= Eugene Wigner =

Eugene Paul " E. P. " Wigner (Hungarian : Wigner Jen? Pál ; November 17 , 1902 ? January 1 , 1995) , was a Hungarian @-@ American theoretical physicist and mathematician . He received half of the Nobel Prize in Physics in 1963 " for his contributions to the theory of the atomic nucleus and the elementary particles , particularly through the discovery and application of fundamental symmetry principles " .

A graduate of the Technical University of Berlin , Wigner worked as an assistant to Karl Weissenberg and Richard Becker at the Kaiser Wilhelm Institute in Berlin , and David Hilbert at the University of Göttingen . Wigner and Hermann Weyl were responsible for introducing group theory into physics , particularly the theory of symmetry in physics . Along the way he performed ground @-@ breaking work in pure mathematics , in which he authored a number of mathematical theorems . In particular , Wigner 's theorem is a cornerstone in the mathematical formulation of quantum mechanics . He is also known for his research into the structure of the atomic nucleus . In 1930 , Princeton University recruited Wigner , along with John von Neumann , and he moved to the United States .

Wigner participated in a meeting with Leo Szilard and Albert Einstein that resulted in the Einstein @-@ Szilard letter , which prompted President Franklin D. Roosevelt to initiate the Manhattan Project to develop atomic bombs . Wigner was afraid that the German nuclear weapon project would develop an atomic bomb first . During the Manhattan Project , he led a team whose task was to design nuclear reactors to convert uranium into weapons grade plutonium . At the time , reactors existed only on paper , and no reactor had yet gone critical . Wigner was disappointed that DuPont was given responsibility for the detailed design of the reactors , not just their construction . He became Director of Research and Development at the Clinton Laboratory (now the Oak Ridge National Laboratory) in early 1946 , but became frustrated with bureaucratic interference by the Atomic Energy Commission , and returned to Princeton .

In the postwar period he served on a number of government bodies , including the National Bureau of Standards from 1947 to 1951 , the mathematics panel of the National Research Council from 1951 to 1954 , the physics panel of the National Science Foundation , and the influential General Advisory Committee of the Atomic Energy Commission from 1952 to 1957 and again from 1959 to 1964 . In later life , he became more philosophical , and published The Unreasonable Effectiveness of Mathematics in the Natural Sciences , his best @-@ known work outside of technical mathematics and physics .

= = Early life = =

Wigner Jen? Pál was born in Budapest , Austria @-@ Hungary on November 17 , 1902 , to middle class Jewish parents , Elisabeth (Einhorn) and Anthony Wigner , a leather tanner . He had an older sister , Bertha , known as Biri , and a younger sister Margit , known as Manci , who later married British theoretical physicist Paul Dirac . He was home schooled by a professional teacher until the age of 9 , when he started school at the third grade . During this period , Wigner developed an interest in mathematical problems . At the age of 11 , Wigner contracted what his doctors believed to be tuberculosis . His parents sent him to live for six weeks in a sanatorium in the Austrian mountains , before the doctors concluded that the diagnosis was mistaken .

Wigner 's family was Jewish , but not religiously observant , and his Bar Mitzvah was a secular one . From 1915 through 1919 , he studied at the secondary grammar school called Fasori Evangélikus Gimnázium , the school his father had attended . Religious education was compulsory , and he attended classes in Judaism taught by a rabbi . A fellow student was János von Neumann , who was a year behind Wigner . They both benefited from the instruction of the noted mathematics teacher László Rátz . In 1919 , to escape the Béla Kun communist regime , the Wigner family briefly fled to Austria , returning to Hungary after Kun 's downfall . Partly as a reaction to the prominence of Jews in the Kun regime , the family converted to Lutheranism . Wigner explained later in his life that his family decision to convert to Lutheranism " was not at heart a religious decision but an anti @-@

communist one " . On religious views , Wigner was an atheist .

