

depend on the crystal symmetry. The main features of the vibrations of these groups, their frequency, for example, are but little affected by the cation. This is in accord with the structure of these ions as deduced by X-ray analysis. In uniaxial crystals, however, the frequency bands are doubled, and this may mean that the equilateral of the CO_3 ion is distorted, though this has not hitherto been detected by Röntgen analysis. The infra-red spectroscope can, therefore, be used to supplement researches with X-rays.

Water of crystallisation gives nearly the same frequencies of vibration as liquid water, but the bands are doubled in uniaxial and tripled in biaxial crystals, showing that the symmetry of the water molecule partakes of that of the crystal as a whole.

This collection of papers when published in book form will doubtless be a welcome addition to the libraries of those interested in molecular structure.

W. E. GARNER.

J. E. LENNARD-JONES.

Obituary.

WALTER HEAPE, F.R.S.

WALTER HEAPE, whose death occurred on Sept. 10, was the son of Benjamin Heape of Manchester, and Mary Heape, daughter of Joshua Heape of Liverpool. Walter was born in London in 1855, and after completing his education at the age of eighteen, entered into business, and was thus occupied until 1879. He was a man of some fortune, and had business interests in different parts of the world, and to these he devoted himself intermittently throughout a great part of his life. But at quite an early age he realised that he had a natural aptitude for scientific pursuits, and coming under the influence of Francis Maitland Balfour, he proceeded to study embryology, a branch of zoology which at that time was undergoing rapid development.

Heape came to live in Cambridge in 1879 as soon as he gave up business. In 1882 Balfour died, and the organisation of zoological teaching and research in Cambridge fell to Adam Sedgwick, who carried on the tradition of his department as a centre for embryological investigation. In conjunction with Sedgwick, Heape undertook the part-authorship of the well-known "Elements of Embryology", published under the names of Foster and Balfour, and for many years in constant use by students of zoology. In 1882 he was appointed demonstrator in animal morphology, but he had no great interest in teaching, and after two years relinquished the post to take up the duties of superintendent of the laboratory of the Marine Biological Association. This appointment he held for two years.

In 1890, Heape was elected to the studentship founded in memory of Balfour for the promotion of zoological research. He was the second Balfour student (succeeding Caldwell) and he occupied the position for three years, after which he held no further academic appointment.

Heape's earliest original work was that on the development of the mole, issued in the *Quarterly Journal of Microscopical Science* in 1886. This work is generally admitted to be a model of its kind and it definitely broke new ground. It was not, however, until Heape's tenure of the Balfour studentship that he commenced those researches on the comparative morphology and physiology of the reproductive processes for which he made his name famous. The earliest of these were upon the menstrual cycle in monkeys, and were published in two elaborate papers in the *Philosophical Transactions*

(1894-97). Not only did Heape describe fully for the first time the histology of the uterine cycle, but he also gave an account of the ovarian changes, showing that although the uterine cycle may continue throughout the whole year, ovulation and breeding are often restricted to certain special seasons, and that menstruation, therefore, may occur quite independently of ovulation, a fact which has recently been confirmed by Prof. Corner. In order to investigate the subject as fully as possible, Heape went to India, where he collected his material, which consisted of monkeys of two genera. Afterwards he supplemented his researches by a study of the menstrual processes in woman, and published a paper in the *Transactions of the Obstetrical Society*. He also, about the same time, published papers on the successful transplantation of fertilised ova from one rabbit to another (and so into a uterine foster mother), on artificial insemination, and on fertility, barrenness, and abortion in sheep.

Heape's best-known work is probably his memoir on the "Sexual Season of Mammals", which appeared in the *Quarterly Journal of Microscopical Science* in 1900. It contains a comparative account of the oestrous cycle for all the different groups for which any data existed. This memoir formed the basis of much future work, and although a certain number of Heape's conclusions have had to be revised in the light of later investigation, the paper will always stand as the first important contribution to the comparative physiology of breeding in the higher animals. It is doubtful whether Heape ever fully grasped the significance of the endocrine functions of the ovaries, and he appears at one time to have entertained the view that the oestrous cycle might continue after these organs had been removed. But it must be remembered that he never had any training in physiology, neither had he worked in a physiological laboratory; yet, in spite of that, his work gave a remarkable stimulus to research in the physiology of reproduction. In 1905, Heape published a paper on ovulation and the degeneration of ova in the rabbit, in which he postulated the seasonal appearance in the blood of a 'generative ferment' which was responsible for the reproductive and sexual activities. It is interesting to note that he was the first to discover that in the rabbit ovulation is dependent on coition, and that it takes place almost precisely $9\frac{1}{2}$ to 10 hours after coition, an observation which, with some modifications, has since been extended to other animals.

