Dr. Alice Hamilton (pathologist, toxicologist, industrial hygienist)

(February 27, 1869 – September 22, 1970)

Another scientist that I admire is Dr. Alice Hamilton. I first learned of her achievements when I was taking an industrial hygiene class in the early 1990s. I was so impressed by how forward-thinking Dr. Hamilton was. She saw the link between factory workers and their health problems. Considered as the mother of OSHA (Occupational Safety and Health Act), Dr. Hamilton was a pioneer in industrial medicine and worker safety.

Her science journey began in Manhattan, New York when Alice Hamilton was born while her mother was visiting her relatives in Manhattan. Immediately after her birth, the family moved back to Fort Wayne, Indiana. As she wrote in her autobiography *Exploring the Dangerous Trades,* "I always have to give New York City as my birthplace, most inappropriately, for I left at the age of six weeks, and I really belong to Indiana". Her childhood home was Fort Wayne, Indiana where her grandfather Allen Hamilton became a wealthy landowner. Allen was a successful businessman and became the president of the first state bank in Fort Wayne. At his death Allen Hamilton left an estate of a million dollars or more which gave financial freedom to his heirs. Thus, Alice Hamilton grew up in a wealthy family. She also learned the importance of education. Her father Montgomery Hamilton believed that women just like men should have a good education. She and her three sisters attended Miss Porter's School in Farmington, Connecticut which was then seen as the ladies' equivalent to Yale University. The school's founder Sarah Porter was the sister of Noah Porter, a professor of moral philosophy and later president of Yale. Ten of the Hamilton young women through two generations have attended this school. In 1885, her

father's business failed, and Alice realized she could no longer depend on the family's wealth. She had to have her own vocation and she chose medicine. Why medicine? As she wrote in her biography "I chose medicine, not because I was scientifically-minded, for I was deeply ignorant of science. I chose it because as a doctor I could go anywhere I pleased – to far-off lands or to city slums – and be quite sure that I could be of use anywhere." But how? She has always studied language, literature, and history. Now she needed to catch up on science and math studies. She studied chemistry and physics at home with a high school teacher and studied biology on her own. Then she enrolled at a local medical college where her father was a trustee. Her father was not sure she was serious about becoming a doctor. She thought enrolling at this local medical college would erase any doubt that she was intent on becoming a doctor. She studied at the Fort Wayne College of Medicine for one year; then she succeeded in gaining acceptance to the best medical schools in the country, first at the University of Michigan then at John Hopkins Medical School. Her father was finally convinced she really was serious in her medical studies and told her that she must have the best medical education open to women. In 1870, when the University of Michigan became coeducational, the medical faculty were resistant. But by the time of Alice's enrollment that posture had changed. Still Alice felt some antagonism from her male classmates. In 1893 when John Hopkins Medical School opened it has always accepted female students. This happened because a major donor stipulated that the institution must be coeducational to receive the donation. At the University of Michigan Alice learned physiology, biochemistry, bacteriology, and pharmacology. Her professors were all male and trained in Germany. After graduation she decided that she would specialize in bacteriology and pathology instead of going into medical practice. Her mentor Dr. George Dock advised her to train in a hospital for a year so she would get more rounded experience and training. She worked for two months at the Hospital for Women and Children in Minneapolis, Minnesota and nine months at the New England Hospital for Women and Children outside Boston.

In the fall of 1895, she and her sister Edith – who had won a European fellowship at Bryn Mawr College – sailed to Europe to study at the University of Leipzig. They had a hard time getting accepted. There was more sex discrimination then what she had experienced at the University of Michigan. They were told to be "invisible" when they were accepted. She thought the classes at the University of Michigan were more demanding than at the University of Leipzig. Still, she studied bacteriology and pathology.

