OBITUARY NOTICES.

FREDERICK DANIEL CHATTAWAY.

1861—1944.

FREDERICK DANIEL CHATTAWAY passed away peacefully at a Nursing Home in Torquay on January 27th in his 84th year.

He was the eldest child of Daniel Clarke Chattaway, a ribbon manufacturer in Coventry, Warwickshire, and the collapse of this industry in 1870 caused the family considerable financial strain. Chattaway's career as a student was more varied than that of most chemists and throughout he supported himself by means of scholarships. His first scientific training was at the Mason College, Birmingham, where he worked under Professor W. A. Tilden; he subsequently spent two years at the Univeristy College of Wales, Aberystwyth, and then proceeded to Christ Church, Oxford, where he studied under A. G. Vernon Harcourt and at the end of three years went to Munich to work under Adolf v. Baeyer and E. Bamberger. In the course of his career he took the B.Sc. degree of the University of London in 1890 with first class honours in Chemistry, the B.A. degree at Oxford in 1891 with 1st class honours, the Ph.D. degree, Munich, in 1893, " Summa cum laude," and in the same year the D.Sc. degree of London.

He was elected a Fellow of the Chemical Society in 1894, subsequently served on the Council for several years and between 1894 and 1936 published some 150 papers in the *Journal*. He was elected a Fellow of the Royal Institute of Chemistry in 1899, served for 5 separate periods on the Council and for 2 periods as a Vice-President, and finally he obtained the Fellowship of the Royal Society in 1907.

His academic appointments were only two, *viz.*, St. Bartholomew's Medical School, London, and The Queen's College, Oxford. In 1893 he became a demonstrator under Dr. W. J. Russell at the Medical School and was appointed Head of the Chemical Department on Dr. Russell's retirement. He resigned this post in 1905, as he wished for wider opportunities for research. In 1907 he became an assistant to Dr. Cronshaw at The Queen's College, Oxford, and succeeded him in 1910. He was elected a Fellow and subsequently Tutor and Praelector in Chemistry. He continued teaching in Oxford to 1935 but remained a Supernumerary Fellow of Queen's until his death. During all these years at Oxford he devoted all his spare time to research work and trained many students in the methods of organic research.

The period between his London and Oxford appointments was spent on the continent in the study of Physical Chemistry, first with Bredig at Heidelberg and subsequently with Ernst Cohen at Utrecht.

Chattaway was a true " organic chemist " and practically all his research work was in this field, investigating the reactions between different types of compounds, isolating new products and elucidating their structure both by analysis and by synthesis.

As a teacher and researcher he was characterised by industry and enthusiasm and both of these he was capable of transmitting to his students. For many years he gave up much time to examination work, but this was not from choice but as a means of assisting his financial resources.

Chattaway's introduction to research was made at Munich, where he worked with Eugen Bamberger on the structure of some of the more complex hydrocarbons of coal-tar. The results of this work were published in some eight papers dealing with the structure of picene, chrysene, phenylnaphthalenes, dinaphthyls and diphenylbenzenes.

