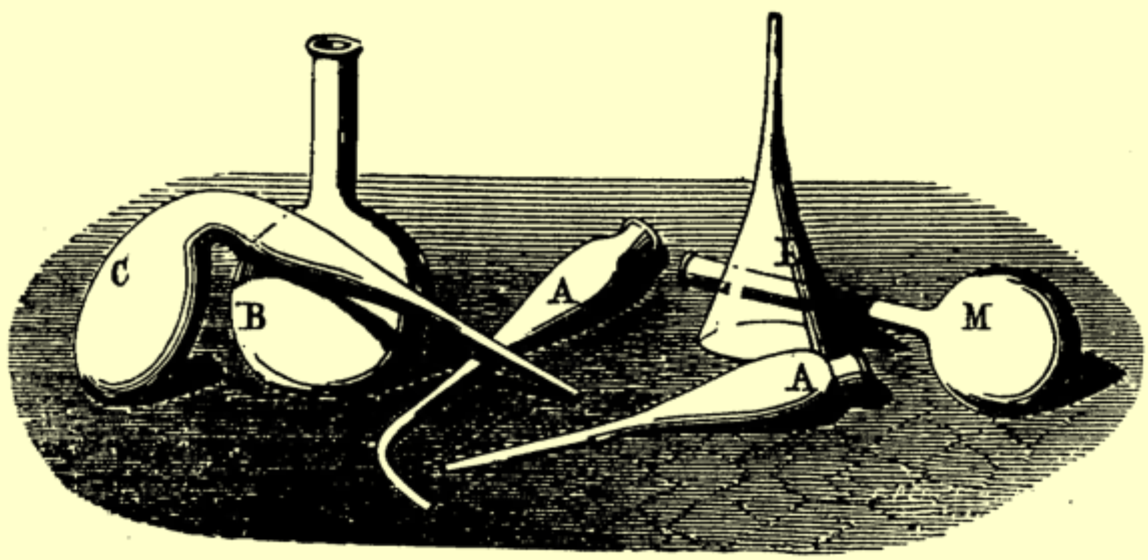
American Chemical Society

DIVISION OF THE HISTORY OF CHEMISTRY



PROGRAM & ABSTRACTS

252nd ACS National Meeting
Philadelphia, PA
August 21-25, 2016

S. C. Rasmussen, Program Chair

Final Program
HIST

DIVISION OF THE HISTORY OF CHEMISTRY

S. C. Rasmussen, *Program Chair*

SUNDAY MORNING

Section A

Philadelphia Marriott - Franklin 4

HIST Tutorial & General Papers

S. C. Rasmussen, *Organizer*
J. S. Jeffers, *Presiding*

8:00 HIST 1: HIST Tutorial: History of chemistry of chemists, by chemists, and for chemists. **C. J. Giunta**

8:40 HIST 2: Why isn't noble gas chemistry 30 years older? The failed (?) 1933 experiment of Yost and Kaye. **J. A. Labinger**

9:10 HIST 3: Cuprene: A historical curiosity along the path to polyacetylene. **S. C. Rasmussen**

9:40 HIST 4: History of copper mining at the Mansfelder Land. **C. Hahn**

Citation for Chemical Breakthrough Award Symposium

Sponsored by PRES, Cosponsored by HIST

SUNDAY AFTERNOON

Section A

Philadelphia Marriott - Franklin 4

1:00 - 1:30 HIST Business Meeting (Open to all HIST members)

A Salute to Ted Benfey at 90: Science, History, Culture & a Commitment to Humanism

J. Seeman, *Organizer, Presiding*

1:30 Introductory Remarks

1:40 HIST 5. Beckman Center for the History of Chemistry: the second generation. **M. Bowden**

2:00 HIST 6. Some thoughts about a typology of experiments in early modern chymistry. **W. Newman**

2:20 HIST 7. Another look at the Kekulé-Couper question. **A. J. Rocke**

2:40 HIST 8. Sharing treasures and honoring Ted Benfey. **J. Seeman**

3:00 Intermission

3:15 HIST 9. O. Theodore Benfey: A vital spirit and intellect. **P. J. Ogren**

3:35 HIST 10. Ted Benfey and three Quaker Colleges: teacher, mentor and colleague. **D. Macinnes**

4:55 HIST 11. Back to the roots. **H. J. Peiper**

4:15 HIST 12. Biting snakes and other tales: Growing up with Ted Benfey. **P. Benfey**

4:35 HIST 13. Reflections on nine stimulating and fascinating decades. **O. T. Benfey**

SUNDAY EVENING

Philadelphia Marriott - 308

5:00 - 8:00   HIST Executive Committee Meeting

MONDAY MORNING

Section A

Philadelphia Marriott - Franklin 4

Chemistry in America: 1676-1876

G. D. Patterson, *Organizer*, *Presiding*

9:00 HIST 14. Introduction to chemistry in America before 1876. **G. D. Patterson**

10:00 HIST 15. Earliest chemistry teaching in the United States: The second Battle of Princeton. **S. K. Vanderkam**

10:30 Intermission

10:45 HIST 16. New England chymistry in the generation after George Starkey. **W. Newman**

11:15 HIST 17. Withdrawn

MONDAY AFTERNOON

Section A

Philadelphia Marriott - Franklin 4

Chemistry in America: 1676-1876

G. D. Patterson, *Organizer*, *Presiding*

1:30 HIST 18. Impact on 19th century chemistry by the faculty and students of Philadelphia's Central High School. **R. A. Egolf**

2:00 HIST 19. Edgar Fahs Smith and chemistry in America before 1876. **L. Farrington**

2:30 HIST 20. Rachel Littler Bodley, first female professor of chemistry at a medical college. **J. Hayes**

3:00 Intermission

3:15 HIST 21. Charles Frederick Chandler: founding father of the ACS. **E. W. Cook**

3:45 HIST 22. Chemistry of T. Sterry Hunt (1826-1892). **G. D. Patterson**

MONDAY EVENING

Section A

Pennsylvania Convention Center - Halls D/E

Sci-Mix

S. C. Rasmussen, *Organizer*

8:00 - 10:00

HIST 24, HIST 36, HIST 39, HIST 41, HIST 42. See subsequent listings.

