Research in Pediatrics for a period of ten years was accepted. An academy committee on awards was appointed, consisting of: Drs. Joseph Brennemann, Chicago; Irvine McQuarrie, Minneapolis; Oscar M. Schloss, New York; Edwards A. Park, Baltimore, and Borden S. Veeder, St. Louis (*chairman*). The committee announces the following rules and regulations governing the award: Two awards, one of $500 and one of $300, will be given annually at the annual meeting of the Academy of Pediatrics; the awards will be made for research work published during the previous calendar year; there is no limitation as to the type or scope of the research except that it be in the field of pediatrics; the award is limited to workers in the United States and Canada; the award shall be limited to investigators who have been graduated not more than 15 years previous to the publication of the research; there is no restriction as to the journal of publication of the research. The award in 1939 will be given for research published during the period January 1, 1938, through December 31, 1938, by a graduate of 1923 or later. The award in 1940 will be given for research published January 1, 1939, through December 31, 1939, by a graduate of 1924 or later, and so on for subsequent years.

THROUGH the bequest of the late William Campbell, for many years Howe professor of metallurgy at Columbia, there have been established the William Campbell fellowships, primarily for scientific research in the field of metals. These fellowships become available for the first time for the academic year 1939–40 for graduate study and research at Columbia University. They carry stipends up to $1,200 per annum as determined by the Campbell Fellowship Committee. Applications accompanied by certified transcripts of academic records, proposed research projects and proposed fields of graduate studies should be filed with the Dean of Engineering, Columbia University, New York City, before March 15.

THE Graduate School of the University of Illinois announces the establishment of four research fellowships to be awarded for one year in the fields of medicine and dentistry in Chicago at a stipend of $1,200 per year (calendar year with one month's vacation). Fellows are eligible for reappointment in competition with the new applicants. Candidates for these fellowships must have completed a training of not less than eight years beyond high school graduation. Applications should be made before March 1. Announcement of the fellowship awards will be made on April 1, becoming effective on September 1. Applications should be made before March 1 to the secretary of the Committee on Graduate Work in Medicine and Dentistry, 1853 W. Polk Street, Chicago, Ill.

ACCORDING to a correspondent of the *Journal* of the American Medical Association, the Association of Physicians in Poland has taken strong action to withdraw Jews from the medical profession. A deputation of the association appealed to the medical departments of all Polish universities not to admit Jews. The demands have been partially followed by the universities. The percentage of Jewish candidates admitted lately to the medical departments in all Poland amounts only to 3.7.

DISCUSSION

DO THE ISOTOPES OF AN ELEMENT HAVE IDENTICAL CHEMICAL PROPERTIES?

THE answer to this question has definitely changed in the last few years. For many years it has been erroneously concluded that the chemical properties of isotopic molecules were exactly identical in every respect. Text-books published within the last year even carry such statements. Many scientists engaged in other fields of research are not aware of recent developments which have changed the answer to this question. In view of recent theoretical calculations and important and dramatic successes in the separation of a number of isotopes by chemical means, our old concept will certainly require some modification. The isotopes of hydrogen, nitrogen, carbon, oxygen, lithium and potassium have all been shown, through fractionation by chemical means, to have small differences in their chemical characteristics.

Since all the isotopes of an element have the same atomic number, that is, the same number of external electrons, we expect them to have the same *kind* of chemical properties, but since the atomic mass is different, we may expect a small difference in the rate or extent to which certain reactions take place. This is what has been found to be true. After the discovery and separation of the hydrogen isotopes, these differences were abundantly verified. Since the mass of deuterium is twice that of hydrogen and since the energy content of their molecules is markedly different, we should expect differences to occur particularly in such properties as rate of reaction, equilibrium states, electrolytic separation and biological behavior. Differences in the rate or extent of various reactions have been found to be from a few per cent. to over a thousand per cent.

