Experiments which we have made on the temperature coefficient of the fractionation factor which are very preliminary indicate that the energy of activation for the process of the escape from the electrodes differs by approximately 1,100 to 1,500 cals., depending on whether it is an H^1_2 or H^1H^2 molecule which escapes. Eyring has suggested that the cause of this fractionation is due to this difference in the energy of activation, and the results which we have secured are of about the order of magnitude to be expected on the basis of his theory.

Newer theories in regard to the velocity of chemical reactions postulate with Arrhenius that there is a certain minimum energy of activation which is necessary for chemical reactions to go with finite velocity. Thus the average molecule at ordinary temperatures or the average pair of molecules at ordinary temperatures will not react, but must be raised to higher energy states before they will do so. In the case of the hydrogen isotopes, we could not at present say very much about the differences in energy between the activated molecules containing H^1 and those containing H^2. Thus the details of the excited states are beyond us at present, or at least this is certainly true so far as any detailed satisfactory discussion is concerned, but we do understand fairly well the unactivated energy states.

The principal difference between the compounds containing the heavy hydrogen and the light hydrogen will be in the zero point energies. This is a residual vibrational energy which the molecule does not lose, even at the absolute zero. It amounts to $\frac{1}{2}$ hν per molecule, where h is Planck's constant and ν is the frequency of vibration of the two atoms of a diatomic molecule relative to each other. The frequency ν depends upon the mass of the atoms of the molecule. Thus the ν's for the H^1_2 and H^2_2 molecules are in the inverse ratio of the square roots of the atomic weights. Hence, it must follow that the residual vibrational energy of the H^2 molecule is less than that of the H^1 molecule, and the calculated difference amounts to 1788.9 cals. per gram molecule. In order for the H^2_2 molecule to react, it must acquire this amount of energy more than the amount required for the H^1_2 to react, on the assumption that no other differences enter in, which is probably not exact. This difference alone will lead us to expect that the relative velocities will be in the ratio exp $\frac{1788.9}{RT}$, which amounts at 700° K to 3.6. In addition to this effect, there are fewer collisions between the heavy molecules of a gas, other things being equal, which also favors the higher velocity of the reaction of the H^1_2 molecules.

The physiological differences between the compounds of the two hydrogens may be of very great importance in physiological studies. Professor Lewis has found that tobacco seeds did not sprout in this water, and Professor Taylor and his coworkers at Princeton have found that animals will not live when placed in the higher concentrations of the deuterium oxide.

The causes for these effects are not entirely clear, but from our own studies in regard to the differences in equilibrium constants, we believe it possible that the ionization constant for the deuterium oxide may be quite different from that of protium oxide. This would have a very marked effect upon living organisms.

In addition to this, the velocities of reactions within living organisms involve hydrogen atoms to a large extent, and since the velocities of chemical reactions may be markedly different, depending upon which isotope is used, it would not be at all surprising if the nice balance of chemical reactions taking place in living organisms would be disturbed to such an extent that life would be impossible. It will be interesting indeed to see whether animals can be acclimatized to the new water.

As to the question of possible industrial uses, no safe predictions can be made. Witness the uses for such substances as neon and argon! New methods of concentrating deuterium may be discovered, materially reducing its cost. The intense research activity here and abroad is likely to result in uses for it. Perhaps it will be as valuable as a by-product of the hydrogen and oxygen electrolytic plants as argon and neon are of the liquid air plants.

OBITUARY

FREDERICK LINCOLN CHASE

FREDERICK LINCOLN CHASE was born at Boulder, Colorado, on June 28, 1865, the son of George Franklin and Augusta Anne (Staples) Chase. He was graduated, A.B., at the University of Colorado in 1886 and was called to Yale Observatory as assistant astronomer in 1890. In 1910 after the retirement of Dr. Elkin from the directorship on account of ill health, Chase succeeded him with the title acting director; but his own health failed soon thereafter, and in 1913 he resigned his post and retired to his farm in Colorado, where he lived until his death on November 9 of this year.