TUESDAY MORNING

Section A

Philadelphia Marriott - Franklin 6

Charles C. Price, 1965 ACS President: Exploring his Legacy after 50 Years

R. A. Egolf, J. Hayes, *Organizers, Presiding*

8:30 Introductory Remarks

8:35 HIST 23. Charles C. Price, 1965 ACS President:an overview of his life and service. **J. Hayes**

9:05 HIST 24. Professional genealogy of Charles C. Price. **V. V. Mainz**

9:35 Intermission

9:50 HIST 25. From reaction mechanisms, synthetic polymers, and chemotherapeutics, to the evolution of life: the wide-ranging scientific life of Charles Price. **R. A. Egolf**

10:20 HIST 26. Charles C. Price: the man and his work. **M. M. Joullie**

10:50 HIST 27. Charles C. Price and the formation of the Chemical Heritage Foundation. **R. S. Brashear**

11:20 Closing Remarks

Elements Old & New: Discoveries, Developments, Challenges & Environmental Implications

Sponsored by ENVR, Cosponsored by CEI, HIST and NOM

Connectivity & the Global Reach of Chemistry: Honoring the Life & Scientific Contributions of Ernest L. Eliel

Sponsored by ORGN, Cosponsored by BMGT, CHED, CINF, HIST, INOR, MEDI, MPPG, PMSE and SCHB

TUESDAY AFTERNOON

Section A

Philadelphia Marriott - Franklin 6

HIST Award Symposium Honoring Ursula Klein

G. D. Patterson, *Organizer*
M. Nye, *Organizer, Presiding*
A. J. Rocke, *Presiding*

1:00 Introductory Remarks

1:10 HIST 28. Methode de nomenclature chimique (1787): A document of transition. **W. Lefevre**

1:40 HIST 29. Periodic table as scaffold and foundation: paper tools and demarcation. **M. Gordin**

2:10 HIST 30. Erlenmeyer as capitalist and entrepreneur: A case study of chemical enterprise in mid-19th-century Germany. **A. J. Rocke**

2:40 HIST 31. Stability and change in chemical problems and methodologies from the 1890s to the 1930s. **M. Nye**

3:10 Intermission

3:25 HIST 32. Delayed reaction: The tardy embrace of physical organic chemistry by the German Chemical Community. **S. J. Weininger**

3:55 HIST 33. Paper tools, paper things and a third-order science of organization. **E. Hepler-Smith**

4:25 HIST 34. Chemists for the common good. **U. Klein**

Elements Old & New: Discoveries, Developments, Challenges & Environmental Implications

Sponsored by ENVR, Cosponsored by CEI, HIST and NOM

WEDNESDAY MORNING

Philadelphia Marriott - Franklin 6

General Papers

S. C. Rasmussen, *Organizer, Presiding*

8:00 HIST 35. Asen Zlatarov (1885-1936): Bulgarian chemist, educator, and writer. **N. V. Tsarevsky**

8:30 HIST 36. Green vitriol ($FeSO_4 \cdot 7H_2O$) in Elizabethan and Stuart England: Chemistry and politics. **M. D. Sacks**, A. Mousavi

9:00 HIST 37. Mysteries surrounding Geber in the discovery of sulfuric acid. **A. Mousavi**

9:30 HIST 38. Reevaluating the role of glass in the development of distillation apparatus. **S. C. Rasmussen**, A. Zumbulyadis

10:00 Intermission

10:15 HIST 39. Maple sugar: America's indigenous chemical engineering product. **M. Paragano**

10:50 HIST 40. Korean chemical scientists and engineers and ACS. **C. H. Do**

11:15 HIST 41. How deuterium got its name: A detailed look at the Urey-Brickwedde correspondence. **D. J. O'Leary**

11:45 HIST 42. Dusting off old ideas: Reviving historical concepts for teaching chemical evolution in *A World from Dust*. **B. J. McFarland**

ABSTRACTS

HIST 1 - HIST Tutorial: History of chemistry of chemists, by chemists, and for chemists

***Carmen J. Giunta**, giunta@lemoyne.edu. Le Moyne Coll, Syracuse, New York, United States*

History of chemistry is a large tent, including individuals trained in and professionally practicing the disciplines of history and of chemistry--and even philosophy and sociology as well. History of chemistry preserves the record of who have been chemists, what they did, when they did it, how they did it, where they did it, and why they did it. By shedding light on chemistry of the past, it can inform and even inspire chemistry in the present and future. This presentation will focus on programs, institutions, resources, and works on the heritage of chemistry geared toward chemists. It will not, however, ignore works of non-chemists, whose professional distance provides salutary perspective valuable to chemists' understanding of their past.

HIST 2 - Why isn't noble gas chemistry 30 years older? The failed (?) 1933 experiment of Yost and Kaye

***Jay A. Labinger**, jal@its.caltech.edu. California Inst of Tech, Pasadena, California, United States*

The first report of a noble gas compound, by Neil Bartlett in 1962, was quickly followed by a number of others. Of course there had been previous attempts, of which the best documented is probably that of Caltech inorganic chemistry professor Donald Yost and his student Albert Kaye; details of their unsuccessful experiments aimed at getting xenon to react with fluorine or chlorine were published in JACS in 1933. After Bartlett's success, a number of commentators looked back to Yost's paper and offered a variety of possible reasons for Yost's failure. Examination of the actual details of Yost's paper, in comparison with those of the later successful reports, refutes all of those interpretations, whereas one particular detail of Yost's experiment, which appears to have gone completely unnoticed, provides a plausible explanation for why Yost did not beat Bartlett and his contemporaries by nearly 30 years, and strongly suggests that with a little more effort and/or luck he could well have done so.

HIST 3 - Cuprene: A historical curiosity along the path to polyacetylene

***Seth C. Rasmussen**, seth.rasmussen@ndsu.edu. Department of Chemistry and Biochemistry, North Dakota State University, Fargo, North Dakota, United States*

Investigations into the polymerization of acetylene began in 1866 with the work of Berthelot, who produced a resinous material comparable to polystyrene upon heating acetylene at extreme temperatures. When heating was carried out in the presence of either elemental carbon or iron, it was found that the temperature required could be significantly decreased, while simultaneously increasing the overall reaction rate. Such efforts were then continued by Hugo Erdmann and Paul Köthner in 1898, who passed acetylene over spongy copper at 250 °C to produce an amorphous solid that they believed to be a complex copper acetylide. The following year, the copper-catalyzed process was also reported independently by Paul Sabatier and J. P. Senderens, who believed the product to be a complex hydrocarbon dispersed with small traces of copper. Sabatier then gave this material the name cuprene in 1900. Generally characterized as a yellowish powdery material, cuprene was generally believed to be an acetylenic polymer of some type and studies of the material continued until 1955, when Giulio Natta successfully reported the production of polyacetylene, $(CH{=}CH)_n$, as a black crystalline polymer. After Natta's report, cuprene became essentially a curiosity and few continued its study. The history of cuprene up through 1955 will be presented, along with more recent attempts to understand the mechanism of polymerization and the composition of the resulting polymeric material.

