

OBITUARY NOTICES.

LEONARD DOBBIN.

1858—1952.

A LINK with the past has been broken by the death of Dr. Leonard Dobbin, which occurred at Edinburgh on March 3rd, 1952, for Dr. Dobbin was recognised for many decades as one of our leading investigators in the history of chemistry. Born at Belfast on July 30th, 1858, Dr. Dobbin in his ninety-fourth year was still actively interested in his favourite field of research—frail in body, but with mind alert and unimpaired.

His early studies were at Queen's College, Belfast, and at the Royal College of Science, London; in 1880 he obtained the degree of Ph.D. at Würzburg and was appointed an assistant in the Department of Chemistry at the University of Edinburgh under Professor Crum Brown. In 1894 he was promoted to a lectureship, and retired with the rank of Reader in 1924.

A number of experimental papers between 1880 and 1893 showed his skill as an organic chemist, and his text-book "Salts and their Reactions," written in collaboration first with Dr. Hugh Marshall and later with Dr. J. E. Mackenzie, has been in favour for nearly fifty years. But the historical development of chemistry became his main study, and in 1889 he organised the five non-professorial members of the teaching staff of the Chemistry Department at Edinburgh University into *The Alembic Club*, an unassuming body which was destined to play a useful part in bringing important chemical communications within the reach of interested readers. The twenty-one *Alembic Club Reprints* now available in booklet form reproduce the classical investigations of the greatest chemists of the past three centuries. Many of these reprints were edited or translated by Dr. Dobbin himself.

His translation of Ladenburg's "Lectures on the History of the Development of Chemistry since the time of Lavoisier" was published in 1900, and his translation from Swedish and German originals of "The Collected Papers of Carl Wilhelm Scheele" appeared in 1931. These were his two major works; minor contributions elucidating points of dubiety or matters of controversy in chemical history flowed from his pen continually.

Dr. Dobbin was an active member of many scientific societies, his association with the Chemical Society dating from 1887. He was elected a Fellow of the Royal Society of Edinburgh in 1881, and his seventy-one years of membership probably constituted a record. He served on the Council of that Society from 1904 to 1907 and from 1913 to 1916, was Curator from 1934 to 1939, and Vice-President from 1939 to 1942. He was also the *doyen* of the Society of Chemical Industry.

One of the most modest of men, and one of the most lovable.

JAMES KENDALL.

FRANCES MARY GORE MICKLETHWAIT.

1868—1950.

MISS F. M. G. MICKLETHWAIT died on March 25th, 1950, in her 83rd year. Her long life covered a period of great activity in chemical research in which she played her part and will be particularly remembered for her work, mainly in collaboration with the late G. T. Morgan (afterwards Sir Gilbert Morgan), during the years 1901 to 1914. She was educated privately and then at the Swanley Horticultural College where her interest in chemistry was first aroused. In 1898 she joined the Royal College of Science and it is a tribute to her interest, ability, and determination that she took this course although she was older than the average of students entering the College. It was much less common and certainly more difficult for a woman to pursue a career on chemistry at that time than in these enlightened days. Miss Micklethwait was awarded the Associateship of the Royal College of Science in 1901 and during the ensuing thirteen years carried out a substantial and varied series of researches in collaboration first with M. O. Forster, then with G. T. Morgan, and finally with J. C. Cain.

In her early work with M. O. Forster, Miss Micklethwait studied the bromination and nitration of benzoylcamphor and obtained indications of the formation of *cis*- and *trans*-isomers of

bromobenzoylcamphor in the bromination researches. She then undertook an extensive series of investigations in conjunction with G. T. Morgan, principally directed to application of the diazo-reaction to a number of amines of the benzene, naphthalene, and diphenyl series. Of special interest were the formation and structure of the diazoimides from aromatic diamines, these cyclic substances being the subject of a number of papers in the *Journal*. In addition to the work with diazo-compounds, G. T. Morgan and Miss Micklethwait prepared complex salts of chloroplatinic acid and chloroauric acid with coumarin. These formed the first of a long series of papers published by G. T. Morgan and other collaborators on residual affinity and co-ordination. Other researches taken up by G. T. Morgan and Miss Micklethwait included investigations of the organic compounds of arsenic and antimony with camphor, resulting in the isolation of dicamphorylarsonic acid and tricamphorylstibine dichloride among other compounds. Some phenyl derivatives of arsenic and antimony were also examined.

