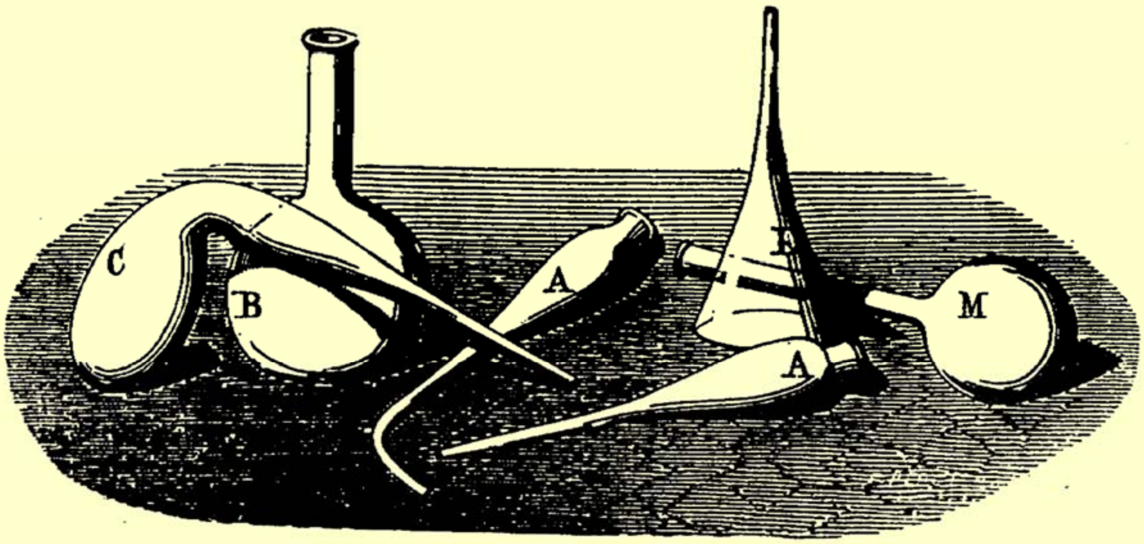
American Chemical Society

DIVISION OF THE HISTORY OF CHEMISTRY



PROGRAM & ABSTRACTS

258th ACS National Meeting
San Diego, CA
August 25-29, 2019

Nicolay V. Tsarevsky, Program Chair

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Final Program

DIVISION OF THE HISTORY OF CHEMISTRY (HIST)

N. V. Tsarevsky, *Program Chair*

SUNDAY MORNING

Section A

Marriott Marquis San Diego Marina
Coronado Room

Bibliography of Chemistry

Cosponsored by CINF

G. D. Patterson, *Organizer, Presiding*
R. S. Brashear, *Presiding*

8:00 HIST 1. Collecting chemical knowledge: History of chemical bibliography and bibliophilism. **R.S. Brashear**

8:30 HIST 2. Boyle's *Sceptical Chymist*, 1661: Current census. **V.V. Mainz**, G.S. Girolami

9:00 HIST 3. Byron A Soule's library guide for the chemist: Guide to the use of the chemical literature. **R.A. Egolf**

9:30 HIST 4. Different editions or different books? The *Regnum minerale* of "Valentin Krautermann". **J.A. Norris**

10:00 Intermission.

10:15 HIST 5. Introduction to the bibliography of chemistry. **G.D. Patterson**

10:45 HIST 6. When books lie: Unravelling the bibliography of Lemery's *Cours de Chimie*. **J.R. Voelkel**

11:15 HIST 7. Chemistry books during the sixties: Renaissance-like flowering. **P. Laszlo**

11:45 HIST 8. Panel discussion: Role of booksellers in the history of chemistry. **G.D. Patterson**, J.A. Norris

SUNDAY AFTERNOON

Section A

Marriott Marquis San Diego Marina
Coronado Room

150 Years of the Periodic Table

Cosponsored by CINF, INOR‡ and PRES

G. Girolami, C. J. Giunta, *Organizers*
V. V. Mainz, *Organizer, Presiding*

1:10 Introductory Remarks.

1:15 HIST 9. Trouble with triads. **W. Jensen**

1:45 HIST 10. Vis tellurique of Alexandre-Émile Béguyer de Chancourtois. **C.J. Giunta**

2:15 HIST 11. Periodicity in Britain: Periodic tables of Odling and Newlands. **J. Poole-Sawyer**

2:45 Intermission.

3:00 HIST 12. Gustavus Detlef Hinrichs and his chart of the elements. **G.S. Girolami**

3:30 HIST 13. Mendeleev in St. Petersburg: Marginality of the periodic system. **M.D. Gordin**

4:00 HIST 14. Lothar Meyer's path to periodicity. **A.J. Rocke**

Chemical Nomenclature & Representation: Past, Present & Future

Sponsored by CINF, Cosponsored by HIST and NTS‡

SUNDAY EVENING

Marriott Marquis San Diego Marina
Newport Beach

5:00 - 7:00 HIST Executive Committee Meeting

Section A

Marriott Marquis San Diego Marina
Coronado Room

150 Years of the Periodic Table

Cosponsored by CINF, INOR‡ and PRES

G. Girolami, V. V. Mainz, *Organizers*
C. J. Giunta, *Organizer, Presiding*

8:40 Introductory Remarks.