Chase was an unusually able observer. In collaboration with Dr. Elkin and with Mr. Mason Smith he determined with the heliometer the parallaxes of more than two hundred stars, and this at least doubled our direct knowledge at that time of stellar distances. By far the greater part of this observing was done by Chase himself, who for a period of twenty years observed on nearly every favorable night. It is well recognized that the heliometer is one of the most difficult and exacting instruments that the astronomer has been called upon to use.

In addition to his work on stellar parallaxes Chase published a valuable Triangulation of the Victoria Comparison Stars in connection with Gill's determination of the solar parallax from the observation of asteroids; a Triangulation of the Stars in the Cluster Coma Berenices; and a painstaking and conclusive research as to the effect of color on heliometer measures.

In recognition of these and other contributions the French Academy of Sciences conferred jointly upon Elkin, Chase and Smith their Lalande Medal in 1908.

Chase was exceedingly fond of athletics and outdoor life. He was an expert tennis player, especially at doubles; with one of his colleagues at Yale he several times won the Connecticut State Championship. Next to astronomy his chief passion was farming. One year when he was in charge of Yale Observatory he plowed up about five acres of the Observatory plat and sowed it in wheat. He did not get much of a return from this adventure except, as he laughingly said, "the fun of doing it." Both in Connecticut and Colorado he hunted on every occasion that he could, and, in fact, it was while hunting that death overtook him. He was found on the evening of November 9, in the shallow waters of a lake near his home, where he had succumbed a few minutes before to a heart attack.

Chase never married. The nearest relatives who survive him are cousins. His father had died a few years ago, and his mother still more recently. A Colorado friend writes of him, "I never saw a more devoted son than he was to his father and mother, both of whom lived to advanced ages."

Chase expressed some disappointment towards the end of his life as to the value of his arduous labors on stellar parallaxes, expressing the view that his results had been superseded by the more accurate photographic methods that followed. But his colleagues saw much more clearly than he did the pioneer rôle he had played, a rôle that helped to make possible the development of more accurate methods.

FRANK SCHLESINGER

RECENT DEATHS

DR. LYMAN CHURCHILL NEWELL, professor of chemistry at Boston University, died on December 13, at the age of sixty-six years.

DR. JOHN MERRILL POOR, professor of astronomy at Dartmouth College and head of the Shattuck Observatory, died on December 11. He was sixty-two years old.

PROFESSOR ALLISON W. SLOCUM, for thirty-nine years professor of physics at the University of Vermont, died on December 10, at the age of sixty-seven years.

JOSEPH L. MAYER, chief chemist of the Louis K. Liggett Company for more than twenty years and head of the department of chemistry of the Brooklyn College of Pharmacy, died suddenly on December 1, at the age of fifty-eight years.

DR. CLOYD N. MCALLISTER, professor of psychology and head of the Normal School at Berea College, died on October 31, at the age of sixty-three years. He had been at Berea for twenty years.

JAMES H. GIBBONEY, chief chemist of the Norfolk and Western Railway, died at his home, Roanoke, Virginia, October 31, 1933, at the age of fifty-four years. He was analyst for some time for the Virginia Geological Survey.

PROFESSOR ERWIN BAUR, director of the grain experimental station of the Kaiser Wilhelm Institute at Müncheberg, near Berlin, died on December 3, at the age of fifty-eight years.

SCIENTIFIC EVENTS

QUARANTINE AGAINST THE DUTCH ELM DISEASE

SECRETARY OF AGRICULTURE WALLACE has announced the establishment of a new quarantine, effective from October 21, designed to prevent further introductions of the Dutch elm disease from Europe. Following the apparently successful efforts made in Ohio to eradicate the few cases of this disease which cropped up there in 1930, the disease suddenly increased last summer, when an outbreak of considerable intensity was discovered in the environs of New York City, principally in northern New Jersey.

According to a bulletin issued by the U. S. Department of Agriculture:

Almost simultaneously with this development, it was found that elm burl logs were being imported into this country from Europe for the manufacture of veneer. Examination of these logs disclosed the presence in