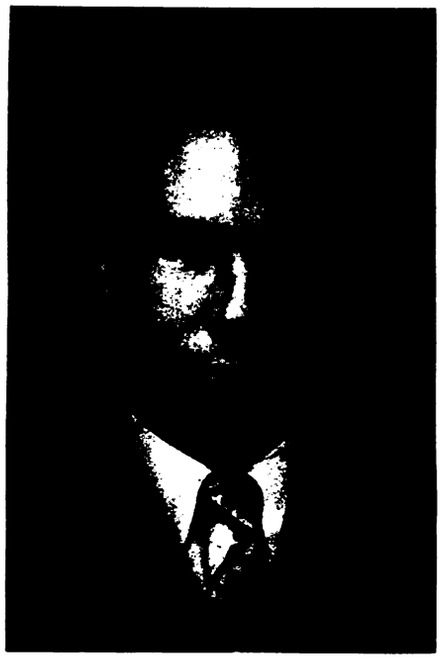

DR. HENRY EYRING

CHEMISTRY

Dr. Eyring Explains Winning Accomplishment

This is the abstract of the paper on "Quantum Mechanics and Chemistry with Particular Reference to Reactions Involving Conjugate Double Bonds" which won the $1000 prize of the A.A.A.S. Atlantic City meeting.

By DR. HENRY EYRING, Princeton University.

THE UNIVERSALLY accepted conception of atoms as positive nuclei surrounded by electrons make it seem obvious that some sort of mechanics of such particles will properly describe their chemical behavior. The success of quantum mechanics in atomic physics where it gives quantitative agreement with experiment, shows us clearly enough the general means to be employed. Because of the complexity of the mathematics, we must use a perturbation theory. A careful application of a perturbation theory, however, may be expected to be as fruitful as such methods have been found to be in astronomy, for example. Among the many results already obtained only a few bearing most directly on the problem in hand can be mentioned.

Heitler and London's calculations for the homopolar bond (*Turn to page* 15)

CHEMISTRY

Chemist Who Works in Library Wins Coveted Award

Textbooks Proved Wrong by Achievement of Young Scientist Which Brings Him A.A.A.S. $1000 Prize

A YOUNG CHEMIST who works with mathematical equations in a library instead of with chemicals in a laboratory has won the $1000 American Association for the Advancement of Science prize for the Atlantic City meeting because his applications of the new quantum mechanics of physics to binding energies between the atoms (valence) have resulted in predictions later verified by experiments. These show that in some cases even elementary text books in chemistry are wrong.

Dr. Henry Eyring, research associate and assistant professor in Dr. Hugh S. Taylor's Frick Chemical Laboratory at Princeton University, is the prize winner. He is 32 years of age.

He has applied quantum mechanics to several branches of chemistry. Through his calculations he utilized the binding energies between atoms in solving problems of how rapidly chemical reactions occur.

The first notable success of his work came two years ago when he showed the conditions governing the conversion of parahydrogen to orthohydrogen. These are two molecular arrangements or varieties of ordinary light-weight hydrogen (atomic weight one) which Prof. Karl Bonhoeffer, then of the Kaiser Wilhelm Institute at Berlin and now at Frankfurt, demonstrated experimentally. There was question as to just how the para sort of hydrogen changed over to the ortho arrangement of the hydrogen atoms. Dr. Eyring's calculations showed that the conversion proceeds more easily by interaction of an atom with a molecule, and not through mere molecular rearrangement.

Mistaken About Flourine

Next Dr. Eyring studied the interaction of hydrogen with fluorine, bromine, iodine, and chlorine, those chemicals known as the halogens. His applications of the new physics showed that contrary to all chemical expectation fluorine is really the least reactive of these chemicals with hydrogen. All the texts and technical chemical literature declared the opposite, that fluorine reacts much more easily than the other elements, chlorine, bromine and iodine.

Here was a clean-cut test of Dr. Eyring's methods. From Germany through experiments performed by Dr. H. Von Wartenburg of Danzig came the verification. He prepared pure fluorine and pure hydrogen and found that they would not react at room temperature. This is what Dr. Eyring predicted and now textbooks that state the contrary are out of date.

Mathematics of Heavy Hydrogen

To the problem of separating ordinary hydrogen from the heavy weight hydrogen discovered a year ago, Dr. Eyring's latest developments of quantum mechanics are applied. This work is not yet announced and will be published in a forthcoming issue of the *Proceedings of the National Academy of Sciences*. At the Bureau of Standards in Washington Dr. E. W. Washburn found recently that when electric current breaks down water into hydrogen and oxygen gas, the first hydrogen given off is almost all lighter hydrogen or the wellknown isotope of mass one. The double weight hydrogen isotope of mass two is given off practically not at all in the early stages of electrolysis. Dr. Eyring has shown that this is a necessary consequence of his method of calculating the speed of chemical reactions when applied to surfaces such as those of the electrodes through which the electricity is applied to the water.