HIST 4 - History of copper mining at the Mansfelder Land

***Christine Hahn**, christhahn@gmx.net. Chemistry, Texas AM University Kingsville, Kingsville, Texas, United States*

The Mansfelder Land is located in Central Germany which is famous for the mining of copper slate which has worldwide a unique composition. Although it contains only about 2-3% of copper, all effort had been done to improve mining technology over 8 centuries since it has started in 1199. The progress in analytical chemistry and chemical separation techniques developed at regional German universities and mining academies afforded an increasing number of elements being recovered from the Mansfelder copper ores. It is very interesting to compare the years of the discovery of new elements with the years when those elements were actually isolated from the ores. In most recent years of the mining, 23 of the more than 50 elements contained in the copper ores were extracted. Over the

800 years 110 million tons of copper were mined until the mines were closed in the early 1990ies. The concomitant development of smelter and metallurgy industry in the Mansfeld area as well as leading persons who largely impacted the mining business will be described in the context of history of science, economy, and the change of the regional political systems.

HIST 5 - Beckman Center for the History of Chemistry: the second generation

Mary Ellen Bowden*, mebowden@chemheritage.org. Chemical Heritage Foundation, Haverford, Pennsylvania, United States*

A recollection of people joining the history of chemistry center five years after its founding at the University of Pennsylvania--how we got there intellectually and professionally and what we did.

HIST 6 - Some thoughts about a typology of experiments in early modern chymistry

William Newman*, wnewman@indiana.edu. Indiana University, Bloomington, Indiana, United States*

The history of early modern chymistry, and for that matter the alchemy of the Middle Ages, has been hampered by the inability of scholars to distinguish among actual experiments that were performed, "conjectural experiments" that were planned out for later testing, fantastic experiments describing results that were outright impossible, and recipes. My paper will attempt briefly to categorize these and other types of "experiments" that one encounters in pre-modern sources in the attempt to throw some new light on this topic.

HIST 7 - Another look at the Kekulé-Couper question

Alan J. Rocke*, ajr@case.edu. History, Case Western Reserve University, Cleveland, Ohio, United States*

It is well known that August Kekulé and Archibald Couper independently and essentially simultaneously arrived at the idea of the self-linking of carbon atoms, the crucial idea that led to the theory of chemical structure. As with every instance of independent discovery, the historical context is both important and complex, and it is also vital to understand each protagonist’s personal route to the discovery. In this case, a satisfactory historical understanding is made challenging by the near total absence of first-hand materials concerning Couper, and by internally inconsistent evidence concerning Kekulé. In past writing, I have made arguments that are sympathetic with Kekulé’s own priority claims. In this presentation I explore some puzzles regarding Kekulé’s route to structural ideas, doubts that may implicitly offer more sympathy to Couper.

HIST 8 - Sharing treasures and honoring Ted Benfey

Jeffrey Seeman*, jiseeman@yahoo.com. University of Richmond, Richmond, Virginia, United States*

To celebrate and honor my friend and colleague -- our friend and colleague -- Ted Benfey, I shall bring my most special words, stories, and photographs to both entertain and hopefully uplight and enrich the audience.

HIST 9 - O. Theodore Benfey: A vital spirit and intellect

Paul J. Ogren*, pcogren@gmail.com. Chemistry, Earlham College, Richmond, Indiana, United States*

Ted Benfey is a teacher in a profound sense – a man who has always been interested in exploring the development of ideas, connections between those ideas, and ways of inspiring others to study new concepts over a wide range of science, philosophy and art. In science, chemistry in particular, he has come back again and again to exploring how we have come from observations of matter and its transformation to models and concepts about the underlying structure of things. Nowadays we may think of such endeavors in terms of high-energy experiments at CERN or searching for gravitational waves, or the possibility of parallel universes. Ted, from the 1950s on, became interested in the question of how chemists, “organic chemists” in particular, moved away from the idea that matter in living systems required some “vital force” in the last part of the 19th century. This movement depended on the development of and confidence in many molecular structure ideas – bonding, geometry, isomers, etc. – structures that could not be directly observed at the time. In this talk I will present Ted’s work with these ideas, as well my own exposure to them as one of his undergraduate students in the 1960s. I also hope to speak about Ted’s writing and thought about a much broader range from the areas of art, culture and spirituality. Ted’s early experiences in Europe and the US, his later life in Japan, his experiences as a Quaker, and his life-long interests in serious study of the human condition have all have given us a gifted view of the universe we live in.

HIST 10 - Ted Benfey and three Quaker colleges: teacher, mentor and colleague

***David Macinnes**, dmacinne@guilford.edu. Chemistry, Guilford College, Greensboro, North Carolina, United States*

Ted Benfey was my teacher and mentor and colleague for 27 years at two different Quaker colleges and he also taught for 8 years before that at another Quaker college. I will speak mostly about the times he was at Earlham and Guilford Colleges and of my debt to him. While at Earlham he helped develop the Chemical Bond Approach with Larry Strong which had strong influence on the teaching of chemistry world-wide as well as on my teaching. He also helped create new more effective courses at Earlham including a capstone senior seminar still found at Guilford College. His views influenced my teaching at Westtown School and, after I joined him in 1973 as a colleague, at Guilford College. He was active in the area of the history of science; training students who went on in the field and in helping the local ACS section find effective ways of connecting industrial and academic chemists.

HIST 11 - Back to the roots

***Hans J. Peiper**, peiper123@web.de. Sugical Departement, Georg-August-Universitaet, Goettingen, Germany*

This paper tells of the unlikely reunion of two authors, who had lost touch with one another as ten-year-olds in Berlin. They rediscovered each other and resumed their friendship in Goettingen while they were both approaching ninety. It was discovered that Goettingen had been the home of many generations of the Benfeys. Three (alle Theodor?) Benfeys shall be discribed, beginning with the famous sanscrid explorer. The youngest of all, Ted, visited the department of chemistry in Goettingen at the Georg-August University, where he viewed an exhibition of important historical background, i.e. Friedrich Woehler, who elucidated urea, the bond between organic and inorganic chemistry.

HIST 12 - Biting snakes and other tales: Growing up with Ted Benfey

***Philip Benfey**, philip.benfey@duke.edu. Biology, Duke University, Durham, North Carolina, United States*

Growing up with a chemist and historian of science had a deep impact on me. I decided I wanted to do anything except science. And yet, fight as I might, I ended up a molecular biologist. I will present some anecdotes from the battle and a brief overview of my current work.

