarded him with affection. He was always ready to help younger men engaged in the study of explosives and his wide knowledge of the subject enabled him effectively to do so.

Among the honours received by Munroe were Commandant of the Order of Medjidje from the Sultan of Turkey, and Officer of the Order of Leopold II. He was President of the American Chemical Society in 1898, and was elected a Fellow of the Chemical Society on March 15th, 1888.

R. V. WHEELER.

HUBERT NAYLOR BARDSLEY RICHARDSON.

1865—1938.

HUBERT NAYLOR BARDSLEY RICHARDSON died at Leicester on May 27th, 1938, at the age of 73.

Being elected in December, 1888, he had been a Fellow of the Chemical Society for close on 50 years. He was also Chairman of Messrs. John Richardson & Co. (Leicester) Ltd., Manufacturing Chemists. Born in 1865, Hubert Richardson was the eldest son of the late John George Frederick Richardson, himself a Fellow of the Society for 30 years, who established the wholesale business of John Richardson and Company in 1869.

Hubert Richardson commenced his education at Uppingham School, where he began his studies in chemistry. From Uppingham he matriculated at Jesus College, Cambridge, where he remained for 3 years, and obtained the B.A. degree, taking chemistry for the Special Examination.

In 1890 Hubert Richardson commenced a course of studies at the School of Pharmacy, Bloomsbury Square, and at the conclusion thereof, successfully passed his minor and major examinations. Considering that he was by this time fully competent to accept a responsible position in the commercial world, his father made him a partner in the firm, and placed the general superintendence of the works under his care. In this position Hubert Richardson soon gave evidence of his exceptional ability, and his uniform kindness of manner and consistent impartiality caused him to become much esteemed by the staff. Although he continued his connection with the business up to the time of his death, Hubert Richardson found time to devote some of his energy to literature, and several publications bear his name, his greatest undertaking undoubtedly being his " Dictionary of Napoleon," which took him several years to compile. He was also a member of the Gypsy Lore Society, in which he always took a great interest.

A keen sportsman, he was Captain of the Uppingham School eleven in 1884, and rowed for his College at Cambridge.

Hubert Richardson leaves a wife, two sons and two daughters.

J. R. E. RICHARDSON.

HARCOURT HENRY BENJAMIN SHEPHERD.

1854—1939.

ANOTHER of our veteran Fellows, Harcourt Henry Benjamin Shepherd, passed away at Bexhill-on-Sea on January 5th, 1939, in his eighty-sixth year, after having been in delicate health for the last few years. He was one of several sons of the late Benjamin Parkman Shepherd, of Bristol, and was educated at the Bristol Grammar School. On leaving school, he became a pupil in the School of Chemistry which was successfully conducted for many years by the late Thomas Coomber and was later taken over by the Society of Merchant Venturers, subsequently becoming affiliated to the University of Bristol. After his course with Coomber Shepherd came to London and continued his studies at the Royal College of Science, where he worked as an assistant under Frankland and Valentin, and later, in 1873, became an assistant in the private laboratory of the late Dr. Augustus Voelcker, where, among his laboratory companions, were the late F. J. Lloyd, the late

Alfred Smetham, the late J. A. Voelcker, and also the writer of this notice, who formed with him a close friendship which lasted for life.

On the recommendation of Voelcker, Shepherd, in 1875, was appointed chemist in the laboratory of Ohlendorff's Dissolved Peruvian Guano Works, then newly established in London for the treatment of raw Peruvian guano with sulphuric acid in order to convert its phosphate into water-soluble form. The work of the factory, which had a good sulphuric acid plant, was gradually extended to the production of superphosphate and of miscellaneous compound fertilisers, the company being later reconstituted as the Anglo-Continental Guano Co., Ltd. Shepherd remained here for the whole of his working life, first as chemist and later as chemical manager, a post which he held until his retirement sixteen years ago.

He was elected a Fellow of this Society in 1874 and in early days he was a regular attendant at the fortnightly meetings of the Society, and was a companionable member of the little coterie of chemists who were specially interested in the development of agricultural chemistry, in the technical aspects of which he continued to take a keen interest up to the end of his sixteen years of retirement, which were spent at Bexhill. He was a member of the abstracting staff of the Journal of the Society during 1876 and 1877.

Shepherd made from time to time useful suggestions in connection with the analysis of fertilisers and feeding stuffs, among them being an ingenious modification of the old Will and Varrentrapp nitrogen bulb used in soda-lime combustions. Although it may have had but small scientific significance, this improvement came as a boon to many analysts many of whose laboratory hours were spent in carrying out this troublesome process before the wet combustion method of Kjeldahl appeared as a star in the analytical firmament. This little device of Shepherd's was communicated to the *Chemical News* (1878, **38**, 251).