In his prize paper delivered to the American Association, Dr. Eyring extended his methods to organic chemistry. Bromine might be added to an organic molecule, butadiene, by two alternative methods. Dr. Eyring calculated which of these methods occurred more easily. His result indicates that the addition occurs in that manner which experiments by organic chemists had showed to be that actually occuring. But he also showed by calcu- (*Turn Page*)

lations that the reaction should not occur at ordinary temperatures when only the gaseous substances are present. He therefore concludes that the reaction which commonly occurs must be accelerated by other substances present, either by solvents or by impurities in the two compounds, which are known as catalysts.

Catalysts or "parson chemicals" play extremely important roles in many industrial chemical processes, being key or trigger substances in hydrogenation, fixation of nitrogen and many other processes even though they do not partake in the reactions themselves. The theoretical pencil-and-paper work of Dr. Eyring therefore promises to illuminate some of the mysteries in this field of chemistry. Dr. Hugh S. Taylor, head of Princeton's chemistry department, has fitted Dr. Eyring's theoretical work into an extensive program of chemical exploration that is now in progress.

Dr. Eyring was born in Mexico of American parents and while an American by heritage and training he is finding it necessary to take legal steps to acquire American citizenship. He is married and has one child. Chemistry is his recreation as well as his vocation.

He was trained as a mining engineer at the University of Arizona, received his Ph. D. in chemistry in 1927 at the University of California, spent 1929-30 at the University of Berlin as National Research fellow, then returned to the University of California as an instructor under the famous Dr. G. N. Lewis. He has been research associate and assistant professor at Princeton since September, 1931.

Science News Letter, January 7, 1933

ANTHROPOLOGY

Man Had Toothache 50,000 Years Ago

MAN'S prehistoric ancestor, Neanderthal Man of 50,000 years ago, must have had toothache, too. Evidences of dental decay and impacted teeth dating that far back are described by Dr. Bernhard Wolf Weinberger, dentist of New York City.

The earliest dentists used some of the same materials, such as gold and silver, and some of the same type of instruments that are now used in dentistry. Pre-Inca Indians sought for means of preserving the individual tooth when it was diseased or decayed, while Old World dentists seem only to have been interested in supplying missing teeth.

Science News Letter, January 7, 1933

PHYSICS

Millikan and Compton Debate Cosmic Ray Facts and Theories

Leaders in Physics Agree About Most of Experiments But Uphold Different Theories Concerning Strange Radiation

TWO OF America's leading physicists, both Nobelists, discussed facts and theories about cosmic rays before the American Association for the Advancement of Science.

About most of the experimental facts they agreed. About the deductions from thousands of experiments performed by scores of investigators ranging the world, they largely disagreed.

Dr. Robert A. Millikan, of California Institute of Technology, upheld strongly as a fact his conclusion that the cosmic rays that enter the earth's atmosphere are photons, like X-rays and gamma radiations of the same family as light and heat.

Dr. A. H. Compton, of the University of Chicago, found "no way of reconciling the data with the hypothesis that any considerable portion of the cosmic rays consists of photons." He concludes that cosmic rays come from outer space as high speed electrified particles, either negatively charged electrons or positively charged protons.

As to what causes the discharging of the sensitive electrical instruments used in detecting the effects of cosmic radiation, Drs. Compton and Millikan agree. Very energetic electrified particles produce the effect, but whereas Dr. Compton considers them the original rays, Dr. Millikan advanced evidence that they are secondary radiation produced in the earth's air by photons smashing into the hearts of air atoms.

X-ray Similarity

To account for the very penetrating radiations that Dr. Millikan and others have observed in the depths of lakes, Dr. Compton countered with the suggestion that electron cosmic rays produce photons in the earth's atmosphere just as electrons striking an X-ray tube target produce X-rays.

His argument fell in line with experimental evidence for a new process of ionization presented to the same session by Dr. Gordon L. Locher, a National Research fellow at the Bartol Research Foundation, near Philadelphia. X-rays are produced in the gas of a detecting chamber by the passage through of swiftly moving particles like electrons, according to Dr. Locher.

Reporting the results of airplane flights this past summer in the United States, Canada and Peru, at altitudes up to twenty-one thousand feet, Dr. Millikan explained that a new type, very sensitive, recording electroscope developed with Dr. H. Victor Neher showed differences in cosmic ray readings at high altitudes that may possibly be explained by a new cause, a modification of the earth's electrical field connected with some secondary influence of sunlight. Changes in the earth's negative electric field such as occur between day and night would change the resistance to the inflow of the secondary negative particles generated by the cosmic rays. But the rays that get down to sea level are so hard that the earth's electrical field would not affect them. This fits in with a lack of significant latitude variation in cosmic ray readings made at sea level by Dr. Millikan and others recently and in past years.

Magnetism Blamed

Dr. Compton and his associates in a world-wide survey during the past eighteen months found larger variations with latitude in cosmic ray intensities on the tops of high mountains. This he attributes to the effect of the magnetic field of the earth, since the earth's magnetism would theoretically keep electrified-particle cosmic rays from reaching the equatorial regions where the Compton experiments show cosmic rays to be less.

As to the energies of cosmic rays, there is difference of opinion. Dr. Millikan cited the experiments of his colleague, Dr. Carl D. Anderson, to show that observed cosmic ray energies lie largely below five hundred million volts and that less than a tenth reach the billion volt range. (*Next Page*)