OBITUARY NOTICE.

JOHN EDWARD LENNARD-JONES.

1894—1954.

By the death of John Edward Lennard-Jones, on November 1st, 1954, the world has suffered the loss of an eminent theoretical chemist and an able administrator. Lennard-Jones was born on October 27th, 1894, and was educated at Manchester University and at Trinity College, Cambridge. On the outbreak of the first world war he became a pilot flying officer in the Royal Flying Corps and later served as experimental officer at the Armament Experimental Station, Orfordness.

In 1919 he returned as lecturer in mathematics to his old university of Manchester. From thence he migrated to Bristol University as Reader in Mathematical Physics and later, in 1925, was appointed as the first holder of the Chair in Theoretical Physics at that University. In the same year he married Kathleen Mary, daughter of the late Alderman S. Lennard of Leicester.

During the years 1930 to 1932 he was Dean of the Faculty of Science in Bristol. In 1930 the University of Cambridge was given a generous bequest by John Humphrey Plummer to endow three new chairs in the faculty of science. By 1932 two of these chairs had already been filled and discussion arose concerning the third chair. It was believed by many that the most pressing needs of the Department of Chemistry would be met by making an appointment in the subject of Inorganic Chemistry, whilst others thought that it would receive most benefit if someone interested in the mathematical aspects of that Science could be appointed. Lennard-Jones's work had already attracted the attention of a number of physical chemists and eventually he was elected as the first John Humphrey Plummer Professor of Theoretical Chemistry and Professorial Fellow of Corpus Christi College. In retrospect, no one in the University of Cambridge can regret what was considered at the time to be a somewhat daring experiment.

During the 1939—45 war, and subsequently, he was closely associated with the work of the Ministry of Supply, particularly in the field of Armament Research; thus from 1940 onwards, he served on several Committees of the Minister's Scientific Advisory Council and from the beginning of 1942 on that Council itself.

In the Autumn of 1942, he was appointed to the responsible and onerous post of Chief Superintendent of the Armament Research Establishment, a position which he held until the end of the War.

In August, 1945, he became Director-General of Scientific Research in the Ministry and played a very active part in the planning and re-organisation of the scientific effort consequent upon the change-over to peace-time conditions and the amalgamation of the war-time Ministries of Supply and Aircraft Production. During this period he was also active in the reorganisation of the Minister's Scientific Advisory Council to suit peace-time conditions.

In October, 1946, Sir John returned to Cambridge but did not cease his interest in Defence Research as he became Chairman of the Minister's Scientific Advisory Council in 1947, a duty which he carried out with his usual high standards of ability and thoroughness until 1953.

From 1942 to 1947 he was a member of the Advisory Council of the Department of Scientific and Industrial Research and of the Scientific Advisory Committee of the National Gallery. He was President of the Faraday Society in the years 1948—1950 and was elected a Fellow of the Royal Society in 1933, on the Council of which he sat during the years 1941—1943.

The death of Lord Lindsay of Birker, the first principal of the new University College of North Staffordshire, left vacant an administrative post at Keele, one of extraordinary interest but full of the novel problems always associated with the development of an educational experiment on new lines. Lennard-Jones was asked to fill this difficult post which he gladly accepted in April, 1953, and was entering on his new work with enthusiasm and interest until his death. He was a D.Sc. of Manchester, and Sc.D. of Cambridge, and was awarded the K.B.E. in 1946 and the Davy Medal of the Royal Society in 1953. Just before his death, as President of Section B of the British Association at Oxford, he was given an honorary degree of that university and a little later, the Chemical Society gave him their highest award—the Longstaff Medal. He is survived by his widow, son, and daughter.