HIST 13 - Reflections on nine stimulating and fascinating decades

***Otto T. Benfey**, benfeyo@gmail.com. Department of Chemistry, Guilford College, Greensboro, North Carolina, United States*

This paper will point to some order and meaning in the experiences I've encountered and the various fields of exploration I have chosen in the last eighty years. My first decade was spent in blissful ignorance of what was going on in Berlin around me. The second decade began with the 1936 Berlin Olympics and my friendship with a ten-year old classmate whom I met again 77 years later. I moved to England, finished high school and entered University College, London (evacuated to Aberystwyth, Wales). There I was steeped in physical organic chemistry which I continued in New York's Columbia. In subsequent years I became increasingly interested in the history of science in 19th century Germany and in the Orient, trying to keep up with a fascinating family, teaching at Quaker colleges, being an editor with the ACS and then with the Chemical Heritage Foundation, and on the side redesigning the periodic table. Most recently I'm learning to write poetry.

HIST 14 - Introduction to chemistry in America before 1876

***Gary D. Patterson**, gp9a@andrew.cmu.edu. Carnegie Mellon University, Pittsburgh, Pennsylvania, United States*

The earliest settlers in America were heavily dependent on practical chemistry for their survival. Simple tasks like extracting salt from seawater and iron from bog ore were necessary. But, leaders, such as John Winthrop, were also interested in academic chemistry and were members of the Royal Society. With the founding of colleges, an academic home for chemistry emerged. The history of chemistry at Harvard, Yale and Penn illustrates the state of chemistry in America before 1876. As the time for the founding of the American Chemical Society approached, the state of American chemistry can be discerned in the leading Journals for the dissemination of chemical intelligence: Silliman's Journal and The American Chemist. It can also be illustrated by the work of future Presidents of the American Chemical Society in the years just prior to 1876. Men like T. Sterry Hunt and H. Carrington Bolton cut a wide path through American chemistry in those years. There is considerable material now available to study the period from 1610-1876. This symposium is intended to chronicle a few of them and serve as a stimulant to further studies.

HIST 15 - Earliest chemistry teaching in the United States: The second battle of Princeton

***Susan K. Vanderkam**, skillian@princeton.edu. Chemistry, Princeton University, Princeton, New Jersey, United States*

From its founding in 1746, Princeton University sought to train students in all branches of philosophy and classical education, including "Natural Philosophy." Visiting lecturers were hired to demonstrate scientific advancements, and scientific apparatus was purchased for demonstrations in the natural philosophy courses. In 1795, Dr. John MacLean, newly trained in Lavoisier's Chemistry, arrived at Princeton from Scotland, and was asked to deliver lectures in this "novel" science. Remarkably, after his first few lectures, the Board of Trustees established a "Chair of Chemistry and Natural History" and hired MacLean to fill that role, creating the first undergraduate Professor of Chemistry in the United States. Yet, when MacLean published essays challenging Joseph Priestley, one of "the founding fathers of chemistry," on the concept of phlogiston, his writings were actively discouraged by an increasingly conservative administration. By 1812 the Board of Trustees adopted a curriculum that emphasized piety and morality at the expense of the sciences, ultimately forcing MacLean's resignation. Chemistry remained a graduation requirement, but for 50 years instruction focused on the "philosophical" side rather than the experimental side of the science. Nonetheless the chemistry faculty continued to keep up with the developments in the field, publishing research articles in the early science journals. Additionally, student notebooks from courses during that era show that advances in the rapidly growing field were incorporated almost as quickly as the information was published in the United States. Still, until after the Civil War, the Board of Trustees resisted any expansion of teaching in the sciences, maintaining an emphasis on classics and theology, with limited opportunities for teaching of the "Practical Arts." Then, in 1868, a turnabout in the battle occurred: James McCosh became college president, bringing with him the German model of education. His inaugural address, "On Academic Teaching in Europe," signaled a shift in the curriculum with a movement toward research-based science. In 1872 the John C. Green School of Science, complete with student laboratories, opened at Princeton University, representing the triumphant transformation in chemical education from natural philosophy to research science.

HIST 16 - New England chymistry in the generation after George Starkey

***William Newman**, wnewman@indiana.edu. Indiana University, Bloomington, Indiana, United States*

Although it is now well known that Robert Boyle's first serious teacher in chymistry was the Harvard graduate George Starkey, the degree to which Starkey's success in England and Europe more broadly was an isolated event has not yet been investigated. My paper will consider some New England chymists in the period from the 1670s through the 1690s in order to see how they interacted with one another and with European natural philosophers.

HIST 17 - Withdrawn

HIST 18 - Impact on 19th century chemistry by the faculty and students of Philadelphia's Central High School

***Roger A. Egolf**, rae4@psu.edu. Chemistry, Pennsylvania State University, Allentown, Pennsylvania, United States*

Philadelphia's Central High School, chartered in 1836 and opened in 1838, is the second oldest public high school in the United States. Its first president was Alexander Dallas Bache, great grandson of Benjamin Franklin and Professor of Natural Philosophy and Chemistry at the University of Pennsylvania. Other well-known early American chemists who taught there before 1876 include James Curtis Booth, Martin Hans Boye, John Fries Frazer, and Benjamin Howard Rand. Among its 19th century students were Thomas Messinger Drown, later head of the chemistry department at MIT and a President of Lehigh University, and Joseph Richards, the first person to earn a PhD in chemistry at Lehigh. This paper will give an overview of 19th century chemistry at Central High School and some of the accomplishments of its faculty and graduates.

HIST 19 - Edgar Fahs Smith and chemistry in America before 1876

***Lynne Farrington**, lynne@pobox.upenn.edu. Edgar Fahs Smith Collection, University of Pennsylvania, Philadelphia, Pennsylvania, United States*

Probably no one did more to document and disseminate information on the early history of chemistry in America in the early twentieth century than Edgar Fahs Smith. He began by collecting books, manuscripts, and images (prints and photographs), in part to answer his own curiosity and in part to use in teaching the history of chemistry to his students. These were aids that he felt made the subject come alive for students, providing an essential human element to that story. He then began to use original materials to tell the story of chemistry in Philadelphia, in the Keystone State, and in America. In doing so he became aware of the enormous gap in what was known about many early American chemists and began writing biographies of significant figures such as Robert Hare and Joseph Priestley as well as more obscure figures such as M. Carey Lea, Samuel Latham Mitchill, Charles Mayer Wetherill, and James Woodhouse, published in journals and as separate pamphlets. Much of what Smith pulled together, with its many excerpts from books and manuscripts, remains an important source of information to this day, as evinced by the Wikipedia articles on Martin Hans Boyè and James Woodhouse.

