OBITUARY NOTICES.

JOHN KEITH ROBERTS.

1897—1944.

JOHN KEITH ROBERTS, only son of H. C. Roberts of Melbourne, Australia, entered Melbourne University with a particular interest in Chemistry. Mainly owing to the inspiration of Professor T. S. Laby he was attracted to the study of Physics. Roberts had a distinguished academic record at Melbourne, becoming Professor Laby's first research student and eventually Demonstrator in Physics. He came to England with the aid of an 1851 Studentship to work under Lord Rutherford at the Cavendish Laboratory and as a member of Trinity College. Here he was engaged on the determination of the mechanical equivalent of heat, gaining the Ph.D. degree in 1923.

In 1922 he joined the scientific staff of the National Physical Laboratory and became a member of the Heat Department, being promoted to Scientific Officer a year later. His work on the thermal conductivity and thermal expansion of crystals of metallic bismuth which was published in the *Proceedings* of the Royal Society led him to investigate the mechanism of heat transfer across liquid metal interfaces. During this investigation in 1924 he developed what was at first thought to be simple arthritis in his hip, but this turned out to be tubercular trouble. He was sent to a clinic in Switzerland, where he had to remain nearly four years. During this period, spent mainly in bed, he took the opportunity of writing his text book on "Heat and Thermodynamics" (now in its third edition), which is one of the standard works on the subject.

He returned to England in 1928 as a Mosely Research Student of the Royal Society and continued to work on problems connected with heat. He became interested in the operation of the Pirani gauge and published during the five years as a Mosely Student, three papers on the exchange of energy between gas atoms and solid surfaces.

In 1933 Roberts was appointed Assistant Director of Research in the Colloid Science Laboratory, Cambridge. He was engaged for nearly six years, until the outbreak of war, in exploring the conditions of formation and the stability of monolayers of gases found on metallic wires. He developed two powerful methods of attack. In the first he showed how the change in accommodation coefficient of the rare gases could be used to examine the formation of monolayers of adsorbable gases. The other consisted in utilising the wire, necessarily a thin one, on which gas adsorption took place as one arm of a Wheatstone Bridge, the heat of adsorption causing a measurable change in the resistance of the wire. A number of papers testify to the great skill displayed in the experimental work and the thoroughness with which the theoretical avenues were explored.

At the outbreak of war Roberts went as Senior Scientific Officer to a Naval Research Establishment on the Clyde and subsequently to one on the Forth, where he was in charge of all the scientific work. Here he was eminently successful and proved himself to have a flair for organisation. In 1942 he was appointed to the very important post of Chief Scientist at the Anti-Submarine Establishment at Fairlie. At this critical moment in the Battle of the Atlantic this was a position of the highest responsibility. New and better detecting equipment was urgently needed, and the Establishment had to be completely reorganised, and new methods introduced in the shortest possible time. By his firm and original handling of this enormous task Roberts achieved one of the most striking successes of the war.

In the autumn of 1943 Roberts was chosen to lead a small party of naval scientists to the United States. He thoroughly enjoyed this and felt quite correctly that the visit had been a great success.

After his return from America in November, 1943, he felt he had still much to do in the Navy, but he was looking forward eagerly to his return to Cambridge, where he had been elected a Fellow of Christ's College, and hoped to direct the Mond Cryogenic Laboratory, a post for which he was eminently suited.

In 1924 he had married the elder daughter of H. W. Sanderson. He was supremely happy in his home, and devoted to his two young daughters, the elder of whom was born in 1932. His own research had always been his great and absorbing interest, but he was deeply interested too in music, and had played the violin since he was a boy, and music had given him the keenest pleasure all through his life. He enjoyed speaking in public, and was an attractive lecturer, clear, concise, and always interesting.

The work at Fairlie was extremely arduous and exacting and it put a continuous drain upon his vitality. In March of this year he developed an acute gland infection complicated by pneumonia and from this he never recovered.

