or the laboratory, concerns itself with the detection and estimation of the power of these forces, and the means by which they may be controlled. We have thus witnessed the rise, not only of a chemistry or, if you will, a physics, as well as a biology of disease, but we are witnessing a spirited study of the underlying factors of constitution as affecting the health or the disease of individuals and of larger units or communities. Medicine, therefore, takes on an almost universal aspect; it is properly considered the most inclusive of the sciences and the most complex of the arts.

But the search for knowledge of the underlying conditions determining health on the one side and disease on the other is no longer confined to man himself. While he is the main object of our pursuit, he is by no means the only or even the chief object which is being investigated. Just as Francis Bacon announced that he proposed to take all knowledge for his province, so does the medical investigator to-day take all animated nature as his legitimate field of exploration. There are no closed compartments in nature into which man, animals and plants can be separately placed. All are related organically and, as we may say, united physiologically and pathologically. No essential biological division exists between man and the lower animals and plants, whether in respect to health or to disease. If, therefore, we would learn, and through learning grow more powerful and effective to prevent and to cure disease, to lengthen life and to increase happiness through security in all its varied forms, then we should endeavor to advance in biological knowledge, which alone can free us still further from the evils of disease.

To the members of the graduating class I offer my sincere felicitations and my wish that they may carry the spirit of the student into whatever branch of medicine they elect to follow. After all, it is the spirit which matters. The college sends you out with high hopes; may your own ambitions realize them.

THE STORY OF ISOTOPES[1]

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THE story of isotopes is not a long one in time for it is practically all comprised within the past quarter of a century, but it presents many points of great general interest. The idea that atoms of the same element could differ in mass was repugnant to chemists and when, about 1910, Soddy proposed that the newly discovered data of radioactivity led inevitably to the possibility of leads occurring of different atomic weights but of identical chemical properties, he received much hostile criticism. The examination of naturally occurring leads by those who had the best reason to doubt the theory, the specialists in atomic weights, showed in due course that Soddy was right.

It is remarkable that the extension of the theory to the non-radioactive elements should have followed so closely, for this depended on a technical advance in methods of analysis of rays of charged atoms which had little or no relation to the discovery of radioactivity. Sir J. J. Thomson's parabola method of positive ray analysis suggested the probability of the inert gas neon being complex and an account of a partial separation of its isotopes was published in 1913, but the first definite proof of the general occurrence of complex elements composed of atoms of whole number mass was given by the mass-spectrograph in 1919. Chicago is closely associated with the early work on isotopes by the well-known researches of Harkins and Dempster. The latter announced the first analysis of a metallic element, magnesium, in 1920.

Aided by its focusing property the first mass-spectrograph had a resolving power sufficient for any element up to the rare earth group, and an accuracy of measurement of about 1 in 1000. During continuous use from 1919 to 1925 it was successfully applied to over 50 elements, the whole number rule was well established and the divergence of hydrogen from this roughly measured. Other slighter divergences were indicated but greater accuracy was required. In this connection one must not omit to note the work of the American Costa, who set up a mass-spectrograph in Paris and in 1925 published comparisons of some light atoms of an accuracy of 1 in 3000.

In the same year the original mass-spectrograph at the Cavendish Laboratory was replaced by a second one having double the resolving power and capable of comparing masses with an accuracy of 1 in 10,000. By means of this work was extended to heavier elements and a large number of new isotopes were discovered. Its high accuracy enabled the divergences from the whole number rule to be measured in many atoms. These expressed as "packing fractions" were found to lie on an interesting curve which has been used by Millikan and others for theoretical purposes. One of the most interesting discoveries made with the second mass-spectrograph was that uranium lead con-

[1] Abstract of an address before the General Session of the Century of Progress Meeting of the American Association for the Advancement of Science, Chicago, June 21, 1933.

tains an isotope 207 which is almost certainly the end product of the actinium series.