HIST 20 - Rachel Littler Bodley, first female professor of chemistry at a medical college

***Janan Hayes**, jmhayesacs@gmail.com. Project Inclusion, Sacramento, California, United States*

Rachel Littler Bodley (1831-1888) is one of the figures that appear in the story of the founding of the American Chemical Society. She graduated from the Wesleyan Female College in Cincinnati when she was 17. In 1862 she became a professor of natural sciences at the Cincinnati Female Seminary and moved to the Women's Medical College of Pennsylvania in 1865. Invited to attend the proposed Centennial of Chemistry in 1874 by H. Carrington Bolton and she suggested in a letter that Northumberland, Pennsylvania would be a great place for the Conference. She was elected a Vice-President of the event. She was also elected Dean of the Medical School in that year. She played a highly visible role in the intellectual life of Philadelphia.

HIST 21 - Charles Frederick Chandler: founding father of the ACS

***Edward W. Cook**, ewcook@caprilands.org. Chemists Club, New York, New York, United States*

Charles Frederick Chandler – Founding Father of the American Chemical Society, was an organizational genus when American chemistry was nascent. With his brother, he edited America's first chemical paper, the American Chemist, from 1870 and which was succeeded by the Journal of the American Chemical Society. He was instrumental with the New York (later American) section of London's Society of Chemical Industry and founded and was first president of The Chemists' Club in 1898, an organization uniquely designed to provide professional assistance and social adhesion and home for chemists and their professional societies in the rapidly developing center of American chemical technology: New York City. His library was the nucleus for the library at The Chemists' Club, which became the greatest chemical library in the Western Hemisphere and the rival of the great Research libraries in Europe. His works in public health were seminal at a time when technology was racing ahead of efforts to understand and control pollution. His academic background from Harvard and Göttingen to Columbia prepared him well to lead American chemistry and chemical technology into the 20th century and new insights into his developmental strategies are offered.

HIST 22 - Chemistry of T. Sterry Hunt (1826-1892)

***Gary D. Patterson**, gp9a@andrew.cmu.edu. Carnegie Mellon University, Pittsburgh, Pennsylvania, United States*

T. Sterry Hunt was one of the most well-known American chemists at the time of the founding of the American Chemical Society. He was a Fellow of the Royal Society (1859), a member of the National Academy of Sciences (1873), President of the American Association for the Advancement of Science (1870) and twice President of the American Chemical Society (1879, 1888). But, what were his views on chemistry. He published them in a book "A New Basis for Chemistry: A Chemical Philosophy" (1890). He was opposed to the notion of atoms and rejected the concept of chemical structure. The philosophical exposition of this book and the likely influences on his thought will be analyzed. Why was someone so far out of the mainstream of worldwide chemistry so popular within the American Chemical Society? An analysis of the community of American chemists involved in the founding will be carried out.

HIST 23 - Charles C. Price, 1965 ACS President: an overview of his life and service

***Janan Hayes**, jmhayesacs@gmail.com. Project Inclusion, Citrus Heights, California, United States*

As a part of the HIST Division project honoring the Science and Legacy of Past ACS Presidents, it is appropriate that at the Fall 2016 National Meeting in Philadelphia we honor Charles C. Price (1913-2001). Price was born, educated, worked, raised a family and died in Pennsylvania. This talk will give an overview to the symposium starting with Price's youth experiences in a Quaker family environment, his early education there, and his later youth in northern New Jersey. We will explore his handicap resulting from an explosion of a box of dynamite caps and its impact on his future activities. We will briefly explore his higher education and early working experiences that led to his contributions during World War II. With this background, this and other talks in the symposium will address Price's leadership in Polymer Science and the related chemical society organizations. Not to be missed will be his contributions as a research professor and academician, including Chemistry Department chair at the University of Pennsylvania. We will also examine his contributions to the American Chemical Society and introduce his role as founding Board Chair for the Chemical Heritage Foundation. Finally, we will take a glimpse at his family life and other activities, such as sailing.

HIST 24 - Professional genealogy of Charles C. Price

***Vera V. Mainz**, mainz@illinois.edu. School of Chemical Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois, United States*

Charles Coale Price III was born in 1913 in Passaic, New Jersey. He went to Swarthmore College, receiving his B.S. in chemistry in 1934. He then attended Harvard University, and obtained his PhD 1936 while working with Louis F. Fieser. He spent one year of a post-doctoral appointment with Roger Adams at the University of Illinois in 1936, and then joined the faculty at the University of Illinois, where he spent the next ten years. This talk will focus on Price's professional genealogy (as opposed to a family genealogy), which traces a person's intellectual line of descent via the PhD advisor or mentor for one's highest non-honorary degree.

HIST 25 - From reaction mechanisms, synthetic polymers, and chemotherapeutics, to the evolution of life: the wide-ranging scientific life of Charles Price

***Roger A. Egolf**, rae4@psu.edu. Chemistry, Pennsylvania State University, Allentown, Pennsylvania, United States*

Charles Price's chemical interests were wide-ranging. He began his career studying organic reaction mechanisms with Louis Fieser, then moved on to a post-doc with Roger Adams where he studied the structure of gossypol. Shortly after finishing his post-doc and joining the faculty at Illinois, World War II intervenes, and Price made his contribution to the war effort by doing research at Illinois on the design of equipment to remove chemical warfare agents from water, synthetic work on the production of chloroquin, and research on emulsion polymerization. After the war, he moved to Notre Dame as head of the chemistry department invented polypropylene oxide-polyurethane rubber, the basis for most of the foam rubber produced throughout the world ever since. After moving to the University of Pennsylvania he continued to do polymer research, along with work on cancer chemotherapeutics that grew out of his earlier war-years work on anti-malarials and chemical warfare agents. He also became increasingly interested in the origin of the universe and the evolution of life, and did research in these fields also. This paper will give a broad, but brief look at Price's research in these fields.

HIST 26 - Charles C. Price: the man and his work

***Madeleine M. Joullie**, mjoullie@sas.upenn.edu. Univ of Penn, Philadelphia, Pennsylvania, United States*

Charles C. Price was a man of many talents. In addition to teaching and research, he was interested in science history and in promoting the understanding of science by the public. He was active in politics as well. He promoted the peace movement and was a supporter of the World Federalist Association. Charles Price was an excellent sportsman that enjoyed squash and sailing. He was a fierce competitor in any game he played. His research interests included polymers, mechanisms of organic reactions, sulfur heterocycles, and many other subjects including the synthesis of life. The presentation will discuss both his life as a scientist and as a man.