In 1883 he also contributed to the *Chemical News* a timely and interesting discussion on the determination of nitrogen in mixtures containing nitrogenous organic matter, ammoniacal salts, and nitrates, a difficult problem which has continued to exercise the ingenuity of agricultural analysts both here and abroad down to the present time and has only recently been worked out to what appears to be a successful issue (see *Analyst*, 1938, **63**, 866). He also contributed to the *Chemical News* (1891, **63**, 251) a critical discussion of the then newly introduced Glaser method for the determination of iron oxide and alumina in phosphates, in connection with which he made some useful suggestions.

During the War he was among those who rendered valuable national service in connection with the manufacture of sulphuric acid for high explosives.

He was an original Fellow of the Institute of Chemistry and was, for many years, a member of the Society of Public Analysts and a Fellow of the Royal Society of Arts.

He married, in 1878, Matilda Tucker, daughter of James Tucker, of Woolston, Hants, whom he survived by 3½ years, leaving two sons and four daughters.

BERNARD DYER.

THOMAS STEVENSON.

1864—1938.

THOMAS STEVENSON died in Edinburgh on October 29th, 1938, at the age of 74.

He served his apprenticeship with his father, a well-known pharmaceutical chemist of his time, and qualified as a pharmaceutical chemist in 1886. As a student he made various contributions to the local branch of the Pharmaceutical Society, and later on published several books dealing with special aspects of pharmacy.

After a period of work in Bombay he returned to Edinburgh in 1902 and resumed practice; in 1906 he founded the *Prescriber*, a monthly journal devoted to reporting the progress of pharmaceutical chemistry. He took an active part in the work of the North British Branch of the Pharmaceutical Society, and served both as a chairman of the Section and as an examiner.

Stevenson was a man of a quiet and kindly disposition. He was interested in music and also took an active part in the development of the Rotary Club movement.

He was elected a Fellow of the Society on December 3rd, 1891. A. LAUDER.

ALFRED EDWIN HOWARD TUTTON.*

1864—1938.

ALFRED EDWIN HOWARD TUTTON was born on August 22nd, 1864, at Cheadle Mosely, Cheshire, and was the only child of James Tutton, a Venetian blind manufacturer. He received his early education at the National School of Edgeley, and at the age of fourteen entered the office of the Town Clerk, and later that of the Medical Officer of Health in Stockport. During this period he attended evening classes at the Mechanics' Institute and Sir Henry Roscoe's evening Chemistry Course at Owens College.

In 1883 he was awarded a Royal Exhibition at the Normal School of Science and Royal School of Mines at South Kensington, together with a Scholarship from the Lancashire and Cheshire Institutes, and this enabled him to obtain the training for a scientific career under Frankland, Thorpe, Judd, and Rucker during the next three years. Here he was awarded the Murchison Medal for Geology, the Tyndall Prize for Physics, and the Hatton Prize for Chemistry, closing with the first-class Associateship of the College, and a teaching Scholarship for a fourth year.

Soon after Thorpe had succeeded Frankland, Tutton was appointed his Demonstrator and Lecturer on the Theory of Chemical Analysis. He collaborated with Thorpe in the investigation of the oxides of phosphorus, and the results of his research, including the discovery of the tetroxide and the study of P_4O_6, were published in a series of papers between 1890 and 1892. The properties of the latter oxide were, as is well known, of considerable pathological interest. He was also occupied during this period with the calculations and maps for Thorpe and Rucker's Magnetic Survey of Scotland.

At this time he became specially interested in Crystallography, the subject to which in later years his most important researches were assiduously devoted. In this (except for a little private instruction from H. A. Miers of the Natural History Museum) he was self-taught; it became the dominant passion of his life.

He was soon occupied in the measurement and description of the crystals of organic substances prepared in the Chemical Laboratory, including Dunstan's pure aconitine. It was not long before he embarked on the specific line of investigation which he pursued continuously for the next forty years—the effect produced on crystal form and physical properties by the replacement of one element by another in a series of allied compounds.

According to his own account of this prolonged research, two very important series of salts were chosen, the first being the sulphates and selenates of the alkali metals potassium, rubidium and cæsium, and of ammonium and thallium, all of which crystallise in similar (isomorphous) forms; the second series consisted of the double sulphates and selenates which the first series form with the sulphates and selenates of magnesium, zinc, iron, nickel, cobalt, manganese, copper and cadmium, and which crystallise with six molecules of water, forming an isomorphous series. In all, no fewer than 91 salts were studied and accurately described in about fifty papers to the Royal and Chemical Societies between 1890 and 1929. The whole of the crystallographic properties were shown to vary regularly with the atomic weight (or atomic number) of the interchangeable elements. The same law was also shown to apply to the perchlorates and double chromates of the alkalis, and probably to any such series in which the unit cell of the space lattice has nearly the same dimensions throughout the series.