During part of her collaboration with G. T. Morgan, Miss Micklethwait was the holder of a Beit Research Fellowship which was a just and appropriate recognition of the excellence of her work.

After G. T. Morgan left in 1912 to take up a Professorship of Chemistry at Dublin, Miss Micklethwait joined with J. C. Cain in research on the nitration of benzidine and toluidine and on the chemistry of the diphenyl series. These researches lasted until 1914.

During the first World War (1914—1918) Miss Micklethwait carried out work of national importance and was awarded the M.B.E. for these services in 1919. She spent a short time in the research department at Boots Pure Drug Co. at Nottingham and then returned to Swanley Horticultural College until 1921. Later she gave a great deal of her time to the preparation of the Index for the revised edition of Thorpe's Dictionary of Applied Chemistry, this being completed in 1927.

Miss Micklethwait was elected a Fellow of the Chemical Society in 1920, became an Associate of the Institute of Chemistry in 1904 and a Fellow in 1907.

Miss Micklethwait was of a modest and retiring disposition and this was reflected in her preference for working in collaboration rather than in striking out on lines of her own. She enjoyed the full confidence of those with whom she worked and there is no doubt that her experience and experimental skill were of the greatest value to her colleagues. She will be much missed by the older members of the Chemical Society who knew her and appreciated her worth. Her research, however, remains to remind us of a fine chemist.

F. H. BURSTALL.

EMIL ALPHONSE WERNER.

1864—1951.

EMIL ALPHONSE WERNER was born on June 29th, 1864, in 15, Leinster St., Dublin, a house that overlooked the park of Trinity College and the buildings with which he was destined to be associated for more than sixty years. He died on March 18th, 1951, at his home in the Dublin suburb of Rathgar. Yet, though the orbit of his activities was small, and remote from the great galaxies of European and American science, there was nothing small or provincial about the man: despite the lack of formal university education, he filled two Chairs of Chemistry with distinction, and his publications include some seventy papers and a monograph.

Emil was the third and youngest son of Louis and Augustine Werner. His father, a portrait painter, had migrated from Strasbourg to Dublin, in 1856, where he set up a photographic studio. Louis, the eldest son, qualified in medicine at the University, and became eminent as an eye-surgeon and the author of a standard text-book on ophthalmology. Alfred, the second son, worked with his father. Emil's schooldays were spent in the Collège St. Martin, at Amiens. Then he returned to Dublin, and joined in the family business. At this point, fate intervened. The chance purchase of a book awoke in Emil an interest in chemistry. From the photographic reagents available, he prepared crystalline specimens of the blue and the red chrom-oxalates that are obtained when potassium dichromate is reduced by oxalic acid. These alleged "double-salts" puzzled him, because they gave none of the usual reactions for chromate or oxalate. In search of the answer, he took the decisive step in his career. He brought his mysterious trophies to the College, and sought an interview with the University Professor of Chemistry, James Emerson Reynolds, F.R.S. It must have been an odd encounter: the photo-

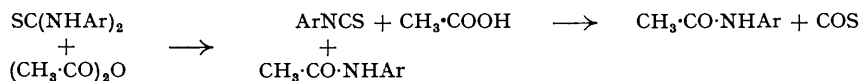
grapher's son, small, shy, but insistent; the future President of the Chemical Society, dignified and unsympathetic. Indeed, had young Werner known Reynolds beforehand, the interview might never have taken place. History repeated itself; David conquered Goliath, only in this instance it was a crystal and not a pebble that embarrassed the giant. Reynolds was unable to explain the conduct of the chromoxalates. The result of the meeting was as unexpected as the result of the tests. Werner was offered, and accepted, the specially created appointment of private assistant to Reynolds, and thus began a partnership that lasted for sixteen years.

