

**Sir James Dewar, LL.D., F.R.S. By Sir James Crichton-Browne, M.D., LL.D., F.R.S.**

(Read October 22, 1923.)

His brains were made in Scotland. Born at Kincardine-on-Forth on 20th September 1842, Sir James Dewar died at the Royal Institution, London, on 27th March 1923, after a very strenuous life productive of scientific discoveries of no mean order. His mother, who died when he was young, is said to have been a woman of strong character; but it was from his father, who was a keen naturalist and, by a self-constructed plant, installed gas in his house when it was unknown in the neighbourhood, that he derived his scientific bent. The youngest of six brothers, he was attending the parish school when an attack of rheumatic fever suddenly interrupted his education and crippled him so that he had to go about on crutches for two years, picking up such scraps of technical knowledge as were available in the shipyards and blacksmith's and wheel-wright's shops, and displaying his manipulative skill in the fabrication of a fiddle which is still preserved and played on from time to time. He used to refer to this period of supposed idleness as the most instructive and stimulating epoch in his early life.

When twelve years old Dewar went to the Dollar Academy, where Mr Lindsay, the then science master, fostered his scientific tastes, and at seventeen he proceeded to the University of Edinburgh. There he attended the Arts classes for two years, and then discovered his destined pathway and diverged into chemistry. Professor Lyon Playfair, quickly discerning his ability, made him his class Assistant, and afterwards his Demonstrator, an office which, on Playfair's retirement on his becoming M.P. for the University in 1869, he continued to hold under his successor, Professor Crum Brown, until 1874.

In 1873 Dr Anderson, chemist to the Highland and Agricultural Society, being in failing health, Dewar was appointed his Assistant, but on Anderson's death in the following year the expected promotion did not come. He had resigned his Assistantship to Crum Brown to devote himself to the work of the Society, and had remodelled the chemical department; but the Council, after discussing whether they should have "a scientific chemist" or "an agricultural chemist" to succeed Anderson,

decided that it must be "a cheap chemist," and continued Dewar in office at a salary of £150 a year.

Few of those who were Dewar's pupils in Edinburgh now survive, but one of them says that he was "brimful of energy and enthusiasm, which he communicated to his class—always lambent, sometimes flashing brilliantly." Intellectual life was vivid in Edinburgh in the sixties and seventies of last century, and there, in contact with vigorous minds variously occupied, Dewar whetted his wits and laid the foundation of that broad culture for which he was afterwards distinguished.

After studying organic chemistry under Kekuli at Ghent, Dewar returned to Edinburgh as Professor of Chemistry in the Dick Veterinary College, and joined P. G. Tait in experiments with Crookes' newly invented radiometer and M'Kendrick in an investigation into the physiological action of light, which formed the subject of a series of papers contributed to the Royal Society of Edinburgh, 1872-76.

In 1875, when not a candidate, he was—doubtless owing to the strong representations of Tait and Professor Humphrey—selected as Jacksonian Professor of Experimental Philosophy in the University of Cambridge, and three years later was appointed Fullerian Professor of Chemistry at the Royal Institution, both of which offices he continued to hold till his death. While highly successful as a teacher at Cambridge, he left it without regret, as he found there none of those facilities for research which opened up before him in London, and of which he so fruitfully availed himself.

It was at the Royal Institution that Dewar's most memorable work was done—the liquefaction of gases being its most signal feature. John Dalton had foreseen that with low temperatures and strong pressure it might become possible to reduce all elastic fluids or gases into liquids, and in 1844 Faraday, by these means, succeeded in liquefying all the then known gases, except nitrogen, oxygen, and hydrogen, and the compound gases, carbonic acid, marsh-gas, and nitric oxide. In 1874 Dewar took up the theme, and contributed his first paper on the subject, on "Latent Heat of Liquefied Gases," to the British Association. From that time onward low-temperature research mainly occupied him for many years. Following on Wroblewski and Olzewski's liquefaction of oxygen, but working on original lines and with ingeniously devised apparatus, he reached in 1885 a temperature of  $-192^{\circ}$  centigrade and produced liquid air, and a little later at  $-216^{\circ}$  centigrade he converted liquid air into a pale blue ice. In 1897 fluorine was liquefied at the Royal Institution, and in 1898 came liquid hydrogen in an open vessel, and the following year hydrogen in a solid form at a temperature of  $13^{\circ}$  absolute. The

only remaining gas resisting liquefaction was helium, which yielded to the experiments of Onnes of Leyden in 1908, at a moment when Dewar had made preparations for attacking the problem in a way which must certainly have secured its solution. Solid hydrogen was procured at  $-260^{\circ}$  centigrade or  $13^{\circ}$  above absolute zero. Dewar made exact measurements of the rate of production of helium from radium.