Heape was also interested in the question of sex determination, and his latest papers were upon this subject. It was at one time rumoured that in certain instances he claimed to have controlled sex. His views, however, were shadowy, and he never clearly formulated them, but latterly, under the influence of the Mendelian discoveries, he adopted the theory that the gametes were themselves sexual, and that in certain circumstances the environment exercised a selective action on the life of the gametes, there sometimes being a preponderance of male gametes surviving, and sometimes an excess of female ones. In support of this view he published papers on the sex-ratio in dogs, in canaries, and in the human population of Cuba.

Mention must also be made of Heape's strong appreciation of the practical side of his subject. His papers on fertility have been referred to above, but he also wrote a book on "The Breeding Industry" (1906), in which he emphasised the economic importance of that industry in Great Britain, the desirability of animal breeders keeping records of their experiences so that these should be available for future use, and the necessity for improved organisation and for the application of scientific method to all branches of livestock breeding. Heape showed also a practical interest in questions of fertility in man and published a book entitled "Preparation for Marriage" (1914). Another book he wrote was called "Sex Antagonism" (1913), and consisted largely of a criticism of Sir James Frazer's "Totemism and Exogamy". Heape also planned the publication of a text-book of comparative embryology to be completed in three volumes. Of these, the first two only have appeared, and he relinquished the editorship after the publication of the first volume, on the invertebrates, by Prof. E. W. MacBride.

In 1891, Heape married Ethel, daughter of Joseph Ruston of Lincoln; she died in 1925. They had one son and one daughter. When in residence at Cambridge, Heape joined Trinity College, and the University conferred upon him the honorary degree of M.A. in recognition of his work and position. He was elected a fellow of the Royal Society in 1906. After leaving Cambridge in 1907, Heape lived successively in Southwold and London and finally in Tunbridge Wells. He was a partner in the 'Heape and Grylls' rapid cinema machine company.

Heape had a strong enthusiasm for his subject and was ever ready to help and encourage others. Had he been a teacher, there is little doubt that he would have had many pupils who would have devoted themselves to generative physiology. As it was, his influence lay chiefly in his writings.

F. H. A. MARSHALL.

LADY BRAGG.

It is not easy to express in these columns the deep loss which science has sustained by the death of Lady Bragg on Sept. 29. She possessed the quality of radiating the sunshine of life wherever she was—at the University of Leeds, University College, London, and since 1920 at the Royal Institution—and her gracious influence cleared

away all clouds as surely as the sun does in the solar system, enabling us thereby to see the stars. It was impossible not to be uplifted and stimulated by her smile, and scientific workers both young and old will cherish it as a glad memory throughout their lives. She did indeed reveal to all with whom she came in contact the "purity of grace. The mind, the music breathing from her face, the heart whose softness harmonised the whole."

Both birth and circumstance combined to produce the note of perfect harmony in Lady Bragg's life. She was the daughter of Sir Charles Todd, Government Astronomer and Superintendent of Telegraphs, South Australia, and in 1889 married Sir William Bragg, who was then professor of physics in the University of Adelaide. By understanding, as well as by social position, she was therefore richly endowed with the power to give light and leading to all around her, and she used her gifts always to promote noble life and high endeavour. We offer Sir William Bragg our deepest sympathy at the loss of his devoted partner, whose influence will be greatly missed over a wide circle. We are thankful for her life, and find consolation in the thought that her spirit remains with us for help and guidance, though she herself has passed into silence.

WE regret to announce the following deaths:

Prof. H. Beckurts, formerly professor of pharmaceutical and food-stuffs chemistry at the Technical Highschool at Brunswick and joint editor of the *Archiv der Pharmazie*, who issued the "Jahresbericht für Pharmazie" from 1881 until 1924, on Sept. 15, aged seventy-four years.

Frank Hurlbut Chittenden, entomologist in the bureau of entomology of the U.S. Department of Agriculture, known for his work on Coleoptera, on Sept. 15, aged seventy years.

Dr. Edward B. Craft, executive vice-president of the Bell Telephone Laboratories, vice-chairman of the engineering and industrial research division of the U.S. National Research Council, on Aug. 21, aged forty-seven years.

Prof. Andrew A. Kerr, head of the department of anthropology in the University of Utah, on Aug. 15, aged forty-nine years.

Dr. George P. Merrill, head curator of geology in the U.S. National Museum and a member of the National Academy of Sciences, known for work on petrography and the history of American geology, on Aug. 16, aged seventy-five years.

Mr. W. DeW. Miller, associate curator of ornithology of the American Museum of Natural History, on Aug. 4, aged fifty years.

Dean F. Franklin Moon, head of the New York State College of Forestry since 1920, and chairman in 1924-26 of the New York section of the Society of Foresters, on Sept. 3, aged forty-nine years.

Prof. R. P. Pictet, of Geneva, whose name will be remembered in connexion with his papers published in 1877-78 on the liquefaction of oxygen, aged eighty-four years.

Dr. Morton Prince, emeritus professor of neurology at Tufts College and associate professor of abnormal and dynamic psychology at Harvard University, who edited the *Journal of Abnormal and Social Psychology* and was president in 1909 of the American Neurological Association, on Aug. 31, aged seventy-four years.