As Werner had no college status, and his taskmaster allowed him no facilities for independent work, he was compelled to continue his investigations at home, where his bench was the bedroom window-sill. From this domestic laboratory came the first of his papers, published in *The Chemical News*, in 1886, and entitled: "The detection and estimation of thallium in lead." It was followed by a description of two tests for the recognition of impurities in ether. These were accepted by "The British Pharmacopœa," and were retained in six subsequent editions, until 1932, by which time Werner had introduced his method for the purification of ether by means of silver hydroxide.

He was by now permitted to work by himself in Reynolds's laboratory, and on February 18th, 1888, he was elected a Fellow of the Chemical Society. In his earliest papers, published in this *Journal* (1887, 1888), Werner showed that the blue chromoxalate, discovered by Gregory, in 1817, is the salt $K_6Cr_2(C_2O_4)_6 \cdot 6H_2O$, a derivative of the acid $H_6Cr_2(C_2O_4)_6$, from which he prepared a series of other salts. The red chromoxalates, discovered by Crofts, in 1842, were shown to be derived from the acid $H_4Cr_2(C_2O_4)_4(OH)_2$. Werner later described a series of compounds in which the oxalate radicle was replaced by malonate (1904).

Thiourea.—Work in the laboratory at this time centred on the properties of the substituted thioureas, a number of which had been prepared by Reynolds. One of Werner's earliest tasks was the study of their reactions with acetic anhydride.

In his first papers on thioureas (1891), he showed that the *s*-diarylthioureas readily yielded *N*-arylacetamides and carbon oxysulphide, in accordance with the equation:

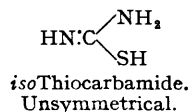
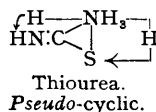
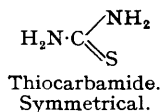


The *s*-dialkylthioureas, when acted on by acetic anhydride, yield the monoacetyl derivatives, which on further heating react with acetic acid to form alkyl *isothiocyanates*, alkylamines, and regenerated acetic anhydride. A subsequent paper (1891) described the reaction between acetic acid and phenyl *isothiocyanate*. The contradictory results of earlier workers Werner showed to be due to variations in the experimental conditions. When glacial acetic acid alone is used as solvent, the end-products are acetanilide and carbon oxysulphide; when acetic acid containing 10% of water is used, the products are diphenylurea, hydrogen sulphide, and carbon dioxide. Among many other compounds prepared and studied were the formaldehyde-thiourea polymers. At that time, chemists were not plastic-conscious, and the industrial applications of these strangely refractory materials was unsuspected. A relevant comment in Werner's note-book runs: "Insoluble in everything, might be of some use for making tombstones!" Work on the desulphurisation of thiourea by heavy metals, and on the reversal of the silver photographic image, had practical results. On the outbreak of the Transvaal War, in 1889, Sir Howard Grubb, expert on optical instruments, sought the aid of Reynolds in the construction of a gun-sight that would simultaneously reflect and transmit light in a specified ratio. By means of thiourea, it was found possible to coat glass with mirrors of lead sulphide of the required degree of transparency.

In 1903, Werner and Reynolds reported that thiourea in acid solution could be determined accurately by titration with iodine, even in presence of an excess of ammonium thiocyanate. This method was applied to a re-investigation of the mechanism of the synthesis of thiourea, first described by Reynolds in 1868. As a result, it was found that, at 170°, a maximum yield of 24.8% of thiourea is obtained from ammonium thiocyanate after 45 minutes, whereas, at 182°, the same equilibrium value is reached in 30 minutes. The mixture, at equilibrium, contains the complex $\text{SC}(\text{NH}_2)_2 \cdot (\text{NH}_4\text{SCN})_3$, which melts at 105–106°, the eutectic point of the system. Thiourea characteristically forms compounds of the type $(\text{SCN}_2\text{H}_4)_4 \cdot \text{MX}$ with the halogen salts of alkali metals, ammonia, and primary amines (Reynolds, 1891; Werner, 1906; Atkins and Werner, 1912). Many attempts were made to increase the yield of thiourea from

ammonium thiocyanate by incorporating a salt in the melt, so as to trap the thiourea. None of these methods proved of value, but the work culminated in an important paper by Atkins and Werner (1912) on the dynamic isomerism of the system, in which they showed that the reversion of thiourea begins about 135°; the complex $(\text{SCN}_2\text{H}_4)_3, \text{NH}_4\text{SCN}$ accumulates in the liquid phase below 140°; and the change in both directions is unimolecular.

