

authors and their eminent leader have not given their careful attention to the X-ray evidence which has been so well described by Dr. Kathleen Lonsdale. This demands a nearly continuous spectrum of vibrational frequencies in the crystal quite contrary to Raman's theory. Krishnan, moreover, ignores the continuous background to the Raman spectrum of sodium chloride observed by Fermi and Rasetti⁸ and stresses only the lines which are superimposed on the background. The lattice theory developed by Born (*loc. cit.*, p. 309) provides an explanation of the X-ray results and also of the small number of lines in the Raman and absorption spectra of crystals. There does not, therefore, seem to be any necessity for introducing arbitrary assumptions into the dynamical theory in order to reduce the number of normal modes of vibration to a few discrete frequencies.

G. D. PRESTON.

¹ Einstein, *Ann. Phys.*, **22**, 180 (1907).

² Debye, *Ann. Phys.*, **39**, 789 (1912).

³ Born and v. Kármán, *Phys. Z.*, **13**, 297 (1912).

⁴ Lonsdale, Reports on Progress in Physics, **9**, 256 (1943).

⁵ Born, Reports on Progress in Physics, **9**, 294 (1943).

⁶ Raman and others, *Proc. Indian Acad. Sci. Bangalore*, 1-102 (1943).

⁷ Lederman, *Proc. Roy. Soc., A*, **182**, 362 (1944).

⁸ Fermi and Rasetti, *Z. Phys.*, **71**, 689 (1931).

OBITUARIES

Sir Joseph Arkwright, F.R.S.

JOSEPH ARTHUR ARKWRIGHT, an honorary member of the staff of the Lister Institute of Preventive Medicine and a former member of the Medical Research Council and of the Agricultural Research Council, died on November 22 after a short illness, a few weeks after the death of his friend and colleague, Sir John Ledingham. He was the son of the late Arthur William Arkwright, of Broughton Astley, Leicestershire, and was born on March 22, 1864. He was educated at Wellington College, and Trinity College, Cambridge, and pursued his medical studies at St. Bartholomew's Hospital, London, qualifying in 1889 and graduating M.D. in 1895.

Arkwright had a many-sided and distinguished career. After postgraduate work at St. Bartholomew's, the Victoria Hospital for Children, Chelsea, and the West London Hospital, he engaged for some years in general practice, chiefly at Hales Owen, Worcestershire; but in 1905 he renounced this work to join the staff of the Lister Institute, first as a voluntary research worker and from 1909 onwards as assistant bacteriologist. He retired from active duty in 1927, but continued to work at Chelsea as an honorary member of the staff. He was elected a member of the governing body of the Institute in 1932 as the representative of the Royal Society and served until January 1 of this year, when the Board recorded its high appreciation of the value of his wise counsel during the period of his service.

Arkwright's work at Chelsea was interrupted by the War of 1914-18 when, after investigating an epidemic of cerebro-spinal meningitis among troops encamped on Salisbury Plain in 1915 and recording his observations on the grouping of meningococcus strains that were isolated, he served in the R.A.M.C. with the rank of major as pathologist at St. George's Hospital, Malta, where with Dr. E. A. Lepper he investigated the occurrence of blackwater fever in the Eastern Mediterranean area. In 1918 he was appointed a member of the War Office Committee on

Trench Fever, and with his colleagues, Bacot and Duncan, demonstrated the constant association of the virus of trench fever with *Rickettsia quintana* in lice. In 1922 he accompanied Bacot to Egypt at the request of the Egyptian Government, to investigate the etiology of typhus fever. After two months work in Cairo, both contracted the disease, to which Bacot unfortunately succumbed; Arkwright recovered from a severe and hazardous illness. Previously, in 1920, he had carried out a series of investigations on foot-and-mouth disease under the auspices of a committee appointed by the Ministry of Agriculture and Fisheries and later became chairman of this committee, as also of the Agricultural Research Council's *Brucella abortus* Committee and the joint committee with the Medical Research Council on tuberculosis.

The subject, however, with which Arkwright's name will always be associated is that of bacterial variation, and his fundamental and luminous researches on the forms of bacteria that he named the "S" and "R" variants, embodied in an outstanding communication to the *Journal of Pathology and Bacteriology* in 1921, gave a new impetus to research in this direction. He was also deeply interested in the carrier problem, and his book, "The Carrier Problem in Disease", published in collaboration with the late Sir John Ledingham, was an important contribution to this subject. He also contributed freely to the Medical Research Council's "System of Bacteriology" and to numerous scientific journals.

Arkwright's active and versatile mind found many channels for its expression. He was appointed a member of the Medical Research Council in 1930 and of the Agricultural Research Council on its inception in 1931. His public-spirited and useful work in these directions only terminated in 1940, when in his seventy-sixth year he retired from the latter of these offices. He was made a fellow of the Royal College of Physicians in 1916 and served on the Council during 1929-31. He was elected a fellow of the Royal Society in 1926, and the honour of knighthood was bestowed on him in 1937 for his outstanding scientific achievements.

Arkwright had a charming personality and extended an ever-helping hand to the younger workers at the Lister Institute, to whom he was a source of encouragement and inspiration. Apart from his special studies he had a broad cultural and scientific background and was a field naturalist of no mean ability, possessing an exceptional knowledge of field botany and of horticulture, and a good working knowledge of other branches of natural science. He married in 1893 Ruth, daughter of the late Joseph W. Wilson, who, with their three daughters, survives him.

R. ST. JOHN-BROOKS.

Dr. G. A. Tomlinson

WE regret to record the death of Dr. George Arthur Tomlinson, a principal scientific officer at the National Physical Laboratory, on December 1, after a short illness.