By his death in April the Navy lost a vigorous and wise Scientific Officer, his Laboratory at Cambridge a brilliant, reliable and kindly colleague, and the world a man of outstanding character who was rapidly establishing himself as a leading authority on molecular adsorption.

ERIC K. RIDEAL.

HENRY JULIUS SALOMON SAND.

1873—1944.

DR. H. J. S. SAND, who died at Nottingham on October 18th, 1944, after a short illness, was born in Dundee on December 7th, 1873. He attended the High School of that City, continued his scientific studies at the Realgymnasium in Dresden, and, after a short period at the Dresden Polytechnic, where Hempel was one of his teachers in Chemistry, proceeded to Zurich and there carried out research under Bamberger at the eidgenöss Polytechnicum, where he was awarded the degree of Ph.D. Part of this work was published conjointly with Bamberger and Büsdorf under the title " Uber die Einwirkung concentrierter Schwefelsäure auf Nitrosoalphyle " (*Ber.*, 1898, **31**, 1513), this being Sand's first scientific publication. In the same year he became a Fellow of the Chemical Society.

He then worked for a short period with Ramsay at University College, London, and from 1899 to 1901 he was a Bowen Research Scholar at Mason College—now the University—Birmingham, working under Professor Percy Frankland, during which time he began the long series of researches in electrochemistry upon which his high reputation as a chemist is largely based.

From 1901—1914, Sand was Lecturer and Demonstrator at University College, Nottingham, on the staff of Professor Kipping, and in 1905 received the degree of D.Sc. from the University of Birmingham.

In 1914 he became Senior Lecturer in Chemistry at the Sir John Cass Technical Institute and from 1921 until 1938, when he retired, he was Head of the Department of Inorganic and Physical Chemistry, becoming a Fellow of the Institute of Chemistry in 1920.

Sand published his scientific investigations in forty-six papers between 1898 and 1944 and in addition published his " Electrochemistry and Electrochemical Analysis " in three volumes between 1939 and 1941, this work summarising the state of knowledge of the subject from both the theoretical and the practical aspect.

Although Sand will chiefly be remembered for his publications concerning electrochemistry and electrochemical analysis, he also published a number of papers on other scientific subjects, including thermodynamics, diffusion, hydration of ions, strong electrolytes, metal hydrides, and the interaction of potassium tetroxide with ice and with dilute sulphuric acid.

His work on electrolytic analysis revolutionised this subject and provided methods which were accurate and rapid, thus contributing to the growing popularity and importance of these methods of analysis not only in academic work but also in industrial control processes and research. Sand devised many useful and ingenious pieces of apparatus, some of which are notable in that they can be constructed mainly from materials found in all laboratories, thus illustrating that important research can still be carried out without the use of expensive and elaborate apparatus. In this connection his papers " New Apparatus for Electrolytic Analysis " (*Analyst*, 1929, **54**, 275) and " The Separation of Metals by Internal Electrolysis " (*ibid.*, 1930, **55**, 309) are of particular interest.

During the latter part of his long period at the Sir John Cass Institute, Sand gathered around him a band of research students who carried out a number of investigations on electrometric methods of analysis, and many of these, as well as many of his former students and colleagues, will feel his loss very deeply, not only because of his scientific ability but also because of his great personal qualities. He was always very ready to help the young student and indeed anyone who required his assistance and advice. Those who knew him will remember his quiet humour and his modest and kindly personality. He was interested not only in scientific matters but in all public issues, although he took no prominent part in public life.

He is survived by his widow and only son, who is now serving with the Army in Africa, to whom all his friends will desire to extend their sympathy.

JAMES G. FIFE.

JAMES NETHERWOOD SUGDEN.

1894—1944.

JAMES NETHERWOOD SUGDEN, born on March 27th, 1894, at Silsden, near Keighley, Yorkshire, was killed in London by a flying bomb on July 11th, 1944.