The Structure of Thiourea.—In 1890, Storch had shown that the oxidative dehydrogenation of thiourea in acid solution yields the base, formamidine disulphide, $\text{H}_2\text{N}\cdot\text{C}(\text{:NH})\cdot\text{S}\cdot\text{S}\cdot\text{C}(\text{:NH})\cdot\text{NH}_2$, which provides direct evidence for the *isothiocarbamide* structure for thiourea. Reynolds accepted this conclusion, and, in 1891, he suggested that the term "thiourea" should be used to denote the free compound, and the term "thiocarbamide" should be used for the system $\text{H}_2\text{N}\cdot\text{CS}\cdot\text{NH}_2$, which only existed in substituted form. There were, however, as Werner seems to have been the first to realise, several objections to the *isothiocarbamide* formulation for thiourea. A compound of the type $\text{H}_2\text{N}\cdot\text{C}(\text{:NH})\cdot\text{SH}$ should be basic, because of its free amino-group, and unstable, because of the presence of an amino- and a thiol group on the same carbon atom. In aqueous solution thiourea is almost neutral, and does not readily resolve into ammonia and thiocyanic acid. Also, as Werner showed later, the production of formamidine disulphide, by the oxidation of the thiourea by nitrous acid, only takes place in presence of strong acids, such as sulphuric or nitric, which would be expected to convert the thiourea into cationic form, $\text{HS}\cdot\text{C}(\text{:NH})\cdot\text{NH}_3^+$. Oxidation in presence of weak acids, such as acetic, only yields thiocyanic acid and ammonia. Werner sought to explain these observations by postulating the existence of a stable, *pseudo-cyclic* form, assumed by thiourea in neutral or faintly



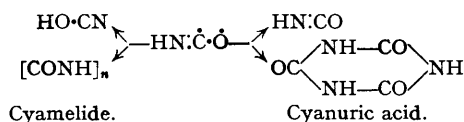
acid solutions. Reynolds did not encourage this hypothesis, and Werner put the work aside, until 1912, when he published it as part of an epilogue to his investigations on thiourea.

In 1903, Reynolds resigned from the University Chair, and retired into private life. He was succeeded by Sydney Young, F.R.S., of Bristol. By this time, Werner, at the age of 39, had established a high reputation as a teacher and a worker, and he would have been a favoured candidate for the Chair. With characteristic modesty, he refused to compete against one whom he regarded as the better man. Neither his merits nor his action were overlooked, and in the next year he was appointed Professor of Applied Chemistry. A period of departmental expansion and reorganisation followed. Young was essentially a physical chemist, and, in consequence, Werner became responsible for the entire teaching of the organic chemistry to all the classes. During these years he published little, apart from two papers on organic iodine compounds (1906, 1907), and an interesting paper on chloral hydrate (1906), in which he showed that one equivalent of alkali can decompose from one to four equivalents of chloral hydrate, according to conditions of concentration and temperature.

Urea.—Werner's interest in thiourea logically extended to urea, especially as regards its formation and decomposition. When heated above the melting point or in boiling aqueous solution, urea resolves into ammonia and cyanic acid, as might be expected were it *isocarbamide*, $\text{H}_2\text{N}\cdot\text{C}(\text{:NH})\cdot\text{OH}$. But at temperatures below 50°, urea in neutral solution is stable, provided that it is preserved from infection by urease-producing organisms—a precaution apt to be neglected. This observation supplied Werner with one of his favourite lecture demonstrations, in which he showed that aqueous urea solutions, kept under sterile conditions for more than ten years, gave no precipitate with silver nitrate or barium hydroxide. Thus he was led to postulate a stable, *pseudo-cyclic* structure for urea, which changed to the *isocarbamide* above a critical temperature or on addition of acid or alkali.