It was of course of the utmost importance, with a view to their examination and employment as agents of physical research, that the gases which Dewar liquefied should be protected against the influx of heat and retained in a static condition, and this result he achieved by his remarkable invention of the vacuum bulb. The methods of obtaining very perfect vacua had interested him as early as 1874, when he read a paper on the subject before the Royal Society of Edinburgh, but it was not until 1892 that he produced those retainers in which liquid air could be stored for days with little or no loss and free from ebullition, so that observations of refractive indices could be carried out. It was Dewar's vacuum bulbs that were the progenitors of the thermo-flask now in universal use, and by which he will be popularly remembered. But vacua of still greater tenuity than that reached in the vacuum bulb became necessary in Dewar's researches, and these he acquired by the use of charcoal. Recalling some experiments which he had performed with Tait in Edinburgh in 1874 on the absorptive power of charcoal, he found that that absorptive power is enormously increased by extreme cold, and thus made a discovery of far-reaching significance which enabled him to substitute vessels of metal for those of glass, to separate gases like hydrogen, helium, and neon from the air, and to accomplish much work otherwise impracticable.

The refrigerating agents which he had thus captured opened up to Dewar new regions for exploration, and he proceeded to investigate electrical conductivity, thermo-electric power, the magnetic properties, and dielectric constants of metals and of other substances at low temperatures. He also tested the effects of extreme cold on phosphorescence, on chemical and photographic action, on the strength of materials, on colour, and on the life of living organisms. In conjunction with Professor Macfadyen he submitted bacteria the cells of which emit light by a chemical process of intracellular excitation to temperatures as low as that of liquid hydrogen, finding that when thus cooled down they became non-luminous, but on thawing immediately emitted light again with unimpaired vigour.

Although mainly identified with the liquefaction of gases, Dewar did admirable service in many other departments of scientific research. As a member of the Government Explosives Committee he was, with Sir

Frederick Abel, the co-inventor of cordite, a smokeless powder, manufactured of gun-cotton and glycerine, which was adopted by the British Government for the army and navy. With Professor G. D. Liveing he carried out an elaborate series of observations on spectroscopy, now collected in a substantial volume and published by the Cambridge University Press. With Sir William Crookes he conducted chemical and bacteriological analyses of the water supplied by the London companies, and independently he made a prolonged study of the problems of capillarity and of soap and other films which he was still prosecuting at the time of his death, and in the course of which he produced gigantic bubbles 17 inches in diameter, which when inflated with pure air lasted for months.

As an expositor of science Dewar was singularly successful, and a full theatre invariably awaited his lectures at the Royal Institution. He never aimed at the eloquence of his predecessor, Tyndall, but was always clear and forcible, happy in his illustrations, and dramatic in his experiments. The juveniles crowded to his Christmas lectures, of which he delivered seven courses, dealing with Atoms, Meteorites, Alchemy, Light, Clouds, Frost, and Bubbles. His Friday evening discourses were epoch-marking, as the occasions for the declaration of his discoveries, and every one of them, and they were forty-eight in number, contained some novel point. His afternoon lectures were an education in physical and chemical science.

The laboratories of the Royal Institution under Dewar's direction became a rallying-ground for men of science from all parts of the world, and were also a source of scientific inspiration and aid, for Dewar was singularly suggestive and generous, and ever ready to help those who sought his guidance. He used sometimes to smile over vicarious manifestations of hints he had thrown out.

Dewar was a man of unbounded energy and strong convictions, which he never muffled, but genial and buoyant in spirit. He had refined tastes, literary, musical, artistic, and a keen sense of humour, and so was a delightful companion, and gathered round him a group of steadfast friends. He adhered firmly to the Scottish philosophy of common sense, and was unscathing in his denunciations of occultism, socialism, psycho-analysis, impressionism *et hoc genus omne*.