In 1896, Edith and Alice came back to America. Edith has a job waiting for her as the headmaster of Bryn Mawr Academy in Baltimore, but Alice did not have a job offer. Alice decided to enroll at the John Hopkins Medical School, which was considered the best medical college in the country. She studied pathological anatomy with Simon Flexner. Flexner was the younger brother of Abraham Flexner who wrote the most famous American report on medical practice in 1910: *Medical Education in the United States and Canada*. Alice would have wanted to get a PhD in Bacteriology from John Hopkins but the university did not grant doctorates to women – just like MIT would not let Ellen Richards earn a doctorate. The training she got at John Hopkins enabled her to teach pathology at the Women's Medical School of Northwestern University.

Hull House

Alice wanted to teach at Northwestern University so she could live at Hull House in Chicago. It has been her dream to be a volunteer resident at Hull House. Founded in 1889 by Jane Addams and Ellen Gates Starr, Hull House was a settlement house in Chicago, Illinois established to serve the newly arrived immigrants from Europe. Most of the residents are poor, working-class families who were employed in factories in the city. In 1902, the Woman's Medical School closed and she got a job as a bacteriologist for the Memorial Institute for Infectious Diseases. She investigated a typhoid epidemic in Chicago. Her early research focused on the causes of typhoid and tuberculosis in the community surrounding Hull House. Her work on typhoid led to the replacement of the sanitary inspector of the area by the Chicago Board of Health. Living side by side with the poor families at Hull House she became interested in the occupational illnesses and injuries of the workers. She realized that industrial medicine was not being studied in America and she decided to change that. In 1908 she published her first article on the topic of industrial medicine: *Industrial Diseases with Special Reference to the Trades in Which Women are Employed.* She wrote about the safeguards used in different European countries and the reasons rates of industrial disease had gone down. She discussed the hazards of lead, mercury, arsenic, phosphorus, and rubber processing. She identified the

industries that were particularly dangerous to women. This article caught the attention of Charles Henderson, professor of sociology at the University of Chicago. At his urging, the governor of Illinois Charles Deneen established the Illinois Commission on Industrial Diseases. Alice was appointed to the commission. At the same time the American Association for Labor Legislation (AALL) broadened its scope to include industrial diseases in its investigation. In 1908 the secretary of AALL, John Commons, asked several physicians including Alice Hamilton how to research industrial phosphorus poisoning.

In 1910, Alice resigned from the Illinois Commission on Industrial Diseases to become the medical investigator for the Illinois Survey. The survey was established to examine six manufacturing toxins, lead, arsenic, brass, carbon monoxide, cyanide, and turpentine. As the survey expanded it included zinc, metol (used in photography), platinum, hydrofluoric acid, compressed air, smelting, printing, plumbing, dyes, painting, mechanical art, lithography, batteries, glazes, enamels, taxidermy, brass processing, steel production, photo engraving, turpentine manufacturing, painting/varnishing, photography, mirror manufacturing and match manufacturing. She based her research on what she had learned from European studies in Germany and England. The studies provided guidance on what to look for in factories, such as lead dust and ventilators. The commission's efforts resulted in the passage of the first workers' compensation laws in Illinois in 1911. During the survey, Alice was asked to represent the commission at the International Congress on Occupational Accidents and Diseases in Brussels. Alice was one of two representatives from the US. She caught the attention of Charles O'Neill, commissioner of labor at the US Department of Commerce. After she finished the Illinois Survey, she was invited to do a lead survey for the whole country. This made her the leading industrial toxicologist in the United States. Although she had much greater autonomy in this federal research, she was not given a salary. Only her expenses were covered after the study was done. She started with lead and then moved to the other toxins. Once she finished each study on one toxin, she would have to negotiate the price with the Bureau of Labor. She wrote an article called *The Economic Importance of Lead Poisoning* which explained that lead poisoning is a real and serious medical problem. She gave detailed descriptions of the industrial processes, resulting illness rates, and the financial costs to the owners. She argued that cleaner facilities were not only an ethical necessity but a smart financial investment. This line of argument is still valid today and is used in studies in occupational safety and health.

Alice used different strategies to bring about changes in the workplace. First, she was willing to work with anyone, including the worst lead manufacturer she had ever encountered. Second, she realized that some factory owners have strong motivation to disguise problems. So she became very good at cultivating secondary sources e.g. apothecaries, visiting nurses, undertakers, charity workers, priests, etc. Third, she learned

how to analyze the politics of each situation. Fourth, she developed her pattern of documenting issues and educating her readers. Finally, she always looked for irrefutable evidence before making her case.