Werner married, in 1911, and, after a honeymoon in the United States, he settled down to a life of domestic comfort and happiness, and when, in the course of time, a son was born, his contentment was complete. Amid such pleasant distractions, his meditations on urea might have continued indefinitely, had he not been catalysed into activity by a paper on the mechanism of Wöhler's synthesis of urea, which Chattaway published in 1912. According to Chattaway, ammonium cyanate on heating dissociates into ammonia and cyanic acid, which recombines with the ammonia to form urea. The theory is straightforward and adequate, but, according to Werner (1913), it is over-simplified in that it does not take into account the

tautomeric change undergone by the cyanic acid, which can exist in the enol form, $\text{HO}\cdot\text{CN}$, and the keto-form, $\text{HN}\cdot\text{CO}$. From a study of the polymerisation of liquid cyanic acid, Werner concluded that rise in temperature promotes the keto-arrangement, while fall in temperature promotes the enolisation. Both forms are in equilibrium with an intermediate form, $\text{HN}\cdot\overset{\cdot}{\text{C}}\cdot\overset{\cdot}{\text{O}}$, or $\text{HN}\cdot\overset{\cdot}{\text{C}}\cdot\overset{\cdot}{\text{O}}^-$, which, during its rearrangement into $\text{HN}\cdot\text{CO}$, tends to polymerise to cyanuric acid, and, during its rearrangement into $\text{HO}\cdot\text{CN}$, tends to polymerise to cyamelide.



Ammonium cyanate is a salt of *enol*-cyanic acid, which is released on heating, and rearranges to *keto*-cyanic acid, which through its carbonyl group adds on to the ammonia to form *isocarbamide*. As the *enol*-cyanic acid accumulates, some of it reacts with the *isocarbamide* to produce biuret, and some of it is removed from the system by polymerisation. This paper and two subsequent ones on the decomposition of urea by heat (1913, ii) and the formation of biuret by the action of cyanic acid on urea (1914) were the first of a series of seventeen on urea, published during the following ten years. The more important of these contributions can be summarised briefly.

I. By use of methyl sulphate as a methylating agent, the corresponding *isocarbamides*, $\text{RN}\cdot\overset{\cdot}{\text{C}}(\text{O}\cdot\text{CH}_3)\cdot\text{NH}_2$ can be obtained directly from urea and its homologues. This affords evidence that urea can assume the *isocarbamide* configuration (1914).

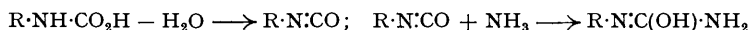
IV. In aqueous solution, urea and pure nitrous acid will not interact unless a strong acid is present to expose the vulnerable amino-group. Under such conditions, urea is resolved into ammonia, which is attacked by the nitrous acid, and into cyanic acid, which is hydrolysed. Hence, one molecular proportion of nitrous acid can decompose completely one molecule of urea in presence of *n*-hydrochloric acid. This affords evidence that neutral urea is not in the *isocarbamide* configuration (1917).

V. Hydrolysis of urea by acids or alkalis involves the liberation of cyanate as an obligatory intermediate reactant (1918).

A group of papers on the mechanism of the synthesis of urea from urethane (1918), carbonyl chloride and ammonia (1918), oxamide (1918), and ammonium carbamate (1920) gave evidence that all these reactions are variants of Wöhler's original synthesis in that they involve the formation of ammonium cyanate.

IX and X. Diazomethane, diazoethane, diazo-*n*-butane, and diazo*isopentane* were prepared by the action of nitrous acid on the corresponding substituted urea. Diazomethane can be used in ethanol solutions to effect the methylation of certain hydroxy-compounds. Under these conditions, urea is not methylated, which indicates that it is not in the *isocarbamide* form (1919).