The next outstanding advance came from a totally different experimental source, the analysis of band spectra by the application of the quantum theory. By this means Giauque and Johnson discovered the rare isotopes 17 and 18 of oxygen in 1929 and similar discoveries followed in connection with carbon and nitrogen. These discoveries are all to be credited to American science which has taken an increasing share in the researches on isotopes in recent years. At the Bartol Institute, Bainbridge, by means of a very powerful apparatus of his own design, has corrected errors in the abundance of the isotopes of zinc and germanium, discovered new isotopes in tellurium and measured the packing fractions of several types of atoms, notably the important beryllium 9.

The latest and most spectacular discovery is that of the hydrogen isotope of mass 2. Following the discovery of the complexity of oxygen Birge pointed out that if the determination of the mass of the atom H_1 by the second mass-spectrograph was to be relied on hydrogen also should have heavier isotopes. Urey, Brickwedde and Murphy made a diligent search and were rewarded by the discovery of H_2. By means of their concentrated samples Bainbridge has photographed the line due to the molecule $H_1H_1H_2$ and so measured the mass of the new isotope. It is unique among isotopes for results of electrolysis give every hope of separating it in quantities on a practical scale and so opening up an entirely new field in chemistry. Its abundance in ordinary hydrogen is still uncertain. If, as results with the band spectra of HCl indicate, this is of the order 1 in 35,000 it is quite inadequate to account for the actual discrepancy which led in the first case to its discovery.

SCIENTIFIC EVENTS

NEW BUILDING FOR THE DEPARTMENT OF ZOOLOGY AT THE UNIVERSITY OF LONDON

THE Earl of Athlone, Chancellor of the University of London, formally opened the new building for the Department of Zoology and Comparative Anatomy, University College, London, on June 12.

According to the London *Times,* the site, acquired on the liquidation of Messrs. Shoolbred in 1931, contains a range of buildings surrounding a courtyard—since named Foster Court in commemoration of the first Provost of the college, Sir Gregory Foster—and the building on the east side of the courtyard is the one that has been adapted to the requirements of the department of zoology. It formerly consisted of stables on the ground floor and workshops on the two upper floors, which have been converted into laboratories, classrooms, a museum and other divisions.

The new main staircase occupies the eastern half of an internal tower, which has been carried up so as to provide a small fourth floor and a flat roof. Built into the eastern containing wall and placed between two plane trees is a gateway, the gift of the Pewterers' Company, in whose hall it stood before demolition. This is believed to date from about 1668–69, and it is suggested that it may be from a design by Wren.

The Earl of Athlone, who lunched at the college and unveiled a mural tablet in Foster Court to the memory of the first Provost, was joined by Princess Alice for the opening ceremony. In his speech he stated that the department of zoology was established in 1828, when Professor R. E. Grant, in his first course of lectures, proclaimed himself a believer in evolution. In 1874 Edwin Ray Lankester was appointed to the chair of zoology, and under his régime practical teaching was introduced. Lankester's personality drew to him many men of great ability, who passed on from the college to fill a large proportion of the chairs of zoology of the Empire. His influence determined the whole character of the teaching of zoology for half a century.

To ensure an adequate training for students of zoology it had become necessary to provide staff and laboratories for the study of genetics, comparative physiology and animal behavior. Through the generosity of the Rockefeller Foundation, the London County Council and Dr. Rodocanachi, it had been found possible to establish posts in those three subjects, to provide those who may be appointed to them with the laboratories and equipment and library facilities, and to bear the heavy cost of their research.

Professor Sir John Rose Bradford, chairman of the College Committee, presided, and was supported by Dr. Allen Mawer, Professor L. N. G. Filon and Professor D. M. S. Watson.

THE WISCONSIN ALUMNI RESEARCH FOUNDATION

THE Wisconsin Alumni Research Foundation has made grants-in-aid to the University of Wisconsin for next year in a sum sufficient to prevent the suspension of its research program which has been threatened by reduced appropriations.

The grants have been approved by the Board of Regents. The exact amount can not be determined until the revised salary schedules for 1933–34 have been fixed and other details of the research program completed.