In London he took up the study of " nitrogen iodide," largely with K. J. P. Orton, and after proving the structure $H_3N{:}NI_3$ studied the action of water, acids, alkalis, reducing and oxidising agents on the compound, the results being published in the *American Chemical Journal*. This work was followed by a study of *N*-halogenated acylanilides of the type, $C_6H_5{\cdot}NCl{\cdot}COR$, also with Orton, and with the wandering of the halogen into the benzene ring. The conclusion was drawn that the migration of the chlorine under the influence of acids is intra- and not inter-molecular, free chlorine being formed which then attacks the anilide ring in the *o*- or *p*-position. The liberation of chlorine by the action of hydrochloric acid on an *N*-chloroacylanilide was subsequently shown to be an extremely useful method for the regulated chlorination of compounds too sensitive to the usual methods. The work on *N*-chloro-compounds was extended to the preparation of arylsulphonamide derivatives of the types $C_6H_5{\cdot}SO_2{\cdot}NCl_2$ and $C_6H_5{\cdot}SO_2{\cdot}NMeCl$, and members of this group which have subsequently found great use in surgery for treatment of infected wounds are chloramine-T, $CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NClNa,3H_2O$, and dichloramine-T, $CH_3{\cdot}C_6H_4{\cdot}SO_2{\cdot}NCl_2$. Nitrogen chlorides derived from aliphatic diamines, *viz.*, $NCl_2{\cdot}[CH_2]_n{\cdot}NCl_2$ and $NClAc{\cdot}[CH_2]_n{\cdot}NClAc$, and also *N*-halogenated derivatives of carbamide and other diamides, including phenylcarbamide, oxamide, malonanilide and malonanilic acid, were also prepared and a simple method for the synthesis of *p*-urazine, $CO\langle^{NH{\cdot}NH}_{NH{\cdot}NH}\rangle CO$, from *s*-dichlorocarbamide and ammonia devised.

Several papers on isomeric hydrazides and on perhalides of quaternary ammonium salts, *e.g.*, NR_4X_3, NR_4X_5, NR_4X_7 and NR_4X_9, followed together with papers on perhalides of alkaloids.

A characteristic feature of Chattaway's work was the zest with which he undertook the study of a common chemical reaction and as the result of careful observation threw new light on its mechanism or isolated products which had previously not been noted. Among such studies may be mentioned : (1) The conversion of ammon-

ium cyanate into carbamide, (2) the interaction of glycerol and oxalic acid, (3) the oxidation of sucrose by nitric acid, (4) preparation of tetranitromethane, (5) the chlorination of ethyl alcohol, leading to a study of alkyl hypochlorites of which the tetra-alkyl compounds are comparatively stable, (6) study of nitro-derivatives of benzil, (7) compounds of the thioparaldehyde type from chloral, (8) quantitative acetylation of phenols in aqueous solution with acetic anhydride, (9) the production of copper mirrors on glass, (10) action of ammonia on esters, where it is shown that, by introducing strongly kationoid centres into the alkyl group, *e.g.*, $CH_3{\cdot}CO{\cdot}O{\cdot}CH<^{CCl_3}_{CH_2{\cdot}NO_2}$, the carbon of the alkyl group becomes so electron-attracting that it and not the carbon of the carbonyl group is attacked by ammonia, yielding acetic acid and $\gamma\gamma\gamma$-trichloro-α nitro-β-amino-propane, $CCl_3{\cdot}CH(NH_2){\cdot}CH_2{\cdot}NO_2$.

In 1902 he published several papers on the action of halogens on arylazoacetates and related compounds. By diazotising tribromoaniline and coupling the product with ethyl acetoacetate, he obtained ethyl 2 : 4 : 6-tribromophenylazoacetoacetate, $C_6H_2Br_3{\cdot}NH{\cdot}N{:}CAc{\cdot}CO_2Et$. When brominated, this yields products which vary with the conditions. (*a*) In acetic acid solution in presence of water or anhydrous sodium acetate a quantitative yield of the bromo-compound, $C_6H_2Br_3{\cdot}NH{\cdot}N{:}CBr{\cdot}CO_2Et$, is formed by the elimination of an acetyl group; (*b*) in glacial acetic acid or chloroform substitution in the methyl group occurs and the product is $C_6H_2Br_3{\cdot}NH{\cdot}N{:}C(CO_2Et){\cdot}CO{\cdot}CH_2Br$ (I), which is also formed by condensing tribromobenzenediazonium chloride with γ-bromoacetoacetic ester. Further bromination yields the compound with the group $\cdot CO{\cdot}CHBr_2$ and finally, by elimination of the $\cdot CO_2Et$ group, the poduct $C_6H_2Br_3{\cdot}NH{\cdot}N{:}CBr{\cdot}CO{\cdot}CHBr_2$ is formed. The ω-bromine atom in (I) is reactive and readily replaced by NH_2, and the amino-compound so formed reacts with an alcoholic solution of potassium acetate, yielding a 4-hydroxypyrazolone derivative.