The start of World War I shifted her priorities. The government required her to investigate the munitions industry and the copper mines in the Western United States. She struggled to balance her antiwar activities and her role as an investigator for the US government. From April to July 1915 over fifty American women attended the International Congress of Women in Hague. The congress was assembled to discuss how to end the war. Alice attended as the personal physician of Jane Addams.

In her study of the munitions industry, she found out that nitrogen oxides were responsible for over half the illnesses and deaths. Nitrogen oxides were used in a variety of wartime industrial processes. The most dangerous use of nitrogen oxides was the use of nitric acid in the manufacture of gun cotton or nitrocellulose. During this time her attention was also called to the health condition suffered by some factory workers called “dead fingers” which is a spastic anemia of the hand, now called vibration-induced Raynaud's syndrome. After an investigation they found out that the men were stonecutters using air hammers that destroy the hands of the workers, but these workers also would suffer from tuberculosis, paralysis, neurasthenia, and even insanity. Alice was asked to investigate, and she confirmed that “dead fingers” was real, but she did not find any tuberculosis cases and insanity cases in the limestone quarry. She did find extremely high rates of tuberculosis among granite workers.

Next, she went to the copper mines to investigate the reports of problems using jackhammers and with men losing weight after working near the acid baths which were used to separate the copper from the tailings. She noted no lasting harm using the jackhammers but suspected mild arsenic poisoning with the acid baths. Since copper ore often has a trace amount of arsenic, she concluded that arsenic poisoning must be the cause of the loss in weight of workers. This was the last investigation she did before going to Harvard.

Harvard Medical School

In 1919 she was hired as an assistant professor in the newly created Department of Industrial Medicine at Harvard Medical School making her the first woman to be appointed to the faculty of Harvard University. The Leaders at Harvard were beginning to realize that a major cause of disease and injury is occupational; that is, these injuries and illnesses happened where people worked. This realization led the dean of

the medical school, David Edsall, to recruit Alice Hamilton. He knew of no one, male or female who had the expertise and educational knowledge of Alice Hamilton. But the school's leaders were hesitant because there had never been a female faculty member. In Alice's own words "I was really about the only candidate available". So they had no choice but to hire her. Her appointment as assistant professor came with requirements e.g. that she would never try to enter Harvard Club – which at that time did not even have a lady's entrance for wives of professors, that she would not ask for her quota of football tickets, and that she would not march in the faculty procession at Commencement. In other words, she got to be a faculty member in name only. She could not enjoy the perks afforded her male colleagues. She did get a concession from Harvard: that she would only teach one term; and at other times of the year, she could continue doing her field work. In 1925, she published *Industrial Poisons in the United States*. In 1934, she published her book *Industrial Toxicology*. In 1947, she asked Harriet Louise Hardy to work with her on the second edition of the book. Harriet Louise Hardy was her protégé who became a pioneer in occupational medicine and the first woman full professor at Harvard Medical School. Sadly, Alice never became a full professor at Harvard.

Throughout her tenure at Harvard, she continued to work for the federal government, primarily for the Bureau of Labor. From 1924 to 1930, she served as the only woman member the League of Nations Health Committee. She advised President Hoover and was involved with various organizations that advocated for worker health, peace and the poor.

After her retirement from Harvard in 1935, Alice served as a medical consultant to the US Division of Labor Standards. She was also appointed assistant professor of industrial medicine emeritus at Harvard.

