isolated from about 5 tons of radium residues. The figures for the present "world production" are correlated in Table 5.

TABLE 5

Year	Amount of Pa in milligrams	Remarks
1927	2	
1928	40	At the I.G. Farbenindustrie A.G., in Ludwigshafen on the Rhine.
1934	700	by G. Graue and H. Käding.
1934	200	at Lindsay Light Co., in West Chicago, Ill.

The total quantity of protactinium available at the end of this year will be over 1 gram.

(7) ARTIFICIAL ISOTOPES. (FERMI'S ELEMENT 93)

Experiments carried out this year by E. Fermi and his coworkers[5] in Italy on the bombardment of uranium with neutrons have led him to believe that artificial elements with an atomic number of 93 and 94 have been formed. Particularly the β-ray emitting product from uranium with a half period of 13 minutes and, very recently, the 90–100 minute element were assumed to be isotopes of element 93 because of the similarity of their reactions with manganese[5] and rhenium (element 75)[6] and their dissimilarity from the heaviest elements.

In collaboration with Mr. M. S. Agruss these reactions were repeated with protactinium and found to be both qualitatively and quantitatively identical with those of Element 91.[7]

Whereas Fermi's interpretation of the neutron bombardment can be expressed by the nuclear equation:

$$U_{92}^{238} + {}_0n^1 \rightarrow 93^{239} + \varepsilon^- \rightarrow 94^{239}$$

leading to elements 93 and 94, our results force us to conclude that Element 91 is being formed either according to reaction A or B:

$$_{92}U^{238} + {}_0n^1 \rightarrow {}_{91}Et^{238} + {}_1H^1; \quad {}_{91}Et^{238} \xrightarrow{\beta} {}_{92}U^{238} \ldots\ldots\ldots\ldots A$$

$$_{92}U^{238} + {}_0n^1 \rightarrow {}_{90}Th^{235} + {}_2He^4;$$

$$_{90}Th^{235} \xrightarrow{\beta} {}_{91}Et^{235} \xrightarrow{\beta} {}_{92}U^{235} \ldots\ldots\ldots\ldots B$$

If these interpretations are correct they point a way to the synthetic production of the fourth and as yet unknown radioactive series, with atomic weights $= 4n + 1$ (n being any whole number), by neutron bombardment of members of the thorium series, as exemplified by the equation:

$$_{90}Th^{232} + {}_0n^1 \rightarrow 88^{229} + {}_2He^4; \quad 88^{229} \xrightarrow{\alpha \text{ or } \beta} \text{fourth series.}$$

(8) FUTURE PRACTICAL APPLICATION

What are the practical uses of Element 91?

It is yet premature to answer this question. Because of its chemical properties, dissimilar to radium, protactinium might find an application in radiology and medicine, different from radium; also constant formation of actinium might be of large practical value. Perhaps the stability in air of the metal or the possibility of plating other metals with it (radio tubes?) will be found useful. We are confident that it will find an application in the future like most of the rare elements; as an example we may remember the case of neon. Twenty-five years ago it was one of the rarest gases in the atmosphere; now its light illuminates the skies.

(9) ACKNOWLEDGMENTS

These investigations, and particularly the extraction of protactinium from radium wastes, required by their very nature large financial expenditures. It was possible to accomplish the work through a generous grant by Mr. Hiram J. Halle, of New York City, to whom we express our sincere gratitude.

We are also much indebted to Professor Julius Stieglitz, of our department, for his continuous help and advice; to Dr. Gustav Egloff for the privilege of using the facilities of the Research Laboratories of the Universal Oil Products Company, and to Surgeon General Hugh S. Cumming, of the U. S. Public Health Service, for his early interest and encouragement.

OBITUARY

BAILEY KELLY ASHFORD

IN the death of Dr. Bailey Kelly Ashford at his home in San Juan, Puerto Rico, on November 1, 1934, tropical medical science loses a distinguished investigator and an eminent physician.

Son of a well-known physician and surgeon, Dr. Bailey Ashford was born on September 18, 1873, in the city of Washington. He left George Washington University in his junior year, took up the study of medicine in the Georgetown Medical School and graduated therefrom in the year 1896. The following two

[4] G. Graue and H. Käding, *Naturwissenschaften*, 22: 386, 1934.

[5] See E. Fermi, *Nature*, 133: 898, 1934.

[6] E. Fermi, E. Amaldi, O. D'Agostino, F. Rasetti and E. Segré, *Proc. Roy. Soc.*, A. 146: 495, 1934.