A good deal of Chattaway's latest work dealt with the study of the condensation products of chloral, bromal, dichloroacetaldehyde and butylchloral hydrate with phenols, amides, etc. Chloral itself unites with *p*-substituted phenols, the product being of the aldol type $NO_2{\cdot}C_6H_4{\cdot}O{\cdot}CH(OH){\cdot}CCl_3$. This product under the influence of sulphuric acid yields the isomeric phenol, $NO_2{\cdot}C_6H_3(OH){\cdot}CH(OH){\cdot}CCl_3$, which can unite with a second molecule of chloral, forming $NO_2{\cdot}C_6H_3{\cdot}[O{\cdot}CH(OH){\cdot}CCl_3]{\cdot}CH(OH){\cdot}CCl_3$ and by the elimination of water a derivative of 1 : 3-benzdioxan is formed, *viz.*, $NO_2{\cdot}C_6H_3<^{O\text{———}CH{\cdot}CCl_3}_{CH(CCl_3){\cdot}O}$. The presence of a substituent ortho to the OH groups in the phenol inhibits the formation of a dioxan compound. 1 : 3-Dioxan itself can be prepared by condensing *p*-nitrophenol with formaldehyde and removing the nitro-group from the condensation product.

Chloral unites with carbamide, yielding first $CCl_3{\cdot}CH(OH){\cdot}NH{\cdot}CO{\cdot}NH_2$ and finally $CO[NH{\cdot}CH(OH){\cdot}CCl_3]_2$; the second stage, however, does not occur with mono- or unsymmetrical dialkyl- or diaryl-ureas. Other diamides, *e.g.*, oxamide and malonamide, also unite with urea, but with malonanilic acid carbon dioxide is evolved. Chloral condenses with arylhydrazines. With phenylhydrazine the reaction is violent but with halogenated phenylhydrazines simple condensation occurs with the elimination of water and the formation of a hydrazone, which readily loses hydrogen chloride at the ordinary temperature, forming a red azo-compound : $C_6H_2Cl_3{\cdot}NH{\cdot}N{:}CH{\cdot}CCl_3 \longrightarrow C_6H_2Cl_3{\cdot}N{:}N{\cdot}CH{:}CCl_2$.

Chattaway also published several papers on the action of halogens on substituted benzaldehydephenylhydrazones. The halogen substitutes both in the nucleus of the hydrazine residue and also the hydrogen of the original $\cdot CHO$ group (ω-substitution). The ω-halogen is extremely reactive and is readily replaced by NH_2 or by $\cdot NH{\cdot}NH_2$. The ω-hydrazino-derivatives react with nitrous acid, yielding derivatives of 1 : 5-diphenyldihydropentazine cyclic compounds with five N-atoms in the ring, $HN<^{CPh{:}N}_{N=N}>NPh$.

Chattaway's influence in the laboratory is best expressed in the words of one of his old students, " Dr. Chattaway was a most stimulating and inspiring influence in the laboratory and filled us with enthusiasm for research. His own tireless energy at the bench and dogged perseverance when things did not go well was an example we shall never forget. Legend has it that the only occasions on which he showed the least signs of losing his temper were when he came across a student working in a slovenly way on a dirty bench. The reprimand invariably had the proper effect. His absorption in his laboratory work was such that, unless reminded, he was apt to forget an engagement or a lecture."

In the usually accepted meaning Chattaway had no hobbies, but apart from his work he had two absorbing passions. The one was for English literature and poetry and the other for the English countryside. His memory was such that after reading a poem twice his knowledge of it was complete. He himself was no mean poet and when a student at Christ Church was awarded the " Constance Naden " gold medal by the Council of the Mason College for a poem entitled " Persephone ". His love of rural England was shown by his annual two or three weeks tour with a friend—in the earlier days on foot, then on cycle and finally by car. He loved the old churches, old monuments and tombs, speculating on the characters of those commemorated. It was always a pleasure to him to engage in conversation with any countryman or woman and to obtain their views on many matters.