During the earlier years of this research *X*-ray methods had, of course, not been discovered, and these dimensions were not at that time capable of direct experimental determination.

Up to the year 1895 this work was carried out at South Kensington and, to a large extent, with apparatus designed by Tutton and constructed for him by Messrs. Troughton and Simms. Sir William Abney, then Director of Science in the Department of Science and Art, recommended him for one of the newly instituted Inspectorships of Technical Schools, to which he was appointed by Mr. (afterwards Sir Arthur) Acland in 1895. In that year Tutton, whose parents were living with him, lost his mother; and Sir Edward Thorpe left

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South Kensington on his appointment to the Government Laboratory, so the change of scene came at an appropriate time, and Tutton left London to take up his abode in Oxford as H.M. Inspector of Technical Schools for that district.

The hope was expressed by Acland that he would take with him into the schools the spirit of research by which he was distinguished, and Tutton lost no time in fitting up for himself a private laboratory in his new residence at Bardwell Road, Oxford.

During his ten years' residence in Oxford he became attached to New College and took the B.Sc. (1895) and D.Sc. (1903) degrees, being one of the first to obtain these degrees by thesis under the newly instituted Statutes, and in 1905 he received the M.A. degree by Decree of Convocation.

He was elected a Fellow of the Royal Society in 1899 at the age of thirty-four. In 1899 his father died, and on June 18th of that year he married Miss Margaret Loat of Cumnor Place.

The remaining three years in Oxford were fully occupied by official work, private research, and the social life of the University.

In 1905 Tutton was transferred by Sir Robert Morant, then Secretary of the Board of Education, to the London district, and with his family he took up his abode in Ladbroke Square and installed there a new research laboratory in which his scientific work was continued with the same assiduity as before. Here he lived for six years.

During his life in London three of his books were published, namely, " Crystalline Structure and Chemical Construction " (Macmillan 1910), " Crystals " (Kegan Paul 1911), and " Crystallography and Practical Crystal Measurement " (Macmillan 1911). Of the last, a new and much enlarged edition in two volumes was published in 1922. This important work is a valuable book of reference containing a very complete summary of the state of crystallographic knowledge at that date, written in clear and intelligible style with numerous illustrations and descriptions of experimental instruments and methods, including those designed by himself.

According to Tutton's own account, two of the instruments, the interferential dilatometer and elasmometer, for determining the thermal expansion and elasticity constants of crystals, by the refined interference method—the unit being the one-eight millionth of an inch—suggested an interesting piece of work which Tutton carried out for the Standards Department of the Board of Trade. For the Warden of the Standards, Major Percy Macmahon, saw that the method of these instruments could readily be applied to the comparison of the parliamentary and local government copies of the standard of length with the Imperial Standard Yard itself, and Tutton was officially asked by the Board of Trade to devise and supervise the construction of an interferential comparator for the Standards Department for this investigation. This was successfully carried out during the years 1907—09, with the consent of the Board of Education, a room being set apart at Old Palace Yard, Westminster, for the instrument and its accessories, and maintained at the official temperature of 62° F. by an electrically controlled thermostat. Tutton received the cordial thanks of the Board of Trade for this work. He had intended using the comparator eventually for the evaluation of the yard in wave-lengths of a standard light radiation (that of the red line of the cadmium spectrum), just as Michelson had, by another method, done for the French metre at Sèvres. But this had to be deferred, as he was transferred by Morant in 1911 to the south-western district centred at Plymouth.

In 1909 Tutton went to Canada with the British Association and delivered one of the evening lectures at Winnipeg on " The Seven Styles of Crystal Architecture," using for projecting polarisation effects a pair of large Nicol prisms made by Ahrens which he had recently acquired. These he also used with good effect in experimental lectures at the Royal Institution and the Royal Society of Arts.

During his thirteen years as Inspector under the Board of Education in the Plymouth district, the Tuttons resided at Yelverton on Dartmoor, and here he was still able to carry on his systematic series of researches.

In 1924 he retired, at the age limit of sixty, from his inspectorship. He was then free to devote himself entirely to scientific work, and after the marriage of his eldest daughter the family removed to Cambridge, where for the next eight years they inhabited a house in

Grange Road; here he installed a new laboratory even better equipped than its predecessors. He was invited to give courses of University lectures for the Department of Mineralogy, and some of these were delivered in his private laboratory.