Tomlinson was born on January 7, 1885, and educated at Nottingham High School, passing on to University College, Nottingham, where he took the degree of B.Sc. (London) in engineering, with first-class honours. He then spent two years as a research student at St. John's College, Cambridge, on post-graduate research. He also gained honours in electrical engineering in the City and Guilds (London) exam-

ination. On leaving Cambridge he worked for a time with Messrs. Kelvin and James White, of Glasgow, on researches relating to electrical and magnetic problems. Later he held, in turn, lectureships in electrical engineering at the Rutherford Technical College, Newcastle-on-Tyne, and at the Borough Polytechnic, London.

In 1915 Tomlinson was appointed to a post at the National Physical Laboratory, where he was first engaged, during the War of 1914-18, on the verification of gauges. From this he turned his attention to devising apparatus for the measurement of gears and gear-cutting hobs, then almost a new field, with which he continued to be closely associated for the rest of his life, developing further methods and instruments for checking the accuracy of gears of all sizes, and of the hobbing machines used in their production. In this subject he became a recognized expert whose advice was sought both by government departments and by private firms.

Among other matters Tomlinson also devoted himself successfully to the study of molecular cohesion in relation to surface phenomena such as pressure corrosion and friction. Following this, he became interested in the geometrical properties of surfaces, and devised the now well-known surface-finish recorder which bears his name, and which is an excellent example of his direct attack on a problem, and his faculty for attaining results by the simplest means.

An altogether different line of work was in connexion with the improvement of time-keepers. He spent much time on the development of a new type of vibration clock, and in experiments on new methods for driving free pendulum clocks. Incidentally to this work, he designed a new type of chronograph for the comparison of time-signals to an accuracy of 0.1 millisecond.

Tomlinson had a flair for instrument design which amounted to genius. More often than not he would make the first model of a new instrument with his own hands, using the material nearest to hand. But though these first models might have a somewhat gimcrack appearance they were always usable tools and, being usually designed to meet some immediate need, were often put into practical service for considerable periods before, as happened in many cases, their proved utility made it desirable to re-design them in a form suitable for commercial production.

Tomlinson—"Tommy" to his friends—had a charming and lovable personality. Modest and unassuming, he was always ready with advice and help for others, and a source of inspiration to those who worked with him. He was a rare combination of man of science and practical engineer, and his death is a national loss. He leaves a widow and two sons.

J. E. SEARS.

Dr. J. N. Sugden

DR. JAMES N. SUGDEN, senior lecturer in inorganic chemistry in the Imperial College of Science and Technology, who was killed by a flying bomb on July 11, 1944, was born at Silsden, near Keighley, on March 27, 1894. As a pupil of the Trade and Grammar School, Keighley, he came under the influence of a former student of chemistry in the Royal College of Science, Mr. Harry Harper, and after a period of study at the Technical College, Huddersfield, he proceeded to South Kensington in 1913.

Having graduated as an associate with first-class honours, and having been awarded the Neil Arnott Studentship and a Royal Scholarship, Sugden devoted himself to investigations which naturally soon became closely related to war problems. He received a commission in the Army, and under the direction of the late Prof. H. Brereton Baker he took part in some of the early scientific work which arose out of the enemy's use of poison gas. Later he was much concerned with the technical development of methods and equipment for ensuring an adequate supply of safe drinking water for troops dependent on contaminated supplies, particularly in France and in Mesopotamia. Under his immediate supervision, large mobile and static chlorination plants with their control laboratories were designed, tested, dispatched, and operated. Returning in 1919 from a prolonged visit to Iraq, he was appointed a demonstrator in chemistry at the Royal College of Science (Imperial College of Science and Technology); he was promoted to be a lecturer in 1922, and senior lecturer in 1943. There he quickly established a reputation as a most conscientious and efficient teacher.

Sugden's methods were often ingenious, and sometimes unorthodox; for he was an individualist whose acidulated epigrams were a tonic to the laggard, but whose meticulous care and patient instruction were an inspiration to every diligent student. Prolonged ill-health restricted the scope of his physical activity, but his mind seemed the more acute. His principal contribution to chemical knowledge concerned the hydration of salts in aqueous solution. This study yielded most interesting results; but he placed his teaching duties before all other attractions, and never regained the physical strength to pursue the inquiry.

Sugden was not an easy man to know. His bachelor life was lonely, and his friends, deliberately few, scattered by the march of time. He was interested in British silver coins, and liked to try his hand at the more erudite literary competitions in periodicals, especially those involving a foreign language. He was a judge of burgundy, and his efforts as an amateur photographer disclosed an artistic perception. While few could phrase a rebuke more mordantly, few enjoyed more gloomily the humour of life or more often delighted their acquaintances with gleanings among the unusual, the comic, or the profound. By his colleagues, as well as by many of the students to whom he ministered for twenty-five years, he will be remembered with affection and with the respect due to one who, having well considered, possessed the courage of his convictions.

A. A. ELDRIDGE.

Prof. B. B. Ray

PROF. B. B. RAY, Khaira professor of physics in the University of Calcutta, died on July 29, 1944. He was a fellow of the National Institute of Sciences of India; and presided over the Physics Section of the twenty-ninth session of the Indian Science Congress, held at Baroda in 1942. Prof. Ray joined the University of Calcutta in 1921 as a lecturer in physics and was one of the early batch of students who carried out research work in physics under Sir C. V. Raman.

Prof. Ray visited Europe twice, once in 1923 and again in 1935. During his first visit he worked at Uppsala in the laboratory of Prof. M. Siegbahn and at Copenhagen under Prof. Niels Bohr. It was in Prof. Siegbahn's laboratory that Prof. Ray learned