After graduating from the secondary school in 1920 , Wigner enrolled at the Budapest University of Technical Sciences , known as the M?egyetem . He was not happy with the courses on offer , and in 1921 enrolled at the Technische Hochschule Berlin (now Technical University of Berlin) , where he studied chemical engineering . He also attended the Wednesday afternoon colloquia of the German Physical Society . These colloquia featured such luminaries as Max Planck , Max von Laue , Rudolf Ladenburg , Werner Heisenberg , Walther Nernst , Wolfgang Pauli , and Albert Einstein . Wigner also met the physicist Leó Szilárd , who at once became Wigner 's closest friend . A third experience in Berlin was formative . Wigner worked at the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry (now the Fritz Haber Institute) , and there he met Michael Polanyi , who became , after László Rátz , Wigner 's greatest teacher . Polanyi supervised Wigner 's DSc thesis , Bildung und Zerfall von Molekülen (" Formation and Decay of Molecules ") .

= = Middle years = =

Wigner returned to Budapest , where he went to work at his father 's tannery , but in 1926 , he accepted an offer from Karl Weissenberg at the Kaiser Wilhelm Institute in Berlin . Weissenberg wanted someone to assist him with his work on x @-@ ray crystallography , and Polanyi had recommended Wigner . After six months as Weissenberg 's assistant , Wigner went to work for Richard Becker for two semesters . Wigner explored quantum mechanics , studying the work of Erwin Schrödinger . He also delved into the group theory of Ferdinand Frobenius and Eduard Ritter von Weber .

Wigner received a request from Arnold Sommerfeld to work at the University of Göttingen as an assistant to the great mathematician David Hilbert . This proved a disappointment , as the aged Hilbert 's abilities were failing , and his interests had shifted to logic . Wigner nonetheless studied independently . He laid the foundation for the theory of symmetries in quantum mechanics and in 1927 introduced what is now known as the Wigner D @-@ matrix . Wigner and Hermann Weyl were responsible for introducing group theory into quantum mechanics . The latter had written a standard text , Group Theory and Quantum Mechanics (1928) , but it was not easy to understand , especially for younger physicists . Wigner 's Group Theory and Its Application to the Quantum Mechanics of Atomic Spectra (1931) made group theory accessible to a wider audience .

In these works , Wigner laid the foundation for the theory of symmetries in quantum mechanics . Wigner 's theorem proved by Wigner in 1931 , is a cornerstone of the mathematical formulation of quantum mechanics . The theorem specifies how physical symmetries such as rotations , translations , and CPT symmetry are represented on the Hilbert space of states . According to the theorem , any symmetry transformation is represented by a linear and unitary or antilinear and antiunitary transformation of Hilbert space . The representation of a symmetry group on a Hilbert space is either an ordinary representation or a projective representation .

In the late 1930s , Wigner extended his research into atomic nuclei . By 1929 , his papers were drawing notice in the world of physics . In 1930 , Princeton University recruited Wigner for a one @-@ year lectureship , at 7 times the salary that he had been drawing in Europe . Princeton recruited von Neumann at the same time . Jen? Pál Wigner and János von Neumann had collaborated on three papers together in 1928 and two in 1929 . They anglicized their first names to " Eugene " and " John " , respectively . When their year was up , Princeton offered a five @-@ year contract as visiting professors for half the year . The Technische Hochschule responded with a teaching assignment for the other half of the year . This was very timely , since the Nazis soon rose to power in Germany . At Princeton in 1934 , Wigner introduced his sister Manci to the physicist Paul Dirac , whom she married .

Princeton did not rehire Wigner when his contract ran out in 1936 . Through Gregory Breit , Wigner found new employment at the University of Wisconsin . There he met his first wife , Amelia Frank , who was a physics student there . However she died unexpectedly in 1937 , leaving Wigner distraught . He therefore accepted a 1938 offer from Princeton to return there . Wigner became a naturalized citizen of the United States on January 8 , 1937 , and he brought his parents to the

United States .

