= John Fenn (chemist) =

John Bennett Fenn (June 15 , 1917 ? December 10 , 2010) was an American research professor of analytical chemistry who was awarded a share of the Nobel Prize in Chemistry in 2002 . Fenn shared half of the award with Koichi Tanaka for their work in mass spectrometry . The other half of the 2002 award went to Kurt Wüthrich . Fenn 's contributions specifically related to the development of electrospray ionization , now a commonly used technique for large molecules and routine liquid chromatography @-@ tandem mass spectrometry . Early in his career , Fenn did research in the field of jet propulsion at Project SQUID , and focused on molecular beam studies . Fenn finished his career with more than 100 publications , including one book .

Fenn was born in New York City , and moved to Kentucky with his family during the Great Depression . Fenn did his undergraduate work at Berea College , and received his Ph.D. from Yale . He worked in industry at Monsanto and at private research labs before moving to academic posts including Yale and Virginia Commonwealth University .

Fenn 's research into electrospray ionization found him at the center of a legal dispute with Yale University . He lost the lawsuit , after it was determined that he misled the university about the potential usefulness of the technology . Yale was awarded $ 500 @,@ 000 in legal fees and $ 545 @,@ 000 in damages . The decision pleased the university , but provoked mixed responses from some people affiliated with the institution , who were disappointed with the treatment of a Nobel Prize winner with such a long history at the school .

= = Early life and education = =

Fenn was born in New York City , and grew up in Hackensack , New Jersey . In the years preceding the Great Depression , Fenn 's father worked several different jobs , including briefly working as a draftsman at the Fokker Aircraft Company . During this time , Charles Lindbergh 's plane The Spirit of St. Louis was briefly stored at one of the company 's hangars . Fenn recalls sitting in the cockpit as a ten @-@ year @-@ old , pretending to pilot the famous plane . When his family 's fortunes took a turn for the worse with the advent of the Depression , they moved to Berea , Kentucky . Fenn completed his education at Berea College and Allied Schools , formally finishing his high school education at the age of 15 , but he took extra classes for another year rather than start college at such a young age . He earned his bachelor 's degree from Berea College in his new hometown , with the assistance of summer classes in organic chemistry at the University of Iowa , and physical chemistry at Purdue .

When Fenn was considering graduate school , he was advised to take additional mathematics courses by Henry Bent , then a chemistry professor at Harvard University . His undergraduate program in chemistry had required minimal math courses , and he had been excused from these due to high marks in his high school courses . Due to Bent 's advice , Fenn added math classes to his schedule . Despite his future success , Fenn always felt that his lack of mathematical skills were a hindrance in his career . After submitting several applications , Fenn received offers for teaching assistantships from Yale and Northwestern , and accepted the position at Yale . Fenn did his graduate studies in physical chemistry under Gosta Akerlof . He obtained his Ph.D. in chemistry from Yale in 1940 and his thesis was 45 pages long , with only three pages of prose .

= = Research career and academic posts = =

After completing graduate school , Fenn 's first job was with Monsanto , working in the Phosphate Division and producing polychlorinated biphenyls (PCBs) . Fenn and his colleague James Mullen became disenchanted with the direction of work at Monsanto , and they resigned together in 1943 . Fenn worked briefly at a small company named Sharples Chemicals that focused on the production of amyl chloride derivatives . In 1945 , he joined Mullen at his new startup , Experiment , Inc , focusing on research and development . Fenn 's first publication came in 1949 as a result of his work with Mullen . That this publication came ten years after he completed graduate school made

Fenn somewhat of a rarity amongst academics .

In 1952 , Fenn moved to Princeton University as Director of Project SQUID , a program to support research related to jet propulsion that was funded by the Office of Naval Research . During this period , Fenn started his work developing supersonic atomic and molecular beam sources , which are now widely used in chemical physics research . After working with Project SQUID , Fenn returned to Yale University in 1967 . He held a joint appointment in the chemistry and engineering departments until 1987 , conducting much of his research in Mason Laboratory . In 1987 , Fenn had reached Yale 's mandatory retirement age . He became a professor emeritus , entitling him to office space at the university , but costing him most of his laboratory space and research assistants .

After a dispute with Yale over his forced retirement and the rights to his invention of electrospray ionization , Fenn moved to Richmond , Virginia to join Virginia Commonwealth University 's (VCU) Department of Chemistry as an analytical chemistry professor . VCU established an engineering department in the late 1990s , and Fenn held a joint professorship between the two departments until his death . Even in his 80s , Fenn enjoyed the opportunity to be in the lab doing research , saying , " I like to mingle and exchange with the young people . It gets me out from underfoot at home . "

= = Research interests = =

While Fenn was working with Monsanto , the company 's research was focused on the production of phosphoric acid and polychlorinated biphenyls (PCBs) . Fenn and his colleagues at Monsanto were largely unaware of the health hazards posed by PCBs , indeed because of their inertness , they " practically bathed in the stuff " . After spending several more years doing various industrial research , Fenn was looking to get back into the academic world . He had the opportunity to go to Princeton University , where he became the director of Project SQUID .

Fenn did not start his Nobel @-@ winning research until later in his career . He was semi @-@ retired when he first published his research on electrospray ionization for mass spectrometry . Fenn felt that his work in electrospray ionization received " a kick in the pants " when proteomics emerged . In 2001 , more than 1700 papers on proteomics were published , many using electrospray ionization . Electrospray ionization provides a way to get accurate information about the mass of a large molecule very quickly , even when it is in a mixture of other molecules . The liquid sample is introduced into an electrospray source (at atmospheric pressure) and desolvated with a flow of heated nitrogen gas . This forms small droplets which evaporate in a region under vacuum , which increases the charge on the droplets . For large molecules like proteins , this often results in multiply charge species . Increasing the charge on the molecules , decreased the mass to charge ratio , which allows the mass to be more easily determined .

