NUCLEAR PIONEER LECTURER

Kasimir Fajans

Dr. Kasimir Fajans has been a Professor Emeritus of Chemistry at the University of Michigan, Ann Arbor, since 1957. While this Pioneer Lecture will be his first professional contact with Nuclear Medicine, he has had personal relations with medical men for a long time and his acquaintance with the atomic nucleus began with the birth of the latter as a scientific concept. He was among the small group of young scientists who attended the lecture given on March 7, 1911, at the Manchester Philosophical Society in which Professor Ernest Rutherford concluded that there must be an electrically charged nucleus in the center of each atom.

Fajans attended high school at Warsaw in Russian Poland and studied in Germany at the Universities of Leipzig and Heidelberg, where he obtained the Dr. phil. nat. in 1909. He did post-doctoral work at Zürich, Switzerland in 1909-10, and at Manchester, England in 1910-11. During the years 1911-17 he was Lecturer at Karlsruhe, 1917-35 Professor at the University of Munich. His first visit to the U.S.A. was as Baker Lecturer at Cornell University in 1930 where the news reached him that the Rockefeller Foundation had granted the funds necessary for erection in Munich of an institute for physical chemistry whose director he became in 1932. This activity terminated for political reasons at the end of 1935 and after a short stay in Cambridge, England, he became professor of chemistry at The University of Michigan.

Fajans was very fortunate having had among his teachers and colleagues numerous outstanding men, and among his research students excellent experimenters. At Leipzig, Wilhelm Ostwald was the great leader in the new field of physical chemistry. At Heidelberg, Georg Bredig conducted Fajans' doctoral thesis in stereochemical catalysis. In the physics seminar of Philipp Lenard, he reported on a paper by Rutherford and Geiger of 1908; this had a decisive influence on his further development.

In Zürich, attempting to improve his insufficient understanding of the binding forces in carbon compounds, Fajans joined the highly successful organic chemist, Richard Willstätter. He soon realized that this attempt was premature, but got some insight into the modern physics attending the lectures of the young, but already famous Albert Einstein.

In Manchester, Rutherford was the ingenious and most helpful leader surrounded by a group of enthusiastic coworkers. Several of these young men later became outstanding on their own merits: J. Chadwick, Charles Darwin, H. Geiger, G. von Hevesy, and H. G. Moseley. It is amazing how simple were the concepts and the apparatus used which led to fundamental clarifications, a great contrast to the present state of research.

At Karlsruhe, Fajans continued the work in radioactivity in the Institute of Physical Chemistry directed by Bredig. In Munich, where Willstätter became Director of the Chemical Laboratory, Fajans was asked to start a division of physical chemistry. W. Röntgen was there as professor of experimental physics, A. Sommerfeld in theoretical physics, P. Groth in mineralogy and crystallography. O. Hönigschmid was invited as professor of analytical chemistry and his atomic weight determinations helped to confirm the Fajans-Soddy theory of the stable isotopes of lead. In Sommerfeld's seminar the progress of quantum theory was

discussed by outstanding guests and local students, among whom were the future leaders W. Heisenberg, W. Pauli, and H. Bethe.

A short time after Fajans' activity in Munich had ended, Moses Gomberg became Professor Emeritus at the University of Michigan, and Fajans was offered a Professorship. He taught students of physics as well as graduate students of chemistry. The doctoral theses of several of his research students were in the field of radiochemistry. These men cooperated with the team of physicists who, under the direction of James Cork, bombarded many elements in the cyclotron. The radiochemical training which Fajans' students acquired proved to be very helpful when the needs of the Manhattan Project required the cooperation of radiochemists. On this occasion Fajans came into contact with S. K. Allison, A. H. Compton, E. Fermi, G. T. Seaborg, F. H. Spedding, and H. Urey.

The research activity of Fajans and his associates extended from 1908 to the present day to numerous branches of physical and general chemistry. As the two main fields one can name radioactivity and isotopes on the one hand, and problems of chemical binding on the other.

In Manchester he found the first case of the branching of a radioactive series at RaC and determined with Moseley the very short half-lives of ThA (0.1 sec) and AcA (0.002 sec). In Karlsruhe he recognized the contrast between α- and β-transformations with respect to the resulting change of the electrochemical and chemical character of the radioelements involved. This led to the establishment of the radioactive displacement laws and to the placing of all radioelements in the periodic system, several of them at the same place. Hence the name isotopes was initiated by Frederick Soddy who also contributed to these clarifications. Further consequences were the discovery with O. Göhring of the first isotope of element 91, and the demonstration of various investigators that lead samples from uranium and thorium minerals have different atomic weights than common lead.

