oxygen scale, the helium atom has a mass very nearly 4·000, while the hydrogen atom has a mass 1·0077. The mass of the helium atom is thus considerably less than that of four free H nuclei. Disregarding the small mass of the electrons, in the formation of 1 gram of helium from hydrogen there would be a loss of mass of 7·7 milligrams.

It is now generally accepted that if the formation of a complex system is accompanied by the radiation of energy E, the reduction of the mass m of the system is given by $E=mc^2$, where c is the velocity of light. This relation between mass and energy follows not only as a direct consequence of the theory of relativity, but can be derived directly from Maxwell's theory, as pointed out by Larmor. On this relation, the energy E liberated in the formation of 1 grm. of helium from hydrogen is equal to $6{\cdot}9 \times 10^{18}$ ergs or $1{\cdot}6 \times 10^{11}$ gramme-calories. This is an enormous amount of energy, large compared even with the total energy emitted during the complete disintegration of 1 grm. of radium and its products, namely, about $3{\cdot}7 \times 10^9$ gramme-calories. It can be calculated that the energy radiated in forming one atom of helium is equivalent to the energy carried by three or four swift α-particles from radium. On this view we can at once understand why it should be impossible to break up the helium nucleus by a collision with an α-particle. In fact, the helium atom should be by far the most stable of all the complex atoms.

It has been pointed out by Perrin and Eddington that in all probability the energy of radiation from our sun and the stars is derived mainly from the enormous emission of energy accompanying the formation of helium from hydrogen. If this be the case, it is easy to show that sufficient energy can be derived from this source for our sun to radiate at its present rate for several thousand million years, whereas the older theories of Kelvin and Helmholtz, in which the heat of the sun is ascribed to the gradual concentration of the material under gravity, make the life of the sun much shorter than modern estimates of the age of the earth and appear to be quite inadequate to provide the requisite energy.

This interesting suggestion of the probable origin of the greater part of the enormous energy radiated by the sun and stars is one of the first-fruits of the investigations on the structure of atoms. It is believed that the formation of helium from hydrogen occurs under certain conditions in the great central furnace of the sun and stars, but there is no evidence, so far, that this combination can be produced under laboratory conditions. It may be that it can be effected only under conditions of very high temperature and enormous intensity of radiation such as occur in the interior of a sun. Even then the process of formation may go on at a very slow rate and for periods measured by millions of years.

Most workers on the problem of atomic constitution take as a working hypothesis that the atoms of matter are purely electrical structures, and that ultimately it is hoped to explain all the properties of atoms as a result of certain combinations of the two fundamental units of positive and negative electricity, the proton and electron. Some of the more successful methods of attack that have been made on this most difficult of problems have been indicated. During recent years, unexpectedly rapid advances have been made in our knowledge, but we have only made a beginning in the attack on a very great and intricate problem.

Great difficulties arise the moment we consider why the nucleus of an atom holds together, and progress seems likely to be slow because it seems clear that the ordinary laws of force between electrified particles break down at such minute distances. There are, however, a number of obvious lines of attack that may yield us very valuable information. In particular, a closer study of the modes of transformation of radio-active bodies, where the process of devolution of elements takes place before our eyes, may be expected to give much important data. During recent years the study of the γ- or very penetrating X-rays from radio-active bodies has progressed very rapidly. The general evidence indicates that the γ-rays, like the α- and β-particle, have their origin in the nucleus. The study of the γ-rays thus gives us information of the frequency of vibration of the electrons which form part of the nuclear structure. In addition, Ellis has shown that it appears probable that the laws of quantum dynamics which govern the motions and vibrations of the outer electrons apply also to the nuclear electrons. If this conclusion can be verified, it offers the hope that we may be able later to form some idea of the detailed structure of nuclei. There are also a number of other lines of evidence that will have to be taken into account in formulating any definite theory of the evolution of the elements; for example, Harkins has pointed out some very interesting relations that appear to exist between the relative abundance of elements in the earth and their atomic number, while the close study of stellar evolution should ultimately throw much light on the general problem.