Despite getting a late start in publishing his research (he did not publish a paper until 10 years after finishing graduate school) , Fenn had over 100 publications at the time of his death . He also wrote a book , entitled Engines , Energy , and Entropy : A Thermodynamics Primer . The Chemical Heritage Foundation Museum in Philadelphia , PA has the instrument Fenn and his graduate students built while they were developing electrospray ionization on display , after receiving it as a gift from Fenn .

= = = Lawsuit = = =

Fenn 's work with electrospray ionization was at the center of a lawsuit pitting him against his alma mater and former employer , Yale University . His initial dispute with the university began in 1987 , when he turned 70 - Yale 's mandatory retirement age . Per university policy , Fenn was made an emeritus professor , which resulted in a reduction to his lab space . Emeritus professors at Yale are still provided with an office , but cannot conduct their own research , nor manage their own labs . In 1989 , when Yale University inquired about the progress and potential about his electrospray work , he downplayed its potential scientific and commercial value . Fenn believed he had the rights to the invention under the Bayh @-@ Dole Act . Fenn patented the technology on his own , and sold

licensing rights to a company he partly owned - Analytica . In 1993 , a private company seeking to license the use of electrospray technology traced its invention to Yale , when the university discovered that Fenn held the patent . Yale 's policy regarding patents generated by faculty or students requires that a percentage of any royalties generated from the patent are used by the university to fund future research . They do not claim the rights to patents that are produced away from university facilities or not related to the researcher 's " designated activities . " Fenn claimed that he owned the technology because the work was completed after he had been forced to downsize at the university 's mandatory retirement age .

Yale University entered into its own licensing agreement with a private company , leading Fenn to file a lawsuit against the school in 1996 . Yale countersued , requesting damages and reassignment of the patent . The two parties did not reach an out of court settlement , despite repeated attempts at mediation . In 2005 , U.S. District Judge Christopher Droney ruled against Fenn , awarding Yale $ 545 @,@ 000 in royalties and $ 500 @,@ 000 in legal fees . Judge Droney was critical of Fenn , saying " Dr. Fenn only obtained the patent through fraud , civil theft , and breach of fiduciary duty . " Evidence presented in the case indicated that Fenn had served on panels at Yale University that reviewed the institution 's policy on intellectual property .

A spokesperson for Yale said , " We are pleased by the result in this case and , in particular , by the court 's vindication of the Yale patent policy . " The ruling , and Yale 's response produced a mixed reaction from some of Fenn 's colleagues and former students , who wrote a letter to the Yale Daily News stating , " " Vindicating the Yale patent policy " is a poor excuse for treating a Nobel Laureate with a 68 @-@ year association with and dedicated service to the University , in such a contemptible manner . "

= = Awards and honors = =

= = = Nobel Prize = = =

Fenn shared the 2002 Nobel Prize in Chemistry with Koichi Tanaka and Kurt Wüthrich " for the development of methods for identification and structure analyses of biological macromolecules . " Fenn and Tanaka split half of the award for their work in developing ionization techniques for using mass spectrometry to analyze large biological molecules . Wüthrich was honored for his work in developing nuclear magnetic resonance techniques to analyze similar molecules in solution . Fenn was honoured largely for his contributions to the development of electrospray ionization , which made the analysis of large molecules by mass spectrometry feasible . Fenn 's Nobel lecture after being presented with the award was entitled " Electrospray Wings for Molecular Elephants . ' He was surprised by his selection as a Nobel winner , saying " It 's like winning the lottery , I 'm still in shock . " At the time of his award , Fenn was working at Virginia Commonwealth University .

= = = Other awards = = =

Fenn received his Nobel Prize fairly late in his career . Prior to being honored by the Nobel Foundation , Fenn had received numerous other awards . Early in his career , Fenn 's research was focused on molecular beams , leading him to be named an honorary president of the Sixth International Symposium on Molecular Beams in 1977 , and the first fellow of the International Molecular Beam Symposium in 1985 . In 1982 , the Alexander von Humboldt Foundation presented him with their U.S. Senior Scientist Award .

Fenn 's work in mass spectrometry earned him another spate of awards later in his career . In 1992 , the American Society for Mass Spectrometry presented him with their Award for Distinguished Contributions in Mass Spectrometry . The International Society of Mass Spectrometry honored him with the Thomson Medal in 2000 , and in the same year the American Chemical Society presented him with the Award for Advancements in Chemical Instrumentation . He was awarded the Association of Biomolecular Resource Facilities Award for outstanding contributions to Biomolecular

Technologies in 2002 . In 2003 , Fenn was honored by his alma mater with the Wilbur Cross Medal , the Yale Graduate School Alumni Association 's highest honor .

Fenn maintained numerous professional affiliations , including membership in the American Chemical Society , the American Society for Mass Spectrometry , Sigma Chi , the American Association of University Professors and the Alexander von Humboldt Association of America . In 2000 , Fenn was made a fellow of the American Academy of Arts and Sciences and in 2003 he was elected to the National Academy of Sciences .

= = Personal life = =

Fenn married Margaret Wilson at the end of his second year of graduate studies . Together , they had three children - two daughters and a son . Margaret was killed in a car accident in New Zealand in 1992 . Fenn remarried , his second wife was named Frederica . He died in Richmond , Virginia on December 10 , 2010 , at the age of 93 , exactly 8 years to the day after receiving his Nobel Prize . Fenn was survived by Frederica , his three children , seven grandchildren , and seven great @-@ grandchildren .