HIST 27 - Charles C. Price and the formation of the Chemical Heritage Foundation

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Charles C. Price (1913–2001) played a very important role in the establishment of the Center for the History of Chemistry (CHOC; later the Chemical Heritage Foundation). This paper will examine the development of his interest in the history of chemistry and his support for having the American Chemical Society select the University of Pennsylvania as the location for the new Center. Having a former president of ACS and chair of the chemistry department at Penn was a tremendous asset in bringing CHOC to Philadelphia. After CHOC was founded in 1982, Price became the chair of its Policy Council (essentially the Board of CHOC) and with the founding director, Arnold Thackray, helped build a strong foundation for the fledgling institution and shape its future.

HIST 28 - Methode de nomenclature chimique (1787): A document of transition

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The *Méthode de nomenclature chimique*, published by the Académie Royale des Sciences in 1787, is rightly praised as a landmark in the history of early modern chemistry. It is also – though not that rightly – considered to be a fruit of Lavoiser's “Chemical Revolution.” Yet the main features of the nomenclature and the classificatory proposal were rather neutral towards Lavoisier's anti-phlogistic system. This becomes manifest by its rapid adoption among opponents as well as adherents of Lavoisier's system. After a short presentation of the Méthode's four authors (Bertholet, Foucroy, Guyton de Morveau, Lavoisier) and the circumstances of their collaboration, my contribution will focus on strange features of the Méthode that reveal the unsettled state of many of the convictions held by the partisans of Lavoisier.

HIST 29 - Periodic table as scaffold and foundation: paper tools and demarcation

***Michael Gordin**, mgordin@princeton.edu. History, Princeton University, Princeton, New Jersey, United States*

One of Ursula Klein's signal contributions to the historiography of science in general, and of chemistry in particular, has been the articulation of "paper tools" as a useful analytic for understanding scientific practice. Developed originally by her for the Berzelian formalism, it has since been applied in many domains across the sciences, including analysis of Dmitrii Mendeleev's periodic system, in which case the Russian chemist's capacity to successfully predict new elements is properly seen as a validation of the utility of the table itself as a paper tool analogous to a laboratory tool. This presentation explores the multiple ways in which the periodic table has been treated as a paper tool for representing underlying chemical regularities, representing the very foundation of chemistry, and then examines how it has at times been explored as a way of revising those foundational laws themselves. In a sense this means appropriating the scaffolding and rejecting the building. In some instances, this kind of exploratory reasoning has been very productive, but in others it has moved to the fringes of acceptability in chemical reasoning. Among theorists on the fringe, the paper tool of the periodic table has assumed a central role in framing a critique of the foundations of chemical reasoning.

HIST 30 - Erlenmeyer as capitalist and entrepreneur: A case study of chemical enterprise in mid-19th-century Germany

***Alan J. Rocke**, ajr@case.edu. History, Case Western Reserve University, Cleveland, Ohio, United States*

Ursula Klein has explored an early variety of "technoscience" as a hybrid scientific-technological form of professional life that flourished long before the paradigmatic corporate-academic-industrial technoscientific model emerged in the 20th century; inter alia, she pointed to the intrinsic focus on the technical manipulation of material productivity that characterized such a large proportion of chemists' activities during the 18th century. This presentation aims to extend this line of thought into the middle of the 19th century, by focusing on a little-explored aspect of Emil Erlenmeyer's early career. His unpublished correspondence with former Giessen comrades Hans Weidenbusch and Carl Clemm-Lennig reveals a hitherto unknown series of entrepreneurial adventures. This new image provides a striking example of how deeply engaged were such apparently "pure" theorists like Erlenmeyer with applied science and material production.

HIST 31 - Stability and change in chemical problems and methodologies from the 1890s to the 1930s

***Mary Jo Nye**, nyem@onid.orst.edu. History, Oregon State University, Corvallis, Oregon, United States*

In her studies of chemistry from early modern days to the mid-nineteenth century, Ursula Klein emphasizes chemistry as useful knowledge, as a science of materials, and as a system of practices that changed slowly over time rather than in revolutionary jumps. We are accustomed to think that revolutionary change did occur at the end of the nineteenth century in chemistry and physics. In this paper I engage the proposition that there was more stability than change in chemical practice and achievement from the 1890s to the 1930s and that, as in the gradualist interpretation of the impact of Lavoisier's discoveries at the end of the 18th century, it took some time for chemists to adopt new mental and physical tools for old and new problems. As a proximate measure of notable chemical research, I examine the character of Nobel Chemistry Awards from 1901 to 1931, taking into account the lag time for Nobel recognition, while juxtaposing the Chemistry Awards with simultaneous Nobel Physics Awards.

HIST 32 - Delayed reaction: The tardy embrace of physical organic chemistry by the German chemical community

***Stephen J. Weininger**, stevejw@wpi.edu. Chemistry, Worcester Polytechnic Institute, Brookline, Massachusetts, United States*

Up to World War II, Germany dominated the Nobel Prizes in Chemistry, especially classical organic and natural product chemistry. Yet physical organic chemistry, which began to flourish in the interwar period in Great Britain and the United States, gained little traction in the German chemical community despite the presence of some first-rank researchers there. Scholars have pointed to the divergent traditions of German physical and organic chemistry as a cause of this lag, but there is more to be said. While I was a visiting scholar in Ursula Klein's group at the Max Planck Institute for History of Science I undertook, in summer 2001, to interview a number of German physical organic chemists whose careers had begun during or not long after World War II. The viewpoints expressed in those interviews, combined with material from a variety of other sources, leads me to conclude that divergent research traditions, differing representational practices and contrasting personalities of their advocates, National Socialist ideology, the exigencies of war, and the structure of German universities all contributed to the delayed embrace of physical organic chemistry by the German chemical community.

HIST 33 - Paper tools, paper things and a third-order science of organization

***Evan Hepler-Smith**, evan.heplersmith@gmail.com. Center for the Environment, Harvard University, Cambridge, Massachusetts, United States*

In her scholarship on "paper tools," Ursula Klein has negotiated a truce in the "war of signs" in which the French philosopher François Dagognet, among others, pit visual and verbal representations against one another. Attending to historical practice, Klein has shown how Berzelian formulas were not just formal signs for representing chemical ideas, but graphically suggestive instruments for doing creative theoretical and experimental work. This presentation will take as its starting point another aspect of Dagognet's 1969 book *Tableaux et langages de la chimie*: his claim that systematic nomenclature and information overload were transforming chemistry into a "third-order science of organization." Between the mid-1940s and the late 1960s, the intricate relationships embodied in systematic chemical names were re-expressed in forms of notation tractable to storage and manipulation on computers. This time, it seems, at least within one corner of the discipline of chemistry, Dagognet was right. In order to grasp the epistemic stakes of this "third-order science," it may be helpful to extend the concept of "paper tools" a step farther. For the architects of early computer-based systems of chemical information, systematic chemical names were "paper things": objects of chemical inquiry in their own right.