Another characteristic was his intense loyalty to institutions and friends. The former is shown by his life-long attachment to the University College, Aberystwyth, and the University of Wales. For very many years he was a member of the Council and of the Court of Governors of the College and also of the University and was a regular attendant at their meetings. He was a past president of the Aberystwyth Old Students'

Association and a past Warden of the Guild of Graduates of the University. His interest in and devotion to educational matters in Wales were such that a well-known Welsh leader once said " I believe Chattaway could have any post in Wales if he wanted it."

For many years he was a member of the Court of Governors of the University of Birmingham and took a keen interest in the work of the University.

To friends of his earlier days he remained intensely loyal. This is shown in his life-long friendships with John Humphrey Davies, afterwards Principal of the Aberystwyth College, and W. H. Lewis, for many years Professor of Chemistry at the University College of the South West at Exeter. Both were fellow students of his at Aberystwyth and at Oxford. I first met Chattaway in 1891 when he was proceeding to Munich and I to Heidelberg. We made a short tour through Belgium and up the Rhine together and he stayed with me in Heidelberg for a few days before going on to Munich; I often met him afterwards in Aberystwyth, Oxford, and latterly in Torquay. Even in his latter days he was a stimulating conversationalist and as stated by one of his friends " In his prime he was brilliant in conversation and was prepared to argue on any topic and on any side, but always in such a whimsical manner that the debate never ran off on unfriendly lines."

In 1894 he married an old Aberystwyth student—Elizabeth Bettany, the second daughter of Thomas Bettany of Birmingham. His only son, who was a King's scholar at Eton and then a Scholar of Christ Church, Oxford, obtained a commission in the Cheshire Regiment in 1915 and was killed in action at Thiepval in 1916. This sad loss was felt by Chattaway for the rest of his life. His widow and only daughter survive him. The daughter, Dr. Margaret Chattaway, took her B.A. degree from St. Hugh's College and subsequently the Ph.D. degree. For some time she was demonstrator in Botany at the Royal Holloway College and then joined the School of Forestry, Oxford, as research botanist. She was awarded the " Elizabeth Sterling " Fellowship at Yale and on leaving there joined the F.A.N.Y.'s and is now a Junior Commander in the Army Education Department.

J. J. SUDBOROUGH.

GERALD TATTERSALL MOODY.

Born March 6th, 1864; died, October 23rd, 1943.

MOODY was born a Londoner and remained one, always residing in the Dulwich area. He chose Chemistry as a career at an early stage when the enlarged facilities for learning it were just coming into being. He was one of the first students of Henry E. Armstrong at Cowper Street, at Finsbury and at the Central Technical College at South Kensington, the Colleges founded by the City and Guilds Institute, and became in due course demonstrator, taking charge of the famous first year " heuristic " course. Later he followed F. S. Kipping as Lecturer. He was a valued member of the brilliant team, Wynne, Kipping, Pope, Lowry, Lapworth, Forster, associated with Armstrong.

Moody will be remembered by many for the part he played in the difficult task of expounding the heuristic method to the first year students, mainly engineers, at the Central Technical College, who did not always take kindly to the doctrine. By practically abolishing the use of textbooks and thereby compelling them to rely almost entirely on their own efforts, particularly in the laboratory work, a method of independence was developed which experience has shown to be of the greatest use in dealing with new problems of every description.