Her Legacy

Alice died of a stroke on September 22, 1970 at the age of 101 at her home in Hadlyme, Connecticut. On her 100th birthday in 1969, President Richard Nixon sent a telegram to praise her for her successes in industrial medicine. Three months after her death, Congress passed the Occupational Safety and Health Act. President Nixon signed it on December 29, 1970. The Act created both the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA). NIOSH is the United States federal agency responsible for conducting research and making recommendations for the prevention of work-related injury and illness. It is part of the Centers for Disease Control and Prevention (CDC). NIOSH named their laboratory in Cincinnati, Ohio as the Alice Hamilton Laboratory for Occupational Safety and Health. OSHA is the government agency tasked with enforcing the safety regulation in the workplace. OSHA's mission is to ensure that America's workers have safe and healthful working conditions free from unlawful retaliation. OSHA conducts its mission by setting

and enforcing standards; enforcing anti-retaliation provisions of the OSH Act and other federal whistleblower laws; providing and supporting training, outreach, education, and assistance; and ensuring state OSHA programs are at least as effective as federal OSHA, furthering a national system of worker safety and health protections.

In 1995 Alice's extensive contributions to public health were commemorated by a U.S. Postal Service stamp. She received numerous awards including the Albert Lasker Public Service Award. This award honors an individual or organization whose public service has profoundly enlarged the possibilities for medical research and the health sciences and their impact on the health of the public. Alice Hamilton has been heralded as a pioneering female environmentalist. The Division of Occupational and Environmental Medicine at the University of California, San Francisco, sponsors an annual lecture named in recognition of her achievements in these areas.

HER SCIENCE JOURNEY

1869 – Alice Hamilton was born in Manhattan, New York

1886 – Attended Miss Porter's School in Farmington, Connecticut

1891 – Studied anatomy at Fort Wayne College of Medicine

1892 – Attended University of Michigan Medical School

1893-1894 – Completed internships at Northwestern Hospital for Women and Children in Minneapolis and New England Hospital for Women and Children in Roxbury, Massachusetts

1895 – Sailed to Europe to study at the University of Leipzig

1896 – Postgraduate studies at John Hopkins Medical School

1897 – Taught Pathology at Woman's Medical School at Northwestern University

1897-1919 – Resident of Hull House

1902 – Woman's Medical School closed. Became a bacteriologist for the Memorial Institute for Infectious Diseases and investigated typhoid and tuberculosis cases in the community surrounding Hull House

1908 – Published *Industrial Diseases with Special Reference to the Trades in Which Women are Employed*

1910 – Appointed by Governor Charles Deneen to the Illinois Commission on Industrial Diseases. Later she resigned to become medical investigator for the Illinois Survey

1915 – Attended the International Congress of Women at Hague

1916 – Started the lead survey for the entire country and wrote *The Economic Importance of Lead Poisoning*

1919 – Hired by Harvard to be an assistant professor, first female faculty member of Harvard

1924-1930 – Served as the only woman member of the League of Nations Health Committee

1925 – Published *Industrial Poisons in the United States*

1934 – Published *Industrial Toxicology*

1935 – Retired from Harvard. Eleanor Roosevelt presented Alice with the Chi Omega women's fraternity's National Achievement Award

1947– Published second edition of *Industrial Toxicology* with help from Harriet Louise Hardy, became the first woman to receive the Albert Lasker Public Service Award for her public service contributions

1948 – Alice received the Donald E. Cummings Memorial Award from the American Industrial Hygiene Association (AIHA)

1956 – Named *Time* Magazine's "Woman of the Year" in Medicine

1970 – Died of stroke in Hadlyme, Connecticut

1973 – Posthumously inducted into the National Women's Hall of Fame

1987 – NIOSH dedicated its research facility as the Alice Hamilton Laboratory for Occupational Safety and Health. The institute also began giving an annual Alice Hamilton Award to recognize excellent research in the field.

1993 – AIHA established an award in Alice Hamilton's honor to recognize the contributions of outstanding women in the field of occupational and environmental hygiene

1997 – American Society for Environmental History started the annual Alice Hamilton Prize for the best article published outside the *Environmental History* journal

2000 – Fort Wayne, Indiana erected statues of Alice, her sister Edith and their cousin Agnes in the city's Headwaters Park

2002 – The American Chemical Society designated Alice Hamilton and her work in industrial toxicology a National Historic Chemical Landmark in recognition of her pioneering role in the development of occupational medicine.

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