HIST 34 - Chemists for the common good

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Like their British, French and Swedish colleagues, the late eighteenth-century Prussian chemists performed technological experiments and works of invention. Franz Carl Achard transformed the laboratory of the Royal Prussian Academy of Sciences into a "beet factory" in order to test the production of beet sugar on a large technological scale. Martin Heinrich Klaproth, who had discovered uranium in 1789, performed experiments with a laboratory worker (Laborant) of the Royal Prussian Porcelain Manufactory in order to prepare "uranium yellow" to be used as a pigment for decorating porcelain. The Prussian chemists argued for the usefulness of chemistry, and they further identified distinct parts of chemistry – "metallurgical chemistry," "technical chemistry," "applied chemistry" as well as analytical methods – that matched more directly with practical fields. In the eyes of these chemists, scientific knowledge was an indispensable part of technological innovation and progress, which would promote the economy of their "fatherland" and the "common good." Around 1800, "fatherland" and "common good" were key words in the discourse about the usefulness of knowledge in Prussia. But what did these two words mean? A century later, these words still played an important role, but their meaning was no longer the same. And when Fritz Haber performed research on chemical weapons for the sake of his "fatherland" and the "common good", nationalism had radically changed the originally liberal meaning of these two terms.

HIST 35 - Asen Zlatarov (1885-1936): Bulgarian chemist, educator, and writer

***Nicolay V. Tsarevsky**, nvt@smu.edu. Department of Chemistry, Southern Methodist University, Dallas, Texas, United States*

Asen Zlatarov or Zlataroff (1885-1936) was one of the first scientists to teach and carry out research on biochemistry, agrochemistry, and food chemistry in Bulgaria. He studied chemistry in Geneva until 1907 and obtained his doctorate in physics from the University of Grenoble in 1908. In 1910, Dr. Zlatarov became Assistant Professor at the University of Sofia, the Faculty of Physical and Mathematical Sciences, and during the following years he rose through the academic ranks, eventually to become the Dean of the Faculty (1931). He studied a number of biochemical processes relevant to the technology of food, and the effect of metals on enzyme activity, but also made contributions to the field of analytical chemistry, proposing the use of Neutral Red (Zlatarov's reagent) for the detection of low concentrations of nitrites. In addition to his research activity, Zlatarov was passionate about bringing science to the public and wrote a number of popular books on hormones, vitamins, microbiology, the oceans, the Sun, cosmic rays, the work of Einstein, etc. In addition, he published a number of poems and a novel, which contributed to his image of a true XX-th Century Renaissance man. This talk will describe the scientific, educational, and literary career of Asen Zlatarov.

HIST 36 - Green vitriol ($FeSO_4 \cdot 7H_2O$) in Elizabethan and Stuart England: Chemistry and politics

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Fiercely independent, Elizabethan England's drive to rise above Catholic Rome's European dominance and become a major power on the western stage fueled its desire to seek out and establish a means of domestically producing "copperas" or "green vitriol" ($FeSO_4 \cdot 7H_2O$). Known since ancient times, this byproduct of the oxidation of pyrite and other iron-rich ores found a diverse range of applications from medicine to leather blackening and still further as the material was calcined for the early production of sulfuric acid. Its most prominent use in the medieval and early modern periods, however, was as a mordant and saddening agent in the dyeing of textiles -a valuable resource under virtual papal monopoly since 1461. Looking to avoid papal tributes and resolve her trade deficit, in 1565, Queen Elizabeth I offered special grants to "certain foreign chymistes and mineral masters" to immigrate to her country and help establish industries in the mining and manufacture of copperas. Between 1566 and 1579, the cost of starting such an operation soared from £5 to £100, before skyrocketing to the then-startling sum of £1,500 in 1585. The circumstances that drove this native demand provide a fascinating look into the early manifestation of the mercantilist identity of England, whose policies promote a domestic economy able to minimize the export of natural resources and gold bullion alike as essential to national security. The crown's strategy demonstrates England's recognition and careful brokerage of knowledge and self-interest: awarding foreign experts privileges and monopolies only to transfer them a few years later to the Englishmen they had trained. The specific chemical importance of green vitriol to the vital English textile industry also offers a window into the period's religious and social conflicts, just as the rise of this early chemical industry proves tantalizingly indicative of England's imperial and industrial future.

HIST 37 - Mysteries surrounding Geber in the discovery of sulfuric acid

***Aliyar Mousavi**, amousavi@ccsnh.edu. Science and Engineering Technology Department, Nashua Community College, Nashua, New Hampshire, United States*

The earliest known document considered to include a recipe for sulfuric acid (H_2SO_4) is the *Summa perfectionis*, written by a Franciscan friar named Paul of Taranto, who lived in the 14th century. From around the middle of the 12th century, alchemical writings said to be of Jabir ibn-Hayyan, the father of Arabic alchemy, who lived in the 8th century, were translated into Latin. The recipe consists of letting “copperas” ($FeSO_4.7H_2O$) be “calcined” in air, followed by allowing the produced gaseous stream to enter water in order to have it “dissolved.” The Summa perfectionis is under the name “Geber”, which is the Latinized expression for the name of an Arab authority in alchemy. The appearance of the Latin work under such a name became a mystery. The solution offered by Berthelot and his collaborators and expressed by a number of latter researchers is that the writer of the Summa perfectionis has used pseudepigraphy in writing it, including the synthetic procedure. However, the fact that by the end of the 10th century, H_2SO_4 had already been mentioned by Rases, a physician whose name is the greatest in the field of medieval chemical science, contradicts their solution and shows that the Franciscan friar has simply “cited” the “discoverer” of H_2SO_4. Still, there is another mystery to be solved. Although several researchers believe that the name “Geber” is the Latinized form of the name “*Jabir*”, according to some, such as Meyer, it is the name by which *Ja'far* is known to western nations. According to Meyer, *Ja'far*, an authority in alchemy, was a teacher of *Jabir ibn-Hayyan*. This is consistent with the conclusion made by Mousavi that *Jabir ibn-Hayyan* was educated by *Ja'far al-Sadiq*, educator and Islamic authority in the 8th century; however, the linguistic process of “*Ja'far*” converting to “Geber” remains partly unexplained.