The failure for many years to achieve a separation of other isotopes by chemical means led to the erroneous conclusion that their chemical behavior must be

exactly identical. Some years ago it was pointed out on theoretical grounds that there should be small differences in chemical behavior, and in 1935 Urey and Greiff made calculations for a whole series of isotopic chemical exchange reactions, a number of which have been used in attempts to separate the isotopes of the lighter elements. Among the two-phase gas-liquid chemical reactions which Urey and his co-workers have succeeded in obtaining some fractionation of the isotopes are: (1) The reaction of ammonia gas with ammonium ion in solution; (2) the reaction of ammonia gas with solvated ammonia in water and in alcohol; (3) the reaction of sulfur dioxide gas with bisulfite ion in solution; (4) the reaction of carbon dioxide with bicarbonate ion in solution. In all these cases the heavier isotope prefers to form the ion and is therefore concentrated in the solution. In this respect the heavier isotope is slightly different chemically from the lighter isotope. The fractionation factors α, which in these cases are the same as the equilibrium constants, give a measure of the chemical differences and are as follows:

(1) $N^{15}H_3 + N^{14}H_4^+ \leftrightarrows N^{14}H_3 + N^{15}H_4^+$ $\alpha = 1.021$
(2) $N^{15}H_3 + N^{14}H_{3(aq)} \leftrightarrows N^{14}H_3 + N^{15}H_{3(aq)}$ $\alpha = 1.006$
(3) $S^{34}O_2 + HS^{32}O_3^- \leftrightarrows S^{32}O_2 + HS^{34}O_3^-$ $\alpha = 1.015$
(4) $C^{13}O_2 + HC^{12}O_3^- \leftrightarrows C^{12}O_2 + HC^{13}O_3^-$ $\alpha = 1.014$

These differences are of the order of 1 to 2 per cent. compared to 300 per cent. to 1000 per cent. for the electrolytic separation of hydrogen and deuterium. However, with sufficient repetition of these equilibrium stages in a counter-current system, appreciable separation of the isotopes can be achieved. By use of reaction (1) Dr. Thode, Dr. Urey and their co-workers at Columbia University have recently announced that they have increased the concentration of N^{15} from 0.3 per cent. to 73 per cent., a remarkable accomplishment and an important one particularly for biological studies.

Lewis and Macdonald, of the University of California, using a counter-current flow of lithium in a mercury amalgam and lithium chloride in an ethyl alcohol solution, increased the concentration of Li^6 from 8 per cent. to about 16 per cent. The Li^6 was preferentially held in the amalgam and in this respect is slightly different chemically from Li^7. A number of investigators, including the present author, have studied the electrolysis of lithium from salt solutions into flowing mercury electrodes. Differences in the rate of discharge of the isotopes ranging from 2 per cent. to 7 per cent. have been observed. These differences are very much smaller than for electrolytic separations of hydrogen and deuterium, but are indeed real.

The present author in collaboration with Dr. Urey has also succeeded in obtaining a small fraction of the lithium and potassium isotopes by chemical exchange with zeolites. Zeolites are complex alkali alumino-silicates commonly used in water softening. The alkali ion is replaceable by other positive ions, and one isotope of lithium, for example, replaces sodium better than the other:

$$Li^+ + Na\ \text{Zeolite} \leftrightarrows Li\ \text{Zeolite} + Na^+$$

The differences are again small, but by use of a 100-foot column, appreciable changes in the isotope ratio were produced. Further studies on these zeolite reactions and other similar reactions are being carried out at the University of Minnesota in attempts to obtain a larger separation of the biologically important and significant potassium isotopes.

It is indeed fortunate that the isotopes of an element all undergo the same *kind* of chemical reaction, otherwise their use in "exchange reactions" and "tracer" reactions would be impaired. By determining the extent to which a light isotope exchanges with a heavy isotope in contact with a molecule, one is in a position to say something about the binding or reactivity of the exchanging atoms. Groups containing the heavy isotope may be followed from one molecule to another in order to determine structure or reaction mechanisms. By synthesizing fats containing heavy hydrogen or carbon, or amino-acids and proteins containing heavy nitrogen or sulfur, or drugs or other chemicals, we may tag or label the molecule and trace it through biological processes. All we have to do is put it in the molecule such that it will not easily leave and exchange for the lighter isotopes. By analysis of different parts of the animal for the heavy isotope, we can determine where the substances fed or injected have gone. This is an example of a tracer reaction in biological chemistry, a very important new tool in the study of nutrition, biology and medicine.

We may conclude, therefore, that while the isotopic compounds of the lighter elements have a sufficient difference in chemical characteristics to afford a separation by chemical means (difficult as it may be), the differences are not sufficient to interfere with their valuable use in tracer and exchange reactions.

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SPAWNING OF OSTREA VIRGINICA AT LOW TEMPERATURES[1]

SINCE the end of the last century it has been generally accepted among aquatic biologists that under natural conditions the eastern oyster (*O. virginica*) may spawn only when the water temperature reaches

[1] Published with the permission of the U. S. Bureau of Fisheries.