Fajans found in 1913 that the half-lives of isotopic α-emitters decrease, and those of β-emitters increase with diminishing mass. Only a few exceptions were observed for the naturally occurring radioelements. Now, with the knowledge of many artificially produced isotopes, the α-rule can be considered as a part of a more complex generalization.

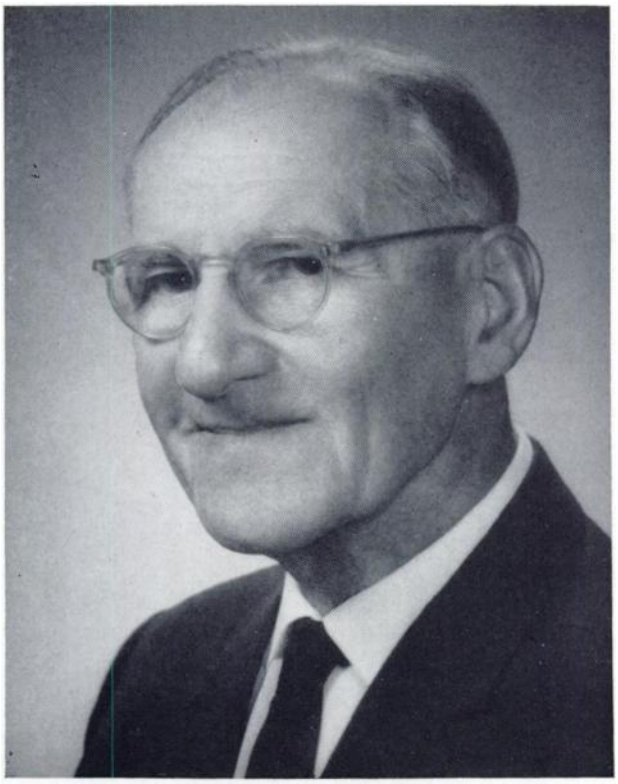
Another rule, formulated in Karlsruhe with P. Beer, was concerned initially with the conditions of the coprecipitation of a radioelement present in extremely small concentrations. It became directly and indirectly the starting point of a broad field of investigations. The rule itself has been extended to Fajans-Paneth-Hahn rule concerning coprecipitation and adsorption of radioelements and dye-ions. The electric charge of the precipitate or adsorbent proved to be one of the dominant factors in these phenomena. The inclusion of silver halides as adsorbents led to the study of their photochemical properties, of light absorption, and to a new method of volumetric analysis with the use of adsorption indicators.

The latter phenomena were recognized to be closely related with the deformation of electronic systems or polarization of ions and molecules. The polarization proved to be fundamental for the understanding of chemical binding and between 1920 and 1925 was approached also from the study of the energy of classical bonds in carbon compounds as well as of the binding in ionic crystals and in solutions of electrolytes. Electronic polarizability and polarization were studied in a long series of refractometric investigations in all states of matter including atomic iodine at 1000° C.

At Ann Arbor, the use of the cyclotron led to the finding of a new radioactive isotope of Pb with A. F. Voigt and of Re with W. H Sullivan. Fajans considers

as his most important achievement in the field of chemical binding the recognition with T. H. Berlin in 1943 that the electronic system of a molecule or crystal is subdivided into groups of definite quantization (quanticules) and that all interactions are due to electric forces acting between the nuclei and electrons within and between the quanticules. This clarified the earlier difficulties in the understanding of organic chemistry, which considered the classical valence bonds to act between neutral atoms. The applications of the quanticule theory are still his main aim.

Among Fajans' books, that on "Radioactivity etc." appeared between 1919 and 1930 in several editions in German, English and Russian. He had been co-editor of "Zeitschrift für Kristallographie." He has lectured in 14 countries and is a member of numerous scientific societies, among them Academies of Sciences in Cracow, Leningrad, and Munich. He holds honorary memberships in nine societies in six different countries. He received the medal of the University of Liège. A "Kasimir Fajans Award in Chemistry" for outstanding doctoral dissertations has been established at The University of Michigan.



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