XI. Only carbamic acid or monosubstituted carbamates yield urea on being heated with ammonia; the reaction requires the intermediate formation of cyanate:



Disubstituted carbamic acids of the type $\text{NRR}'\cdot\text{CO}_2\text{H}$, which cannot be dehydrated to cyanates, do not give rise to urea (1920).

While the earlier part of this work was in progress, Werner became engaged in special research problems arising out of war-time requirements. These included methods for the large-scale preparation of cyanamide (1916), methylamine, ethylamine, diethylamine (1917, 1918), and α -naphtholphthalein (1918). He also set up a laboratory plant for dyeing woollen garments made by local war-work committees. The Irish Rising of 1916, and the "bad times" of 1920—21, imposed pain and anxiety. Held by ties of affection to the Country that had adopted his parents and supported his family, held by ties of loyalty to a Commonwealth that for him denoted freedom and justice, Werner withdrew into himself, and took no part in any political activity. He had strong views, but his powers of control were stronger.

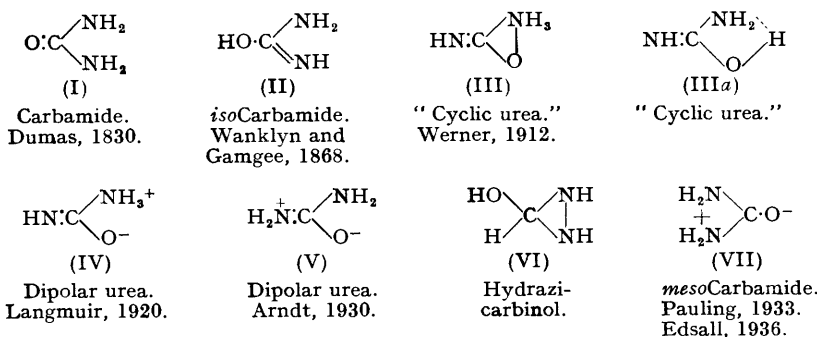
The Structure of Urea.—

"It is certainly instructive and not necessarily humiliating to realise that the molecular structure of a substance already synthesised one hundred years ago, a substance with a

molecular weight of no more than 60, is yet a matter for debate. It is not surprising. A molecule of such biochemical prominence is likely to assume during its complex metabolic career just as many forms as with due regard to the decencies of valence it can assume."

F. Gowland Hopkins, 1928.

Since so much of Werner's work was devoted to the structure of urea, it is relevant to set forth the various forms that urea can assume, "with due regard to the decencies of valency."



When Werner introduced the cyclic formulæ for thiourea and urea, the convention for denoting polar states by means of electric-charge signs had not come into general use, and he employed the ring structure commonly ascribed to "inner salts." This led to confusion, shared by Werner and his critics, for it made one of the nitrogen atoms appear to be quinquevalent, which had never been his intention. Langmuir was the first to point out that Werner's cyclic structure (III) is equivalent to the dipolar structure (IV), and he concluded: "Since in this case the oxygen and the nitrogen cannot hold a pair of electrons in common, it seems desirable not to connect them by a valency bond in the formula" (1920). The alternative dipolar structure (V), however, is preferable, if one assumes that urea does exist in dipolar form (Taylor and Baker, 1937). Werner never became reconciled to a dipolar urea. Such a compound, by analogy with the α -amino-acids, should exhibit a wide buffering range in aqueous solution, which urea does not, and should be deaminated readily by nitrous acid in absence of strong acids. Alternative formulations, suggested by the present writer, were (IIIa), a cyclic structure involving a hydrogen bond, and (VI), a hydraziccarbinol system; but these did not meet with Werner's approval. No single formula could be devised that would adequately represent the configuration of the urea molecule. In his own way, slowly and laboriously, Werner was approaching the modern concept of resonance stability, according to which urea is a hybrid, a *meso*carbamide, in which the positive charge alternates between the two nitrogen atoms. "I think we should be grateful to Professor Werner for the 'ring' and 'open' formulæ for urea," wrote Sir Frederick Gowland Hopkins. "Anyhow, it is significant that a century after Wöhler's synthesis we are still discussing the matter."