Left an orphan at an early age, he was brought up by a grandmother, who, being confined to the house in her latter years, relied on him to represent her at the principal ceremonial events in the neighbourhood, particularly at funerals of her contemporaries. To these early experiences may be attributed perhaps his somewhat grim sense of humour and his ability to face the gloomier transactions of life with apparent equanimity.

In 1905 he entered the Trade and Grammar School, Keighley, where his interest in chemistry was aroused by the teaching of an old student of the Royal College of Science, Harry Harper. From 1911 to 1913 he was a student at the Technical College, Huddersfield, whence he proceeded to the Royal College of Science as the first of a long line of Keighley Grammar School boys subsequently drawn to the laboratories at South Kensington. In 1914 he was awarded the Associateship of the Royal College of Science with First Class Honours in Chemistry, the Neil Arnott Studentship of the University of London, and a Royal Scholarship.

His work as a research student was soon diverted to problems related to the war; and in this connection he became, in effect, the personal scientific assistant to Professor H. Brereton Baker. Later he obtained a General Service Commission in the Army and was concerned with a variety of chemical investigations bearing on new developments in warfare. When the enemy introduced the use of " gas," he took part in some of the early trials with this new weapon. He was among those who, in the course of an experimental gas attack on Salisbury Plain, had collected air samples at various points by breaking the seals of a number of evacuated bulbs and were then ordered by a notably senior officer to take samples in a second trial by " opening the other ends " of the same bulbs; but he, probably more than anyone, appreciated the humorous side of this attempt by superior military authority to override the laws of nature. To him fell also certain unpopular tasks, such as the disposal of leaking cylinders of some of the more lethal experimental war gases; duties that he performed with characteristic aplomb.

His main contribution to the war effort, however, was in connexion with water supplies. Under the direction of Professor Baker and Colonel Horrocks of the Army Medical Service, he was largely responsible for the technical development of methods and equipment for countering possible enemy action in poisoning or infecting sources of drinking water and for purifying by chlorination water from rivers or canals that was otherwise unsafe for consumption by the troops. A number of plants designed for these purposes were mounted on lorries or on barges and despatched to France. The question of water supplies for the Mesopotamian Expeditionary Force called for special consideration in view of the high risks of waterborne disease in a country where the rivers were also the time-honoured depositories of garbage and sewage and where the temperature during a large part of the year was particularly favourable to the multiplication of micro-organisms. The problem was attacked energetically, and plants of considerable size were constructed for treating river water by sedimentation, alum injection, filtration (through moving sand filters), chlorination and dechlorination. Some were designed as stationary plants to be set up at suitable places on the banks of the rivers Tigris and Euphrates; others, mounted on barges, as mobile plants, to be towed up these great waterways as the army advanced. In the scientific development of this equipment and in the training of the necessary technical personnel, Sugden—then a subaltern (subsequently Captain) in the Inland Water Transport section of the Royal Engineers, attached to the War Office—played a leading part. He had the satisfaction of seeing over a dozen complete plants, valued at several hundred thousand pounds, shipped to Iraq in **1917**; and of going out to that country in **1918**, when he found most of them in efficient operation.

In October, **1919**, Sugden joined the teaching staff of the Royal College of Science (Imperial College of Science and Technology), where he remained for the rest of his life. He was promoted to Lecturer in **1922**, and to Senior Lecturer in **1943**. He was an excellent teacher. His lectures were models of clarity: he took much trouble in selecting his material and arranging it in a logical sequence, and had a happy knack of " putting it over " in a way which made it acceptable even to lesser intelligences. In the laboratory he caught and held the interest of students, and if his replies to their more ill-considered questions were apt to be disconcerting, they soon realised that his purpose was the worthy one of inducing them to do some thinking for themselves. Those who judged from his stooping figure and his features (so inspiring to the cartoonist) that they had found someone out of whom a rise might be taken, soon realised their mistake: the overt expression of his wrath could subdue; the exercise of his mordant wit could annihilate. From his desk in a corner of the " First Year " Laboratory he gazed dispassionately for a quarter of a century at successive generations of students, discounting routine enquiries by the display of a number of printed notices, but always ready to give personal advice when the situation warranted it. Students recognised him as a " character "—and bestowed their affection accordingly.