As a very young boy Moody became interested in chemistry through his maternal grandfather, then an old man, who in his earlier days had been associated with Owen in delivering lectures at the Bermondsey Mechanics Institute. In his middle teens, in 1880, he was one of the first students in the temporary laboratory roughly constructed in one of the attics of the Cowper Street School to which H. E. Armstrong and W. E. Ayrton had been apointed teachers pending the building of Finsbury Technical College, which was originally intended as a trade school, but on the advice of Armstrong, Ayrton and Robins was changed to a technical College, with day and evening classes.

Armstong took to young Moody and at once welcomed him into his family circle, encouraging his wider interests, and, finding that they had many tastes in common, took him on geological excursions. Moody was always a keen walker and went off for long walks with his dog in Kent on Saturdays. Later he always took his holidays high up in the mountains in Switzerland. He shared with Armstrong a love and an understanding of gardening and was a regular attendant at the Royal Horticultural Shows. Another interest common to both men was a love of music—he became a frequenter of the Opera.

Moody went on to Finsbury, attending both day and evening classes. When the new building—the Central Technical College at Kensington—was opened, Armstrong was appointed as Professor and Moody went there with him. As the students grew, for it must be noticed that the facilities were provided ahead of the students, novel methods of teaching were developed by each of the four professors—Unwin, Ayrton, Armstrong and Henrici—who became world famous.

His preoccupation with teaching gave Moody little time for research. He published 4 papers in our *Journal* and 11 in the *Proceedings*, one of the most important being on the mechanism of the rusting of iron, always a controversial subject. He gave a paper to the Geological Society on the cause of variegation in coloured rocks.

Moody first took an interest in finance in connection with his mother's capital. He applied his keen analytical mind to the study of investing as a science and finally abandoned teaching to spend his whole time

in the city. He became Chairman or Director of several Investment Trusts and other companies, some of which he led out of difficulties to prosperity. He was very successful and had a high reputation in the City, amassing a considerable fortune which he bequeathed to the Dyers' Company. Armstrong always took pride in Moody's success in Finance as proving the all-round value of the heuristic training.

Moody was exceptionally versatile and capable of great application. In addition to his London external degree of D.Sc., and we believe a degree in Music, he read for the bar and became a bencher of Grays Inn, being called to the Bar in 1910 when he was 46.

He took a considerable part in the affairs of London University, being a member of the Senate and of the Council for external students.

Moody had a long connection with the Worshipful Company of Dyers and was elected Prime Warden in 1936. Moody represented the Dyers' Company on the City and Guilds Institute and served on their various committees as well as on the Delegacy which manages the City and Guilds College. He represented them also on the Medal Committee of the Society of Dyers and Colourists, a connection which led to his election as President of this society in 1936.

He married Hester Sophia Dixon, one of a large family, whose brothers, Walter Dixon, F.R.S., the pharmacologist, and Vice-Admiral Sir Robert Bland Dixon, Chief Engineer to the Navy, both attained distinction.

Moody's early cynicism induced by contact with unruly students developed with advancing age, but he retained and cherished his friendship with many old chemical friends. He and his wife found great pleasure in giving hospitality both in their charming house and gardens on Sydenham Hill and in town.

E. F. ARMSTRONG.

GEORGE SENTER.

1874—1942.

THE passing of the late Principal of Birkbeck College will have aroused many thoughts of gratitude and regret in those who love the College. For nearly the whole of the period between the two great wars he directed its development, and its graduates all over the world will remember the inspiration, advice, and practical help he has given them. They will regret that his years of retirement have been all too few and have been darkened by another war.