From 1924 onwards Tutton lectured at a number of centres each year in various parts of the country for the Gilchrist Educational Trust. He regarded "Ice and Snow" and "The Wonders of Alpine Glaciers" as the most popular subjects. These were illustrated by lantern slides selected from the many which he had made from the negatives taken during his visits to the Alps. Most of his holidays were spent among the Swiss Alps, where he combined the study of ice and snow with the pursuit of climbing, both equal pleasures to him.

In 1926 he met with a somewhat serious accident on the Aiguille Goûter.

In 1926 he received the honorary degree of D.Sc. from the University of Manchester.

His long series of researches on the sulphates and selenates, which to his great pleasure were often called "the Tutton salts," was brought to a close in 1928 by his Royal Society paper on the thallium double salts.

In the following year he visited South Africa with the British Association and gave an address summarising these researches.

He was now able to return to the evaluation of the Imperial Yard in wave-lengths of light which, by reason of his removal from London, he had been obliged to postpone in 1911. In the meantime (to quote from Tutton's own account of this investigation) there had been under construction for him at the works of Troughton and Simms a Universal Interferometer, which combined a duplicate of the essential interferometric portion of the comparator, with improvements suggested by experience at the Standards office, and additions fitting it for the measurement of minute distances or small amounts of motion in general; for instance, the piezo-electric changes in crystals or the determination of torsion in such small bodies as crystals. This instrument—the last made by the old firm of Troughton and Simms (before their amalgamation with Cooke)—was completed just before Tutton removed to Cambridge and was installed in the new private laboratory there. In 1930, therefore, with this instrument Tutton determined by actual counting the number of interference bands (nearly eleven thousand), corresponding to the one-eighth of an inch, as a base line. This being ascertained many times over, the stepping off from this base line, by doublings and additions, to the yard was carried out at the Standards Department, on the author's comparator there, as originally intended.

The final result was communicated to the Royal Society in April, 1931. The accuracy of his work was fully confirmed by the determination of this length made at the National Physical Laboratory in 1934.

This work seems to have involved considerable eye-strain and in 1931 the Tuttons left Cambridge and, after a year's continental travel for purposes of health, settled at Dallington in Sussex.

The greater part of his scientific apparatus was purchased by the University of Manchester for the Department of Physics for use in the Sub-Department of Crystallography under the charge of Dr. H. E. Buckley.

In 1937 Tutton was a member of the Delegation from the British Association to the jubilee meeting of the Indian Science Congress.

The enforced retirement from research, which was his passion, and the loss of his favourite instruments, caused much regret, but there were compensations, and the last seven years of Tutton's life were very happily passed in a charming house among peaceful surroundings and with the companionship of loving relatives.

His death took place at Dallington on Thursday, July 14th, 1938. His was a life of earnest and continuous effort. He had always felt a great pride in his work, and in the fact that it was the fruit of his own independent industry, carried out with his own apparatus and by himself alone. If his published writings sometimes suffered from unnecessary prolixity, it was because he spared no words or facts in the endeavour to vindicate the completeness and accuracy of his work. In all that he did he aimed at a finely finished production. The conscientious craftsman is proud of his work, and Tutton was proud of his research. In his work and life he was *ad unguem factus homo*.

He leaves a devoted wife and a family consisting of two sons, Captain John Tutton, R.E., and Michael Tutton of the Colonial Office in Tanganyika, and four daughters, the eldest of whom, Mary, married Commander C. E. Simms, R.N., whose grandfather was head of the firm of Troughton and Simms mentioned above as the makers of Tutton's best apparatus.

[The above account was compiled from autobiographical notes left by the late Dr. Tutton.]

DENNIS TYRRELL.

1866—1938.

DENNIS TYRRELL was born in 1866 and received his general education at the Presbyterian School, Norwich. On leaving school he studied chemistry under Mr. R. S. Cahill and later under Mr. S. Hewett. In 1886 at the age of 20 he entered the service of Messrs. Youngs, Crawshay and Youngs, holding for many years the position of Assistant Brewer to the late Mr. C. T. Lincoln. The remainder of Tyrrell's life was passed with this firm, afterwards a Company, and for the last 27 years he was their Head Brewer.

Tyrrell devoted his entire attention to the scientific brewing of beer and stout and he lived to see the brewery which he managed for so long completely installed with up-to-date apparatus and plant for the purpose which he had at heart.

By his death on November 26th, 1938, Messrs. Youngs, Crawshay and Youngs, Ltd., lost a most able and faithful servant, and keen regret is felt by the directors, staff and employees.

Tyrrell was elected a Fellow of the Chemical Society on June 17th, 1903.

W. A. N. TYRRELL.