Naturally a great deal of Lennard-Jones's contributions to science are less significant to chemists than to physicists but in the field of theoretical chemistry he has made several outstanding contributions. The determination of the nature of intermolecular potential energies from the experimental second and third virial coefficients of the compressibilities of gases had long been the subject of detailed examination; the work of Keesom being regarded as classical in this field. The modern phase of the subject began in **1924** when Lennard-Jones, using a soft-sphere model, introduced his well-known semi-empirical law for the intermolecular potential $E(r)$:

$$E(r) = \frac{a}{r^n} - \frac{b}{r^m}$$

When n and m are assigned the values of **6** and **12**, the calculated expression for the second virial of many gases fits the data within experimental accuracy. Several of the diatomic gases also, such as H_2 and N_2, and also CH_4, likewise conform closely in their properties given by this equation; and extensions to molecules of cylindrical symmetry such as CO_2, C_2H_4, and C_2H_6 have been made by several of his junior colleagues.

The theory of Frenkel and Eyring that a liquid contained vacant sites or holes likewise received Lennard-Jones's attention. Eyring and his co-workers were led to the assumption that a molecule of liquid was confined in a small volume of the surrounding molecules but that within this volume the molecule was free to move under the combined forces of the neighbours which confined it in its cell. Lennard-Jones showed that with values of n and m taken as **7** and **13**, respectively, a molecule moving in a field of twelve neighbours would have nearly constant potential energy over a large part of the cell. He then went on to consider fusion as an order–disorder transition, visualising the existence of two interpenetrating lattices of atoms and holes respectively; the interatomic forces tend to produce an orderly alternation of lattice points whilst the entropy tends to produce a disordered arrangement. The forces involved are both of long range and of short range; on expansion of the lattice the long-range forces disappear first and at this stage fusion occurs. At Cambridge he took a great interest in the experimental work going on in the laboratories and finding that the subject of adsorption and heterogeneous catalysis was receiving a great deal of attention he devoted much time and thought to the examination of the problems involved. No less than twelve papers were devoted to developing a fundamental theory of adsorption kinetics. Simple considerations permit one to obtain the value of the product $\alpha\tau$ involving the accommodation coefficient of a gas striking a surface and its lifetime in the adsorbed phase. Lennard-Jones obtained expressions for these constants in terms of the physical properties of the solid and its surface field. He determined, *inter alia*, the free surface energy of the surfaces of heteropolar crystals, and the conditions for surface migration, and obtained an expression for the interaction energy of a metal surface with a non-polar molecule. He initiated the development of a mathematical laboratory and installed one of the first computing machines, encouraging the experimentalists to make free use of it.

He initiated, when at Bristol, his life-long enquiry into the wave-mechanical aspects of molecular structure, developing the concept of molecular orbitals. In his first paper, a classic in this field, he brought out in a simple way the mathematical implications of the experimental studies of quantum numbers in molecules made by R. S. Mulliken and others. The central idea here is that each bonding electron moves in some form of orbit, similar to the situation in atoms except that the molecular orbits are polycentric instead of monocentric. In the exceedingly important field of aromatic and condensed molecules, Lennard-Jones made valuable contributions to our knowledge of the behaviour of the π-electrons, and showed in particular how quite small differences between C–C bond lengths may be attributed to their influence. This work he continued at Cambridge and his most recent papers describe the theory of transformation between molecular and equivalent orbitals for symmetrical molecules, equivalent orbitals being regarded sometimes as bond orbitals around a central atom and at other times as associated with a bond between two atoms—the concept made use of by Slater and Pauling.

"L. J." to his many friends and "Ted" to a few, Lennard-Jones always had time to discuss problems of mutual interest and would take both trouble and time in helping to solve them. He loved the open air and was most knowledgeable on bird lore and was probably at his happiest in taking long country walks. No more fitting description of his personality can be given than in those words written by Chaucer:

A knight ther was, and that a worthy man,
That fro the tyme that he first bigan
To ryden out, he loved chivalrye,
Trouthe and honour, fredom and curteisye.
He nevere yet no vileinye ne sayde
In al his lyf un-to no maner wight.
He was a verray purfit knight.

ERIC K. RIDEAL.