The Royal Botanic Society's Gardens.

THE gardens of the Royal Botanic Society, Regent's Park, are one of the landmarks of London. They occupy the whole of the Inner Circle of Regent's Park, an area of nearly 20 acres. The accompanying aerophotograph shows very well their main features. The Society was established by Royal Charter in 1839, "for the promotion of botany in all its branches, and its application to medicine, arts, and manufactures, and also for the formation of extensive botanical and ornamental gardens within the immediate vicinity of the metropolis." The first president was the Duke of Richmond, and the first secretary James De Carle Sowerby, a botanist and artist, whose father, James Sowerby, was a well-known botanist in his time. The latter was author of "English Botany," a classic collection of coloured drawings of British plants, and other works. The son, James De Carle Sowerby, inherited his father's tastes as a botanist and artist. He also handed on to *his* son and grandson the office of secretary, the latter resigning shortly before the war.

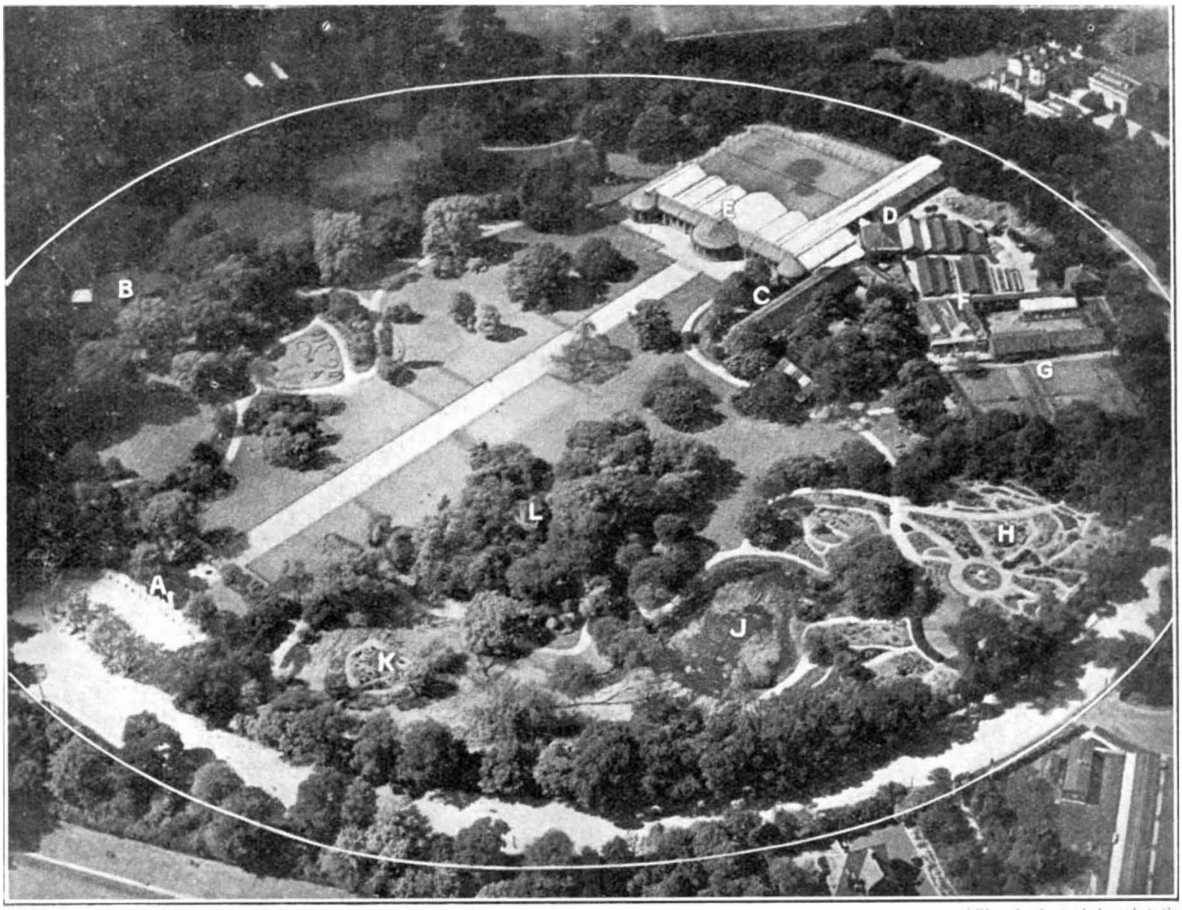
Their Majesties the King and Queen and Queen Alexandra, and H.R.H. the Prince of Wales are patrons of the society, and the present President is Viscount Lascelles. The grounds of the gardens were originally intended as the site for a royal palace, and had been used as a nursery garden. They were cleared and laid out as an example of English landscape gardening, an artificial lake being excavated and a mound formed near the centre of the ground in the process. In 1845 the conservatory was erected. It was the first large iron house built in England, the palm-house at Kew being constructed later. The herbaceous garden, in which the plants were arranged according to the natural orders, was also a novelty in its time. It includes economic and medicinal plants, and has proved very useful to botanical students throughout the history of the gardens. As early as the 'eighties of last century 600-800 students' tickets were issued annually. The gardens have also been and are still an important source of specimens for botanical teaching in London. The kitchen-garden and rock-garden are other features having their special uses.