[7] A. V. Grosse and M. S. Agruss, *Phys. Rev.*, 46: 241, 1934; results with rhenium yet unpublished.

years he dedicated to specializing in the Army Medical School and was commissioned from it as assistant brigadier surgeon of the expedition of 1898 to Puerto Rico. Shortly after his arrival he made his first important contribution to science and to mankind.

On November 24, 1899, he announced that he had found "the cause of many pernicious, progressive anemias of the Island to be due to *Ankylostomum duodenale*." Soon after this discovery Dr. Ashford was instructed by the chief surgeon to aid the Superior Board of Health in preparing a pamphlet on anemia, its causes, treatment and prevention, which appeared in 1900. Following this publication, others have appeared on the subject of uncinariasis, many of which are to-day regarded as the most complete and accurate expositions of the hookworm problem extant.

In December of 1897 he returned to Washington, carrying with him the worms he had obtained from several of his anemic patients. These parasites he left in the hands of Dr. Albert Hassall, who, recognizing the possibility of their being a new species, recommended a more detailed study of them. His supposition proved correct, and later they were named by Dr. Stiles *Necator americanus*.

Realizing the importance of this discovery and the significance of a disease which accounted for over thirty per cent. of the total high mortality at that time, Dr. Ashford expressed his earnest desire to return to the island in order to do further research. His request was granted, but the importance of his work in the treatment and prevention of uncinariasis was not fully realized until the year 1904, at which time the government of Puerto Rico provided funds for the study and treatment of anemia, and authorized the organization of the Porto Rico Anemia Commission. The personnel of this commission was made up of the early associates of Dr. Ashford, namely, Dr. Pedro Gutiérrez Igaravídez, Dr. Walter King and Dr. I. González Martínez. The results of their work are well known and have stimulated endeavor in various organizations to eradicate hookworm disease throughout the tropical world.

Through these preliminary investigations on tropical diseases, Dr. Ashford saw the importance of developing a center for such purpose. As early as September 5, 1906, he began striving towards the formation of a School of Tropical Medicine in Puerto Rico, and it was his privilege to see completed in May, 1926, the School of Tropical Medicine of the University of Puerto Rico, under the auspices of Columbia University. He was appointed professor of tropical medicine and mycology in this institution, and from that time, until the acute stage of his illness, was most actively engaged in investigating tropical anemias, sprue, filariasis and such like conditions, and at the same time devoted himself to the needs of a large number of patients.

Dr. Ashford's work was not confined only to the Island of Puerto Rico. Soon after the cyclone of 1908, he was commissioned to the state of Mississippi, where he was placed in charge of relief work. In January, 1916, he visited Brazil, at the request of the Rockefeller Foundation, to study and to organize a campaign against tropical diseases, and to demonstrate to the Brazilian the advantages of the field dispensary as a means of extending the public health program far into the interior of the state, and thus get in closer touch with the agricultural laborer. Then came the world war, and in June, 1917, Dr. Ashford enlisted under General W. L. Sibert. In France he was exceedingly active in organizing a school for the training of American officers at Langres and in inspecting dressing stations and the French and British hospitals. Colonel Ashford's activities in the world war, his hostilities against tropical diseases and other incidents of his energetic and varied life are interestingly and well told in his recent book, "A Soldier in Science."

Dr. Ashford received many citations and medals. As a tribute to his rapid rise to distinction and for his incalculable services to the island, the Legislature of Puerto Rico voted him special thanks for his "commendable accomplishments as a benefactor to humanity." The Medical Association of Puerto Rico enrolled him as an honorary member; President Gómez of Venezuela decorated him with the Medal of Public Instruction for his valuable work in the interest of the education of the people of Venezuela. For his services in the field of medicine, the King of Egypt distinguished him with the title of King Commander of the Order of the Nile. The degree of doctor of science was conferred on him from three different sources; from Georgetown University, from the University of Puerto Rico, in recognition of his untiring services to the people of the island, and from Columbia University, in acknowledgment of his achievements in the field of tropical medicine. The University of Egypt accorded him the honorary doctorate of medicine. For his services in the world war the United States Government conferred upon him the Victory Medal; for his activities with the British Government, he was created Companion of the Order of St. Michael and St. George. In December, 1933, the Government of Puerto Rico symbolized the affection of its people for him by presenting them with a bronze bust of Dr. Ashford, which has been placed in the School of Tropical Medicine, the center point of his labors and unselfish service to others. In his speech of acceptance of this gift, which conveys the admiration which the people of Puerto Rico had for