George Senter was born on January 25th, 1874, at Kildrummy, Aberdeenshire. He was the son of a farmer in a corner of Scotland which escaped most of the troubles of the Stuart times and in which educational opportunities have long been available for all classes. Senter soon showed his quality and won the Bell Scholarship of the Pharmaceutical Society, which brought him to the Society's school in London, where he qualified as a pharmacist. His true love, however, was chemistry and he wooed her in the laboratories of Ramsay, at University College, London, and in those of Ostwald at Leipsig. There he made many lifelong friends amongst the enthusiastic group of students who were founding the new science of physical chemistry. His gifts as teacher, writer and administrator were quickly recognised on his return to London. His most famous book, " Outlines of Physical Chemistry," was first published in 1909 and has run through seventeen editions. This book has inspired generations of students throughout the world and its clarity and common-sense attitude have been greatly valued. In 1912 the title of Reader was conferred on him and in the same year he was elected a member of the Senate of London University. In 1914 he was appointed Head of the Chemistry Department of Birkbeck College. It is an interesting sidelight on the views held thirty years ago that this appointment required him to resign from the Senate. In 1918 he became Principal of the College and thereafter the story of his life is one of outstanding service to the College and the University.

His first task as Principal was to revive the life of the College after the damage caused by the first world war. This was made more difficult by the large influx of students who crowded both day and evening classes. The writer well remembers the problems which arose in 1919 to 1921 with accommodation packed beyond capacity and the staff all too few and often inexperienced. Yet students, staff, and Principal were full of enthusiasm and these hectic years are a happy memory. During this period two important events occurred which were largely due to the efforts of the Principal. The sports ground at Greenford was acquired in 1919 and in 1921 the College was recognised as a School of the University. This recognition was for five years in the first place : it was renewed in 1925 and finally was granted without time limit in 1932. The report of the University inspectors which led to this decision summarised the progress of the College in the following words, " The College has expanded quickly in many directions and fulfils with increasing efficiency its original aim, namely, that of providing culture and instruction in the evening for students who are otherwise occupied in the daytime and who seek the degrees of the University. We believe that in this aim and achievement Birkbeck College is unique in the British Isles."

Two features of the progress of the College in the twenties and early thirties may be mentioned, since they were particularly encouraged and fostered by the Principal. The first was the development of a corporate student life which presented many difficulties in an evening College. Senter took a special interest in the activities of the Students' Union and was regularly to be found at the sports ground at Greenford not only on the high days of special athletic events but also on the pleasant informal occasions of the ordinary week-end activities. The other feature of College life on which Senter laid special stress was the development of postgraduate

work. The success of this is shown by the fact that from 1931 until the outbreak of the present war about 180 postgraduate students registered each session. They were divided almost equally between the Faculties of Arts and Science.

As a physical chemist Senter made a number of important contributions to the science, and though he was Principal of Birkbeck College he for many years remained Head of the chemistry department and directed the work of a group of research students. His earlier work was concerned with the development of biological applications of the new science of physical chemistry and included some work on enzyme reactions. His major work was, however, the application of methods of chemical kinetics in the problem of the Walden inversion. This was pioneering work undertaken at a time when little was known about the complexity of such reactions. In a series of papers published in the *Journal* of the Chemical Society between 1914 and 1925 Senter and his students shed a good deal of light on the problem of replacement reactions in solution. After 1925 his duties as Principal compelled him to give less and less time to this work. More recently Ingold and his collaborators have made important advances in this field and have paid tribute to the valuable work which came from Senter's laboratory. Senter's contributions to the Faraday Society's discussions must also be mentioned; in particular his introductory paper to the discussion on " Passivity " is a model of clearness as well as a summary of valuable information. Of his other publications his " Outlines of Physical Chemistry " has already been mentioned; his " Textbook of Inorganic Chemistry " has also been of great help to students. Both books are characterised by extreme clearness of expression and a common-sense attitude towards theory which are especially helpful to beginners.

It would be tedious to recite all the University appointments which Senter held. Suffice it to say that he served on the Senate from 1912 to 1914, 1922 to 1923 and from 1928 to 1939. The last period he was ex-officio a member of the Senate in virtue of his position as Principal of the College. This brought Birkbeck into line with other large colleges whose heads are automatically Senators. In 1934 to 1935 he was Deputy Vice-chancellor. He served on many committees and boards; of these chemists will remember his helpfulness on the Board of Studies in Chemistry, of which he was Chairman for thirteen years.

S. SUGDEN.