The greenhouses are now in need of replacement, and that process will begin shortly with the erection of two new and modern houses. The museum contains an important collection of economic products, particularly of tropical plants. The library is chiefly devoted to economic botany, including agricultural and horticultural publications. The Victoria House contains a warm-water tank in which *Victoria regia* is grown very successfully every year. In the late summer this is one of the sights of the gardens. In this house are also grown bananas, rice, bamboo, sugar cane, the sacred lotus, as well as a variety of tropical water plants and climbers. Some of the other houses are devoted to orchids, succulents, ferns, stove plants and bedding plants.

A practical gardening school was established in 1897, and has done excellent work. Lady gardening students were first admitted in 1904, and they have been very successful. They now number 22, and a new students' house was recently built for them. The course in practical gardening extends over three years, and includes practice in all the operations of gardening, as well as a certain number of lectures. Those who have completed the course have been very successful in the gardening competitions of the Royal Horticultural Society and in obtaining situations.

The gardens are also recognised as a meteorological station for London. The society possesses a complete set of instruments, and daily observations are made and published. The records include ground temperatures and sunlight.

In the years before the war the gardens ceased to



[Photo by Central Aerophoto Co.

ROYAL BOTANIC GARDENS.

A = MAIN ENTRANCE. B = MUSEUM AND LIBRARY. C = FELLOWS' ROOMS. D = VICTORIA REGIA HOUSE AND GREENHOUSES. E = CONSERVATORY. F = STUDENTS' HOUSE: PRACTICAL GARDENING SCHOOL. G = KITCHEN GARDEN. H = ORDER BEDS AND METEOROLOGICAL INSTRUMENTS. J = LAKE. K = ROCK GARDEN AND SUNDIAL. L = TOWER AND SUN RECORDER.

make progress and fell into debt. Beginning in 1906, a Commission from the University of London considered the possibility of incorporating them into the University and making them the centre of a Botanical Institute, but the scheme was not adopted. Since the war the gardens have taken on a new lease of life. An energetic Superintendent has been appointed, who has already increased considerably the utility and the amenities of the gardens. Ground has been set apart for genetic experiments under the direction of Prof. Ruggles Gates, of King's College, London. Several hard tennis courts have also been built, which are a considerable source of income.

