

# Chemical Genealogy of a Physical Chemist: Robert E. Belford

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## I.) INTRODUCTION:

“History is a guide to navigation in perilous times. History is who we are and why we are the way we are.”

-David C. McCullough

David McCullough hits the nail on the head. People are the way they are because of events of the past. We are all products of our environment, and that environment goes back a long way. We are influenced by people that we spend time around, consequently those people were influenced by people they spent time around, etc. Essentially we are all culminations of the “most influential” traits of the previous generation.

**Robert E. Belford, (1957- ), Ph.D., 1993, Arizona State University,**

I have the current pleasure to be working as an undergrad student for Bob Belford doing research on education, and the development of supplemental materials for education. He has created a collaborative computer based program, which acts much like a wiki (an online web page authored by users of that web page). This allows people to interact with the web page by doing searches on any words they don't know, or by interacting with the wiki database to retrieve further information on specific words. Through different research, he is also trying to further the field of “green” chemistry by re-developing experiments to make them more environmentally friendly. Bob also taught my freshman chemistry courses, which really set me

on the track to become a chemist. His explosive energy and, entertaining lectures caught my attention and the overall challenge of the course had me hooked. Bob is continuing his work developing interactive educational materials that will enhance the students and teachers overall abilities in the course of chemistry.

From this line, I made only one assumption, which will be denoted shortly. We start in the field of physical chemistry and traverse back to the beginnings of chemistry learning.

## II.) Twentieth Century Mentors

Bob received his PhD in physical chemistry from the Arizona State University in , under Professors Sheng Hsien Lin, and Tom Moore. We only follow the line of Sheng Lin, and with the one assumption that Sheng Lin, received his PhD from Henry Eyring.

**Sheng Hsien Lin (1937- ), PhD, Utah University, 1964.** Henry Eyring, thesis mentor.

*\*\*Note that the assumption I made was that Henry Eyring was the thesis mentor of Sheng Lin. Eyring was in charge of the graduate school at the University of Utah during the time Sheng Received his Ph.D. They also collaborated on a few papers together during their time together at Utah. I could not establish a direct connection between these two individuals at this time.\*\**

Lin received a BS degree and MS degree in Chemistry, from the Taiwan University, and received his PhD from Utah University, specializing in physical chemistry. He was a postdoctoral fellow at Columbia University, and became a professor of Chemistry at Arizona State University. He is currently Director and Special Distinguished Research Fellow of Institute of Atomic and Molecular Science, Academia Sinica and also serves as a professor of Chemistry at National Taiwan University

**Henry Eyring (1901-1981), Ph.D., Berkley 1927;** George Ernest Gibson, thesis mentor.

Henry was a very intelligent child in school which enabled him to skip a few grade levels. He won a state fellowship to the University of Arizona to study mining engineering. After seeing the dangers in mining he changed his field to metallurgy. In 1923 he received his BS in mining engineering, and one year later received his masters in metallurgy. He then went on to receive his PhD from Berkley doing studies on the ionization of various gases, by alpha particles of polonium. He then went on to the University of Wisconsin, where he studied the decomposition of  $N_2O_5$  and the field of chemical kinetics, which was his interest for the remainder of his life. In 1946 he was approached by the University of Utah to be the dean of the graduate school, which he accepted. During his years at Utah, he published around 485 papers on different fields in chemistry. Those who came in contact with him remember his outgoing personality and thoughtfulness for others. He later lost his life to a battle with cancer.

**George Ernest Gibson (1884-1959), Ph.D., Breslau, 1911;** Richard Abegg, thesis mentor.

Gibson studied metal ammonia solutions and their electrical conductivities, as well as the gas spectra of thallium and halogen. He also studied the luminescence effects of gases when they are irradiated with alpha particles. Through studies of low temperature calorimetry he showed that the third law of thermodynamics can not be applied to non crystalline states.

Nineteenth Century Mentors:

**Richard Abegg (1869-1910), Ph.D., Berlin, 1891;** August Wilhelm von Hofmann, thesis mentor

He studied the dielectric constant of ice, and electrochemical potentials in non-aqueous solutions. He discovered the theory of freezing point depression. Was killed in a hot air balloon accident. He learned Organic Chemistry from Hoffman, however turned to study physical chemistry from Friedrich Oswald. Later in life he served as Nernst's private assistant.

**August Wilhelm von Hofmann, (1818-1892), Ph.D., Giessen, 1841;** Justus von Liebig, thesis mentor.

Did many studies in Organic Chemistry, and discovered the first unsaturated alcohol. He discovered formaldehyde. He synthesized amines from alkyl iodides, discovered the first quaternary ammonium salts, ethylene diamine, and diethylenetriamine. He also suggested the word "valence."

**Justus von Liebig (1803-1873), Ph.D., Erlangen, 1822;** Karl Kastner, thesis mentor.

Discovered structural isomers, and the concept of functional groups replacing the compound radical theory. He was a pioneer in agricultural and food chemistry and promoted the view that metabolism involved the oxidation of food. He also devised combustion analysis. He left Erlangen after starting a student riot and headed to Paris to learn organic chemistry from Gay-Lussac.

Eighteenth Century Chemists:

**Karl Friedrich Wilhelm Gottlob Kastner (1783-1857), Ph.D., Jena, 1805;** Johann Gottling, thesis mentor.

Kastner, was an active person, and studied in fields such as, pharmacist, chemist, and a teacher. He wrote textbooks on chemistry, industry, and meteorology. From his analysis of mineral waters he developed water purification methods, and later developed a galvanometer.