The recognition of Dewar's scientific attainments was world wide. The four Scottish Universities and those of Oxford, Dublin, Brussels, and Christiania conferred on him honorary degrees. He was awarded the Copley, Rumford, and Davy Medals of the Royal Society of London. He was a Fellow of Peterhouse, Cambridge. He was ex-President of the Chemical Society, the Society of Chemical Industry, and the

British Association. He was an Honorary Member of the New York Academy of Science, of the Philosophical Society of Philadelphia, of the Royal Academy of Science of Belgium, of the Institute of Science and Letters of Milan, of the Royal Academy of Rome, of the Verein of Frankfurt, and of the Chemical Society of Berlin. Only his own country was chary in acknowledging his merits. He was knighted in 1904; but while honours have been yearly showered on mediocrities, no other public distinction was ever bestowed on this great man, who had so beneficially extended the boundaries of human knowledge.

Sir James Dewar married in 1871, Rose Helen, daughter of Mr William Banks of Edinburgh, and their golden wedding was celebrated in August 1921. He was elected a Fellow of the Royal Society of Edinburgh in 1869, and awarded the Gunning Victoria Jubilee Prize for the period 1900-1904.

PAPERS BY THE LATE SIR JAMES DEWAR, F.R.S., IN THE PUBLICATIONS  
OF THE ROYAL SOCIETY OF EDINBURGH.

PROCEEDINGS.

Vol. vi, 1866-69.

On the Oxidation of Phenyl Alcohol, and a Mechanical Arrangement adapted to illustrate Structure in the Non-saturated Hydrocarbons. P. 82.

On a Derivative of Meconic Acid. (Written in conjunction with William Dittmar.) P. 129.

Motion of a Palladium Plate during the formation of Graham's Hydrogenium. P. 504.

Vol. vii, 1869-72.

Note on the Atomic Volume of Solid Substances. P. 70.

Note on Inverted Sugar. P. 77.

On the Oxidation Products of Picoline. P. 192.

On Cystine ( $C_3H_7NO_2S$ ). (Written in conjunction with Dr Arthur Gamgee.) P. 201.

Note on a New Scottish Acidulous Chalybeate Mineral Water. P. 470.

Note on Cystine. P. 644.

Note on Sprengel's Mercurial Air Pump. P. 662.

On Recent Estimates of Solar Temperature. P. 697.

On the Temperature of the Electric Spark. P. 699.

On the Chemical Efficiency of Sunlight. P. 751.

Vol. viii, 1872–75.

On the Physical Constants of Hydrogenium. No. 1, p. 49.

Note on the Thermal Equivalents of the Oxide of Chlorine. P. 51.

On the Physiological Action of Light. No. 1. (Written in conjunction with Dr J. G. M'Kendrick.) P. 100.

Do. Do. Do. No. 2, p. 110.

Do. Do. Do. No. 3, p. 179.

On the Physiological Action of Ozone. (Written in conjunction with Dr J. G. M'Kendrick.) P. 211.

Preliminary note on a New Method of obtaining very Perfect Vacua. (Written in conjunction with Professor P. G. Tait.) P. 348.

Notes:—1. Problems of Dissociation. 2. Formation of Allotropic Sulphur. 3. Heat of Fermentation. P. 380.

On the Formation of Allotropic Sulphur. P. 382.

On the Physiological Action of Light. Part II. (Written in conjunction with Dr J. G. M'Kendrick.) P. 513.

Note on the Physiological Action of Light. (Written in conjunction with Dr J. G. M'Kendrick.) P. 534.

Farther Researches in very Perfect Vacua. (Written in conjunction with Professor P. G. Tait.) P. 628.

#### TRANSACTIONS.

On the Oxidation of Products of Picoline. Vol. xxvi, 1870–72, p. 189.

On the Physical Constants of Hydrogenium. Vol. xxvii, 1872–76, p. 167.

On the Physiological Action of Light. Part I. (In conjunction with Dr J. G. M'Kendrick.) Vol. xxvii, 1872–76, p. 141.

---

#### ERRATUM.

P. 256, 11 lines from bottom, for carbonic acid *read* carbon monoxide.