Dr. Ashford, the director of the School of Tropical Medicine said, in part:

> To our immediate Association it will be a silent and ever-present inspiration of courage and victory in the face of overwhelming odds; to the People of Puerto Rico who have made possible this noble gift, it is a visual recognition of the affection felt by rich and by poor alike for one who has given his services freely and impartially. Not only do they regard him as a healer, but as an instructor who has indicated the way to health to thousands of living in hookworm-infested areas. To future generations it will be pointed to with pride, as a symbolized standard of high achievement by which to measure their own attainments.

Dr. Ashford is survived by his wife and three married children, all at present in Puerto Rico. He was buried on November the second, according to the rites of the Episcopal Church, and with full military honors, in the military cemetery of San Juan. Affection and respect were shown by thousands of people, who from all walks of life followed their beloved soldier and scientist to the grave.

GEORGE W. BACHMAN

PHILIPP FISCHELIS

DR. PHILIPP FISCHELIS died at his home in Philadelphia of angina pectoris on Tuesday, October 30, 1934, at the age of 76. He was buried the following Friday at Chelten Hills Cemetery in Philadelphia.

Although not in the best of health for some months he had continued his teaching in the School of Dentistry of Temple University and had lectured to his classes on the afternoon preceding his demise. He returned to his home from a faculty meeting late on Monday, October 29, and passed away shortly after midnight.

Dr. Fischelis was born on December 8, 1857. He studied biology and medicine at various universities in Europe, including Leipzig, Koenigsberg and Berlin. He received the degree of doctor of medicine from the University of Berlin in 1885 and after further study and interneship at hospitals in Berlin he came to the United States in 1889, settling in Philadelphia, where he practised medicine for many years and taught histology, embryology and pathology at several medical and dental colleges. In 1890 he married Ernestine Kempt, who died in 1923. They had three sons and three daughters, all of whom survive.

Among the teaching positions held by Dr. Fischelis are the following: Instructor in rhinology and laryngology at the Philadelphia Polyclinic (1893–1902); demonstrator of histology and embryology, Medico-Chirurgical College of Philadelphia (1903–1909); associate professor (1909–1917); professor of histology, embryology and general pathology and director of laboratories in the Dental School of Temple University, Philadelphia (1917–1934).

His researches in Germany and in this country included work on the development of the thyroid and thymus glands and lungs. He was author of the chapters on reproduction and evolution in "Ott's Physiology" and co-author with Dr. I. N. Broomell of "Anatomy and Histology of the Mouth and Teeth."

He was a member of the American Medical Association, the Pennsylvania and Philadelphia County Medical Societies, the American Association for the Advancement of Science, the American Association of Anatomists, the Association of American University Professors, the National Geographic Societies and other organizations.

A wide circle of friends, colleagues and former students mourn his loss.

A CORRESPONDENT

MEMORIALS

A PORTRAIT of Dr. Otto Knut Olof Folin, who, at the time of his death, on October 25, was Hamilton Kuhn professor of biological chemistry at Harvard, was presented to the university at memorial exercises held in the Medical School on November 23. Professor Walter B. Cannon presented the portrait, and Dr. David L. Edsall, dean of the Medical School, accepted it in behalf of the university. The other speakers were Professor Cyrus H. Fiske and Professor Henry A. Christian. The portrait was originally to have been given in Dr. Folin's presence at a dinner celebrating his service to the university.

AT the fiftieth anniversary meeting of the Association of Official Agricultural Chemists at Washington, Dr. W. D. Bigelow, director of the research laboratories of the National Canners Association of Washington, delivered the fourth Wiley Memorial Address, his subject being "Food Preservation in Relation to Public Health." Dr. Bigelow was the first assistant chief of the Bureau of Chemistry of the U. S. Department of Agriculture, under Dr. Wiley, the first president of the association.

THE Adolph Lomb Optical Library has been presented to the University of Virginia by Henry C. Lomb, of New York, as a memorial to his brother, Adolph Lomb. Liberal provision has been made for the shelving of this special library and for keeping the material up to date. Included in the collection are 706 books, 470 monographs and brochures and 174 bound and 86 unbound volumes of scientific journals. According to Professor Llewellyn G. Hoxton, head of the school of physics, there are among these many rare volumes that can not be found elsewhere in the United States and in but few European libraries.