**Johann Friedrich August Gottling (1753-1809), Apothecary., Langensalza, 1775;** Johann Wiegleb, thesis mentor

He was a teacher, and a salesman. He wrote textbooks on analytical chemistry and studied sulfur, arsenic, phosphorous, and mercury. He developed and sold chemical assay kits, and studied oxidation of compounds by nitric acid. He was also one of the first German chemists to take a stand against the phlogiston theory and accept the chemistry of Lavoisier.

**Johann Christian Wiegleb, (1732-1800), Apothecary., Langensalza, 1765;** Ernst Baldinger, thesis mentor

Wiegleb was a German chemist who supported theory of phlogiston. Founded the first chemical-pharmaceutical institute in Germany. Disputed the possibility of transmutation of the elements.

**Ernst Gottfried Baldinger, (1738-1804), MD., Jena, 1760;** Christoph Andreas Mangold, thesis mentor.

Baldinger was a professor of medicine, and founded a chemical laboratory at Murburg. He also established the first specialized scientific journal that was written in any language.

**Christoph Andreas Mangold, (1719-1767), MD., Erfurt, 1751;** Georg Erhardt Hamberger, thesis mentor.

Mangold was a professor of chemistry, anatomy, and philosophy. He proposed a new system of medical thought where the diagnosis was provided based on chemical testing of the patient compared to the symptoms of the patient. He rejected the theories of simple disease and illness cures. Recognized the importance of distinguishing the underlying illness and overlaying complications.

Seventeenth Century Chemists:

**Georg Erhardt Hamberger (1697-1775), MD., Jena, 1721;** Johann Adolph Wedel, thesis mentor.

Hamberger was a professor of medicine, surgery and botany. He studied the mechanism of breathing. He also wrote a

textbook on the physiology and function of muscles.

**Johann Adolph Wedel, (1675-1747), MD., Jena, 1697;** Georg Wolfgang Wedel, thesis mentor.

Wedel was a professor of medicine. He published articles on fermentation, camphor and magnesium carbonate, and the combustion of sulfur in addition to various medical articles.

**Georg Wolfgang Wedel (1645-1721), MD., Jena, 1669;** Werner Rolfinck, thesis mentor.

Georg Wedel, was a professor of surgery, botany, medicine both theoretical and practical, and chemistry. He studied electrochemistry of copper sulfates onto iron, and volatile salts from plants. He also invented new medicines.

Sixteenth Century Chemists:

**Werner Rolfinck (1599-1673), MD., Padua, 1625;** Adriaan Spieghel, thesis mentor.

Rolfinck was the first professor of Chemistry at Jena. He also gave lectures on botany, surgery and anatomy in which executed criminals were dissected. He opposed alchemical and superstitious thinking, and wrote a book on chemical impossibilities.

**Adriaan van den Spieghel (1578-1625), MD., Padua, 1603;** Giulio Cesare Casseri, and Girolamo Fabrici thesis mentors.

Spieghel was also a professor of botany, surgery, and anatomy. Published works on malaria and tapeworms. Wrote one

of the first texts on plant anatomy. He also wrote “De humani corporis fabrica” another text on anatomy.

**Giulio Cesare Casseri (1552-1616), MD., Padua 1580;** Girolamo Fabrici thesis mentor.

Professor of surgery and anatomy. Gave the first detailed descriptions on the organs of speech and hearing, especially the tympanic nerve and the relation to hammer and stirrup bones of the ear. He also published a text with many anatomical tables.

**Girolamo Fabrici (1533-1619), MD., Padua 1559;** Gabriele Fallopio thesis mentor.

Professor of surgery and anatomy. First to publish on the valves in the veins. He also wrote on the anatomy of the larynx, the lenses of the eyes, respiration, and actions of muscles. He also founded fields of comparative and developmental embryology. Was a teacher to William Harvey who discovered circulation of the blood.

**Gabriele Fallopio (1523-1562) MD., Ferrara 1548;** Antonio Brasavola, thesis mentor.

Fallopio was a professor of surgery, botany, and anatomy. He discovered the fallopian tubes, and wrote on the anatomy of the kidneys. He describes the structure of the skull, and facial nerves. He was the first to describe the cochlea vestibules, and semicircular canals.

**Antonio Musa Brasavola (1500-1555), MD/Ph.D, Ferrara, 1520;** Nicolo Lonigo, thesis mentor

*Sheng Lin*

[http://www.tafaward.com/Award%20Recipients/1995/sheng\\_h sien\\_lin.htm](http://www.tafaward.com/Award%20Recipients/1995/sheng_h sien_lin.htm)

Personal physician to Francis I, Charles V (Germany), Henry VIII (England), and to a successor of Popes: Paul III, Leo X, Clemens VII, Julius III. Introduced the use of plants for medical purposes, and produced a summary of Galen's writings. He also organized the botanical gardens of Belvedere.

Fifteenth Century Chemists:

**Nicolo da Lonigo (1428-1524), MD/Ph.D, Padua, 1453;** Pelope thesis mentor.

Lonigo was one of the most famous scholars of his time. Responsible for the reformation of medicine in the 16<sup>th</sup> century. He was a professor of math, medicine, and Greek philosophy. He translated many Greek medical texts into Latin, and was the first to publish on Syphilis.

No more data can be found after this point.

### **Acknowledgements:**

Special thanks to Dr. Belford for allowing me to use him as my reference point to trace his chemical genealogy.

### **References:**

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