In 1919 a Government Committee was appointed under the chairmanship of Sir David Prain, to consider how the work of the Royal Botanic Society could be made more useful from the scientific and educational point of view. Definite recommendations were made, which it is hoped will be carried into effect as funds become available. The recommendations included (1) the establishment of a School of Economic Botany, where a knowledge of economic and tropical plants and their products could be obtained; (2) an Institute of Research, especially on the living plant and its physiology; (3) a centre for teaching in horticulture; and (4) courses in school gardening for teachers. When these are all carried out they will involve an annual expenditure of about 3000*l.* for salaries and expenses, and an initial outlay of some 5000*l.* for laboratories and equipment. Such an Institute of Economic Botany would be of enormous value to botany in this country, and in particular would contribute much to the economic development of our tropical possessions.

It is highly desirable that the necessary funds for this purpose should be forthcoming in the near future, so that the reconstruction of greenhouses and other buildings, which has become essential, can be carried out in a scheme harmonious with the present arrangements of the gardens. Botany in Great Britain has occupied in some respects a unique position, especially in its many-sidedness and in the closeness of the relations which have usually existed with economic, agricultural, and horticultural interests, and an Institute of Botanical Research of the kind recommended by the Government Committee in 1919 would probably do more than any other measure for the advancement of botanical science throughout the Empire. Any public-spirited citizen who would set the example of subscribing funds for this purpose would earn the gratitude of all those who have at heart the development of botanical science for the welfare of mankind.

Obituary.

S. P. Smith.

THE name of Stephenson Percy Smith, whose death is reported at New Plymouth, New Zealand, is probably more widely known than any other among students of Polynesian ethnology. Mr. Smith was born at Beccles in Suffolk, and arrived with his parents at the infant settlement of New Plymouth on February 7, 1850. In 1855 he entered the Government Survey Department, passing upwards through all grades and becoming Surveyor-General in 1889, a post which he held till his retirement in 1900. Among a number of important and arduous departmental undertakings carried through with conspicuous ability were the survey following the great eruption of Tarawera, and the mapping and charting of the Chatham Islands and the Kermadecs. His ability in affairs was recognised and made use of by the New Zealand Government on several occasions, perhaps most notably when he was dispatched to Niue, where he drew up the constitution under which that island has prospered ever since.

In spite of his varied services to the State, it is in another capacity that he will be best remembered, namely, as the leading authority on Polynesian traditions. A few months before his death a fourth edition appeared of "Hawaiki: The Whence of the Maori," a book which has been more widely read and more often quoted than any other modern work on Polynesia. In its latest form it has been considerably expanded, and it is weightier and more mature, even, than before. He published several other books dealing with the Maori, and a very large number of papers, every one of which is of value.

A service to ethnology almost as important as the publication of his own works was performed by Percy Smith in the capacity of president of the Polynesian Society and editor of its Journal. He was the most prominent of its founders in 1892, and he presided over it and guided it until his death. Thirty volumes of the Journal have appeared, and the immense industry and the scholarship involved in editing them and in translating numberless papers published in them, would alone constitute a notable life-work. By thus providing a means for the rapid publication of ethnological research in New Zealand and the Pacific he performed a service for anthropology in that part of the globe probably greater than has been rendered by any other worker in the field. He was an honorary member of many scientific societies in different parts of the world, and in New Zealand had been honoured by a Fellowship of the New Zealand Institute, and by the award of the Hector Medal.

No one could meet Percy Smith without recognising the strength and range of his intellect. He rendered ready help alike to great and small. His loss will be felt not only by those who knew him personally and experienced his generous help, but by every student who begins research in the field of which he was the unchallenged master.

H. D. S.

WE notice with regret the announcement of the death, on July 27 last, of Dr. A. J. Harries. Dr. Harries, who was born in 1856 and received his medical education in London and Brussels, was well known for his work on electro-therapeutics and kindred subjects. Among a number of medical works which he published was "A Manual of Electro Therapeutics," issued in 1890; he was also the author of papers on the dangers and uses of electricity, including one contributed to the Leeds meeting of the British Association in 1890, in which it was pointed out that current strength, as well as voltage, is an important factor in estimating the danger to life from accidental contacts with "live" wires and structures.