= = Manhattan Project = =

Although he was a professed political amateur , on August 2 , 1939 , he participated in a meeting with Leó Szilárd and Albert Einstein that resulted in the Einstein ? Szilárd letter , which prompted President Franklin D. Roosevelt to initiate the Manhattan Project to develop atomic bombs . Wigner was afraid that the German nuclear weapon project would develop an atomic bomb first , and even refused to have his fingerprints taken because they could be used to track him down if Germany won . " Thoughts of being murdered , " he later recalled , " focus your mind wonderfully . "

On June 4 , 1941 , Wigner married his second wife , Mary Annette Wheeler , a professor of physics at Vassar College , who had completed her Ph.D. at Yale University in 1932 . After the war she taught physics on the faculty of Rutgers University 's Douglass College in New Jersey until her retirement in 1964 . They remained married until her death in November 1977 . They had two children , David Wigner and Martha Wigner Upton .

During the Manhattan Project , Wigner led a team that included Alvin M. Weinberg , Katharine Way , Gale Young and Edward Creutz . The group 's task was to design the production nuclear reactors that would convert uranium into weapons grade plutonium . At the time , reactors existed only on paper , and no reactor had yet gone critical . In July 1942 , Wigner chose a conservative 100 MW design , with a graphite neutron moderator and water cooling . Wigner was present at a converted rackets court under the stands at the University of Chicago 's abandoned Stagg Field on December 2 , 1942 , when the world 's first atomic reactor , Chicago Pile One (CP @-@ 1) achieved a controlled nuclear chain reaction .

Wigner was disappointed that DuPont was given responsibility for the detailed design of the reactors , not just their construction . He threatened to resign in February 1943 , but was talked out of it by the head of the Metallurgical Laboratory , Arthur Compton , who sent him on vacation instead . As it turned out , a design decision by DuPont to give the reactor additional load tubes for more uranium saved the project when neutron poisoning became a problem . Without the additional tubes , the reactor could have been run at 35 % power until the boron impurities in the graphite were burned up and enough plutonium produced to run the reactor at full power ; but this would have set the project back a year . During the 1950s , he would even work for DuPont on the Savannah River Site . Wigner did not regret working on the Manhattan Project , and sometimes wished the atomic bomb had been ready a year earlier .

An important discovery Wigner made during the project was the Wigner effect . This is a swelling of the graphite moderator caused by the displacement of atoms by neutron radiation . The Wigner effect was a serious problem for the reactors at the Hanford Site in the immediate post @-@ war period , and resulted in production cutbacks and a reactor being shut down entirely . It was eventually discovered that it could be overcome by controlled heating and annealing .

Through Manhattan project funding , Wigner and Leonard Eisenbud also developed an important general approach to nuclear reactions , the Wigner ? Eisenbud R @-@ matrix theory , which was published in 1947 .

= = Later years = =

Wigner accepted a position as the Director of Research and Development at the Clinton Laboratory (now the Oak Ridge National Laboratory) in Oak Ridge , Tennessee in early 1946 . Because he did not want to be involved in administrative duties , he became co @-@ director of the laboratory , with James Lum handling the administrative chores as executive director . When the newly created Atomic Energy Commission (AEC) took charge of the laboratory 's operations at the start of 1947 , Wigner feared that many of the technical decisions would be made in Washington . He also saw the Army 's continuation of wartime security policies at the laboratory as a " meddlesome oversight " , interfering with research . One such incident occurred in March 1947 , when the AEC discovered that Wigner 's scientists were conducting experiments with a critical mass of uranium @-@ 235

when the Director of the Manhattan Project , Major General Leslie R. Groves , Jr . , had forbidden such experiments in August 1946 after the death of Louis Slotin at the Los Alamos Laboratory . Wigner argued that Groves 's order had been superseded , but was forced to terminate the experiments , which were completely different from the one that killed Slotin .