Werner's approach to the problems of the biological origin and enzyme decomposition of urea were prejudiced by his conviction that cyanate is an obligatory intermediate in the reactions. A considerable amount of time was spent in a vain search for cyanate in animal and plant tissues, for which purpose a specific and delicate test was devised. In 1923, Mack and Villars had claimed that cyanate can be isolated from solutions of urea undergoing zymolysis by soya-bean urease. The experiments were repeated, under Werner's direction, with apparent success, but, eventually, it was found that the enzyme preparations were contaminated with labile carbamide or guanidine derivatives that were decomposed by the ammonia liberated during the zymolysis, and vitiated the cyanate test. During this work, Werner examined a variety of seeds and plant tissues, and showed that the root nodules of leguminosæ were rich in urease.

In 1923, Werner published his monograph, "The Chemistry of Urea." Although well-arranged and clearly written, it was somewhat of a disappointment to his friends, as it represented less than half of the book that he could and should have produced. Too much space was devoted to the details of the experimental work, and almost no account was given of the extensive research on the substituted ureas, thioureas, and guanidines. Werner, himself, was not satisfied with the monograph, and he allowed it to go out of print.

The International Congress of Physiology, held in Edinburgh, in 1923, gave Werner an opportunity to bring forward his work on urea. At the Congress he met for the first time Kossel, Van Slyke, Gowland Hopkins, Barger, and other men capable of understanding and criticising his theories. But he became so interested in the communications and other activities of the meeting that he failed to do justice to his beloved "cyclic urea." The chemists, suspicious of what looked like quinquevalent nitrogen, refused to commit themselves; the biochemists were prepared to accept any formula that might account for the remarkable stability of urea in the animal body. Little came of the Congress, but a vague impression that Werner was trying to formulate urea in a new and unconventional code.

When Sydney Young retired in 1928, Werner, amid general approval, was called to the University Chair. He was now in his sixty-fourth year, a time of life when professorial burdens are discarded rather than assumed. Uncomplainingly, he laid aside for ever his research work, and took on the heavy and vexatious tasks of organising and supervising large classes. From his early training at the hands of a severe taskmaster, he had, in the words of Yeats, "plucked bitter wisdom that enriched his blood," and he gave of his substance freely and gladly to all who were his pupils. He had hoped to be able to retire on reaching his seventy-fifth year, but the outbreak of the Second World War, in 1939, made it necessary for him to remain in office. Eventually, in 1946, he was able to entrust the welfare of his Department to a worthy successor, Dr. Wesley Cocker, the present occupant of the Chair.

A man of middle height and strong physique, with dark hair, and lively, hazel-brown eyes, Emil Werner resembled in appearance his famous cousin, Alfred Werner, of Zurich. It was unfortunate that the two men were not personally acquainted. Emil's diffidence kept him from making a first approach; had he done so, the chemistry of urea might have progressed on a straighter road.

Although most friendly and companionable, Werner was temperamentally a solitary worker. He had associated with few collaborators, but they were of the best: W. R. G. Atkins, F.R.S.; J. Krall, sometime Professor of Chemistry in Agra College; K. C. Bailey, late Fellow and Registrar of Trinity College. Werner's long life brought an abundant harvest of memories that were golden in many ways, for they recorded the age of a Golden Jubilee and a golden sovereign; an age of high bicycles and horse-drawn tramcars; gas-lit theatres and rowdy music-halls; the laboratory in which Reynolds worked in a frock-coat, using apparatus of Waterford glass that had been handled by Humphrey Davy.

To those who were close to him, Werner was more than a professor; at times he seemed to embody the spirit of chemistry itself, as a force, a discipline, and an inspiration, "seeking beneath the common thing the hidden grace." He asked little of life, and none of the bright prizes of the scientific world came his way. But he had better rewards: the satisfaction of honest work well done, the unbroken happiness of his home, the peace of a contented mind; and when Death at last overtook him, she came in the guise of her gentle sister, Sleep.

W. R. FEARON.