HIST 38 - Reevaluating the role of glass in the development of distillation apparatus

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Although basic distillation apparatus, generally referred to in later times as an alembic, dates back to the first century CE, its design was relatively static until the 13th century. Such advances in still design coincide with the increasing use of glass-based still components and it is commonly stated that it was the versatility of the forms possible from the shaping of glass that led to such advances. One of the most significant and crucial advances was the development of the water-cooled condensing coil, sometimes called a 'wormcooler', which was introduced by Taddeo Alderotti of Florence during the late 13th century. In order to more carefully investigate the role of glass in this advance, a new English translation of the final section of Alderotti's *Consilia medicinalia* has been prepared and a careful analysis of his first description of this development will be presented. Particular effort will focus on materials utilized and evidence (or lack thereof) relating to the role of glass in this innovation. Finally, alternate possible contributions of glass in distillation apparatus beyond simple versatility of form will be presented.

HIST 39 - Maple sugar: America's indigenous chemical engineering product

***Matthew Paragano**, matthew.paragano@yale.edu. Yale University, New Haven, Connecticut, United States*

Predating the arrival of alcohol in North America, Native Americans spent substantial effort producing maple sugar. Production of maple sugar from the dilute sugar in maple sap (~2% by weight) was achieved through boiling off excess water, a time- and energy-intensive process. The maple sugar produced provided them with sustenance and served as the fundamental flavoring additive in food (as salt was generally not used). This time of the year became known as the “month of boiling”, during which the tribe was focused on the production of sugar for the coming year. This was a fairly unique industrial decision given by the limited availability of maple sap during the spring thaw period. After the arrival of Europeans, and with a burgeoning sugar trade, production exploded, and maple sugar acquired a commodity status. With so great an effort, and assets related to production tightly protected as in any engineering effort, maple sugar production should be known as America's indigenous chemical engineering product. However, substantial industrial production of sugar by Native Americans might not have been feasible if not for the discovery of freeze concentration, which permitted pre-concentration of the maple sap from 2% sugar to over 25% sugar. The net effect of this discovery was dramatic, as the energy requirement for boiling was slashed tenfold. Even more impressive is that under ideal conditions, Native American production of maple sugar was as energy efficient as the mechanized, highly engineered process it is today.

HIST 40 - Korean chemical scientists and engineers and ACS

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ACS South Korea International Chemical Sciences Chapter was established in April 15, 2014 with approval by ACS Council on March 19 at Dallas meeting and ratification by ACS Board of Directors on April 15. It’s a time to find out the relationship between ACS and Korean chemical scientists and engineers in S. Korea and in the United States and to describe it as a part of the history of ACS. Early history of chemistry connection between S. Korea and the United states started with the establishment of Gwanghyewon, the first modern medical facility in Korea under royal finance and support in 1885 by H. N. Allen (1858-1932), a Protestant medical missionary. H. G. Underwood (1859-1916), a Presbyterian missionary taught chemistry and physics at Gwanghyewon and that might be the first introducing modern chemistry in Korea by an American. Two chemists, Joseph D. Park (1906-1989) and Taikyue Ree (1902-1992) are good examples for early chemistry history of S. Korea. Prof. Joseph D. Park, born in Hawaii of Korean parents obtained a Ph. D. in chemistry from Ohio State University in 1937. He served as a professor at University of Colorado from 1947 till 1972 when he was appointed as the 2nd President of Korean Advanced Institute of Science and Technology in S. Korea. He served as chair of Division of Fluorine Chemistry, ACS in 1966. Prof. Taikyue Ree, the first Ph.D. in chemistry holder in Korea visited to University of Utah and co-worked with Henry Eyring (1901–1981) and established Ree-Eyring Generalized Flow Theory. He also assisted and advised many Korean chemists to study in the United States. Real progress in chemical industries started after the Korean War and chemical scientists and engineers studying in the United States contributed greatly. According to 1993 statistics of Korean Chemical Society, of 1,792 Ph.D. in chemical scientists and engineers in Korea, 34% of Ph.D. was from the United States. They contributed in education, industries and government in S. Korea. It also suggested that many Korean chemical scientists and engineers joined ACS and presented their results in ACS meetings and published in ACS journals. We aims through this talk to find out past connection and contribution of Korean chemical scientists and engineers and ACS as a part of the history of ACS.

HIST 41 - How deuterium got its name: A detailed look at the Urey-Brickwedde correspondence

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Harold C. Urey discovered the mass 2 hydrogen isotope in 1931 and is credited with naming it by June of 1933. The historical record indicates that finding a name was not a straightforward process, and Urey's correspondence in the spring of 1933 with collaborator Ferdinand Brickwedde indicate that as many as ten different monikers were in play. While Urey and Brickwedde exchanged their opinions on possible names for 'the hydrogen', it was Urey's doctoral advisor G.N. Lewis who decisively influenced him to settle on the name deuterium. This talk will build upon my earlier analysis of the Urey-Lewis dynamic (See: O'Leary, Nat. Chem. 2012, 4, 236.) and focus on the deliberative process undertaken by Urey and Brickwedde as they tried to find appropriate names for the hydrogen isotopes.

HIST 42 - Dusting off old ideas: Reviving historical concepts for teaching chemical evolution in *A World from Dust*

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In my popular science book *A World from Dust*, I present R.J.P. Williams's hypothesis that the evolution of life was shaped by a chemical sequence, along with recent evidence that supports that hypothesis. Because Williams's chemical sequence is told as a narrative, his hypothesis is told as a story with examples and illustrations from diverse liberal arts. I derived several examples from historical concepts that are then modified in the light of recent scientific findings. For example, in Chapter 4 of *A World from Dust*, the concentration of elements in the ocean is related to the biological function for which each element is used, just as the ancient concept of the Great Chain of Being related life forms to function. How this concept was used in the book, and what it implies, have both changed dramatically from its original use, yet in a modern setting, the concept retains explanatory power for relating elemental solubility to function and how that has changed over time for redox-sensitive elements. Other historical examples used to explain modern concepts in the book include how Lawrence Principe's experience in successfully recreating alchemical experiments shows that complexity and accuracy in re-creating initial conditions may help recreate the chemical origin of life; how the Aristotelian idea of formal cause may help explain Adrian Bejan's observation that flowing energy and matter form similarly shaped branching structures in very different contexts; and how a classification scheme based on broad functional and chemical characteristics ("chemotypes"), not on specific Linnaean taxonomy, illustrates the interplay of Williams's chemical sequence with natural history in the context of ancient microbial evolution. These four cases show how history can help explain chemistry and biology, if the historical concepts are modified and reinterpreted in light of the scientific evidence.