Feeling unsuited to a managerial role in such an environment , he left Oak Ridge at the end of summer in 1947 and returned to Princeton University , although he maintained a consulting role with the facility for many years . In the postwar period he served on a number of government bodies , including the National Bureau of Standards from 1947 to 1951 , the mathematics panel of the National Research Council from 1951 to 1954 , the physics panel of the National Science Foundation , and the influential General Advisory Committee of the Atomic Energy Commission from 1952 to 1957 and again from 1959 to 1964 . He also contributed to civil defense .

Near the end of his life , Wigner 's thoughts turned more philosophical . In 1960 , he published a now classic article on the philosophy of mathematics and of physics , which has become his best @-@ known work outside of technical mathematics and physics , The Unreasonable Effectiveness of Mathematics in the Natural Sciences . He argued that biology and cognition could be the origin of physical concepts , as we humans perceive them , and that the happy coincidence that mathematics and physics were so well matched , seemed to be " unreasonable " and hard to explain . His original paper has provoked and inspired many responses across a wide range of disciplines . These included Richard Hamming in Computer Science , Arthur Lesk in Molecular Biology , Peter Norvig in data mining , Max Tegmark in Physics , Ivor Grattan @-@ Guinness in Mathematics , and Vela Velupillai in Economics .

Wigner was awarded the Nobel Prize in Physics in 1963 " for his contributions to the theory of the atomic nucleus and the elementary particles , particularly through the discovery and application of fundamental symmetry principles " . The prize was shared that year , with the other half of the award divided between Maria Goeppert @-@ Mayer and J. Hans D. Jensen . Wigner professed that he had never considered the possibility that this might occur , and added : " I never expected to get my name in the newspapers without doing something wicked . " He also won the Franklin Medal in 1950 , the Enrico Fermi award in 1958 , the Atoms for Peace Award in 1959 , the Max Planck Medal in 1961 , the National Medal of Science in 1969 , the Albert Einstein Award in 1972 , and the eponymous Wigner Medal in 1978 . In 1968 he gave the Josiah Willard Gibbs lecture .

Mary died in November 1977 . In 1979 , Wigner married his third wife , Eileen Clare @-@ Patton (Pat) Hamilton , the widow of physicist Donald Ross Hamilton , the Dean of the Graduate School at Princeton University , who had died in 1972 . In 1992 , at the age of 90 , he published his memoirs , The Recollections of Eugene P. Wigner with Andrew Szanton . In it , Wigner said : " The full meaning of life , the collective meaning of all human desires , is fundamentally a mystery beyond our grasp . As a young man , I chafed at this state of affairs . But by now I have made peace with it . I even feel a certain honor to be associated with such a mystery . " In his collection of essays Symmetries and Reflections ? Scientific Essays (1995) , he commented : " It was not possible to formulate the laws of quantum mechanics in a fully consistent way without reference to consciousness . "

Wigner died of pneumonia at the University Medical Center in Princeton , New Jersey on 1 January 1995 . He was survived by his wife Eileen and children Erika , David and Martha , and his sisters Bertha and Margit .

= = Publications = =

1958 (with Alvin M. Weinberg) . Physical Theory of Neutron Chain Reactors University of Chicago Press . ISBN 0 @-@ 226 @-@ 88517 @-@ 8

1959 . Group Theory and its Application to the Quantum Mechanics of Atomic Spectra . New York : Academic Press . Translation by J. J. Griffin of 1931 , Gruppentheorie und ihre Anwendungen auf die Quantenmechanik der Atomspektren , Vieweg Verlag , Braunschweig .

1970 Symmetries and Reflections : Scientific Essays . Indiana University Press , Bloomington ISBN 0 @-@ 262 @-@ 73021 @-@ 9

1992 (as told to Andrew Szanton) . The Recollections of Eugene P. Wigner . Plenum . ISBN 0 @-@ 306 @-@ 44326 @-@ 0
1995 (with Jagdish Mehra and Arthur S. Wightman , eds .) . Philosophical Reflections and Syntheses . Springer , Berlin ISBN 3 @-@ 540 @-@ 63372 @-@ 3