Never a robust man, his activities as a research worker were restricted by the need to harbour his energies. His most important investigation was on the hydration of salts in aqueous solution by a partition coefficient method. From a careful examination of a number of salts of the alkali and alkaline earth metals it appeared that for a given salt at a specified temperature the " hydration number " was practically constant up to " normal " concentration. Moreover, for a series of salts of two different metals (or of two different acids) there was a constant difference between the hydration numbers of corresponding salts; indicating that the hydration of a dissolved salt, like its equivalent conductance at infinite dilution, could be regarded as made up of two separate contributions, one characteristic of the cation, and the other of the anion. This additive relation was found to hold even for salts for which the apparent hydration numbers were negative (potassium nitrate and chlorate). In order to explain such negative values of hydration Sugden postulated that only cations are actually hydrated and that anions make negative contributions to the hydration number through a depolymerising effect on water. He showed also that there was a relation between the viscosities of salt solutions and the hydration numbers.

The results of this investigation (J., **1926**, **174**) were remarkably consistent and represent a contribution to our knowledge of aqueous electrolyte solutions the importance of which may not yet have been fully recognised. He was awarded the degree of Ph.D. in **1924** for a thesis embodying part of this work. He had planned to extend the investigation to the correlation of hydration with other properties of electrolyte solutions, but was obliged to abandon the programme because of eye strain. He made some interesting observations on phase reversals in emulsions, and devised a number of useful lecture experiments. As a practical worker he displayed much ingenuity and took pleasure in securing a maximum of simplicity and neatness in setting up apparatus. It is greatly to be regretted that recurrent periods of ill-health prevented him from continuing research work in his later years.

Sugden was an individualist. From his early youth he had been accustomed to fend for himself and to take full responsibility for his own affairs. He expected little from mankind, and was thus spared many possible disappointments. He deliberately limited the circle of his friends and the range of his interests, lest they should become a burden to him. From most organised groups of people he stood apart, and was the despair of those who sought his support for societies and clubs; but among a small group of his chosen friends he was happy, and his shrewd, dry humour would then find expression in conversation that often rose to brilliance. But for the most part he was a lonely man, and one who had learned to bear, if not to enjoy, a solitary life. His reference to a holiday in Touraine as having been spent " sitting under a banana tree reflecting on death, decay, and strong electrolytes," and his claim never to have been to a cinema, were largely figures of speech but nevertheless indicative of a real distaste for being caught up in a crowd.

He spoke French and German with some fluency and derived much quiet amusement from the exercise of his wit in these languages—to the delight of the wise and the discomfiture of the foolish. His individuality was much in evidence in the choice of his minor interests : he could speak with some authority on the seasonal variation in the exchange value of the French franc, on British silver coins issued since the reign of George I (of which he had a fine collection), and on the wines of Burgundy. To these diverse matters, as to his scientific work, he brought a characteristic acuteness of mind and a highly original outlook. In human affairs he showed an almost intuitive understanding of other people's views and feelings that enabled him to predict, often with uncanny accuracy, their actions under given conditions.

From the vast tapestry of life he selected for study a few particular areas. His artistry led him to choose neither the more highly coloured nor the more representational patches, but rather those that seemed somewhat dull and undistinguished. His genius enabled him to show that there was something unexpectedly interesting or bizarre in their structure or arrangement—a queer twist in the threads, an unsuspected knot, a peculiar relation of coloured strands—that threw a new light on the make-up of the whole gaudy pattern.

To him humans were nothing if not individuals. To those of us who held him in esteem and affection he was a very real and unusual person whom we remember as " J. N."

H. J. T. Ellingham.