8:45 HIST 15. Discovery of the elements predicted by Dmitri Mendeleev's table: Scandium, gallium, and germanium. **M.V. Orna**, M. Fontani

9:15 HIST 16. Rare earth elements. **A. De Bettencourt Dias**

9:45 HIST 17. History (and pre-history) of the discovery and chemistry of the noble gases. **J.A. Labinger**

10:15 Intermission.

10:30 HIST 18. Sir John F.W. Herschel and the concept of periodicity. **G.D. Patterson**

11:00 HIST 19. Hydrogen, helium, and metals: When astronomy met the periodic table. **V.L. Trimble**

11:30 HIST 20. Hydrogen to oganesson: Philatelic celebration of the periodic table. **D. Rabinovich**

Chemical Nomenclature & Representation: Past, Present & Future. Challenges & Opportunities in Chemical Representation

Sponsored by CINF, Cosponsored by HIST and NTS‡

MONDAY AFTERNOON

Section A

Marriott Marquis San Diego Marina
Coronado Room

1:00 – 1:30 HIST Business Meeting (Open to All Members)

150 Years of the Periodic Table

Cosponsored by CINF, INOR‡ and PRES

C. J. Giunta, V. V. Mainz, *Organizers*
G. Girolami, *Organizer, Presiding*

1:40 Introductory Remarks.

1:45 HIST 21. Impact of 20th century physics on the periodic table and questions still outstanding in the 21st century. **E.R. Scerri**

2:15 HIST 22. Uses of the periodic system after radioactivity and the discovery of the neutron: Contrasting views of Lise Meitner and Ida Noddack. **B. Van Tiggelen**

2:45 HIST 23. Mary Elvira Weeks and *The Discovery of the Elements*. **V.V. Mainz**

3:15 Intermission.

3:30 HIST 24. From neptunium to mendelevium: Element discovery and the birth of the atomic age. **K. Chapman**

4:00 HIST 25. Transactinide elements: How the 7th row of the periodic table was discovered. **D.A. Shaughnessy**

4:30 HIST 26. Periodic table after period 7. **V.P. Pyykko**

CHAS 40th Anniversary Symposium

Sponsored by CHAS, Cosponsored by HIST

Chemical Nomenclature & Representation: Past, Present & Future. InChI'ng Forward

Sponsored by CINF, Cosponsored by HIST and NTS‡

MONDAY EVENING

Section A

San Diego Convention Center
TBD

Sci-Mix

N. V. Tsarevsky, *Organizer*

8:00 - 10:00

10, **21**. See Previous Listings.

42, **51**. See Subsequent Listings.

TUESDAY MORNING

Section A

Marriott Marquis San Diego Marina
Marina Ballroom Salon E

HIST Award

J. Seeman, *Organizer, Presiding*

9:00 HIST 27. Personal reflection on Ted Benfey's early contributions to chemical education. **L.E. Overman**

9:30 HIST 28. Ted Benfey and the Chemical Heritage Foundation. **N.D. Heindel**

10:00 HIST 29. My "TED Talk": Tribute to Ted Benfey and *Chemistry*. **M.V. Orna**

10:30 Intermission.

10:40 HIST 30. Traveling with Ted Benfey: Greensboro, Munich, and Newton. **W. Newman**

11:10 HIST 31. Periodicals, periodical elements, and structures of periodicity: Perspective on the work of Ted Benfey. **A.J. Rocke**

11:40 HIST 32. Ingold, Bartlett, and the status of physical organic chemistry. **S.J. Weininger**

Gerry Meyer: The First 100 Years

Sponsored by SCHB, Cosponsored by BMGT, CHED, ENFL‡, HIST and SCC‡

TUESDAY AFTERNOON

Section A

Marriott Marquis San Diego Marina
Marina Ballroom Salon E

HIST Award

J. Seeman, *Organizer, Presiding*

1:30 HIST 33. German prince and the encouragement of trade, culture, and chemistry in Victorian Britain. **R. Anderson**

2:10 HIST 34. From Armstrong’s reversed electrolysis and heuristic teaching method to O. T. Benfey’s solvent salt effects in hydrolysis and the changing American chemistry curriculum. **W. Brock**

2:40 HIST 35. Recent advances in the history of chemistry. **J. Seeman**

3:10 Intermission.

3:20 HIST 36. Ted Benfey: Friend to colleges, chemistry, and art. **J. Fernandes**

3:50 HIST 37. Remarks and reminiscences. C. Benfey, **P. Benfey**, S. Benfey

4:30 HIST 38. My path from organic research chemistry to becoming a science historian. **O.T. Benfey**

Gerry Meyer: The First 100 Years

Sponsored by SCHB, Cosponsored by BMGT, CHED, ENFL‡, HIST and SCC‡

WEDNESDAY MORNING

Section A

Marriott Marquis San Diego Marina
Marriott Grand Ballroom Section 9

150 Years of the Publication of the 1st issue of Zhurnal Russkogo Fiziko-Himicheskogo Obshtestva

D. E. Lewis, N. V. Tsarevsky, *Organizers, Presiding*

8:45 HIST 39. Foundation and early activities of the Russian Chemical Society. **N.V. Tsarevsky**

9:15 HIST 40. Russia's first professional chemical journal: *Zhurnal Russkogo Khimicheskogo Obshchestva*. **D.E. Lewis**

9:45 HIST 41. Volkova effect: Women in and behind the pages of the Journal of the Russian Chemical Society. **M.D. Gordin**

10:15 Intermission.

10:30 HIST 42. Salvaging the past: Conversion of low-resolution historical images to line art. **M.J. Adlington**, S.L. Mahoney, M.A. Bergs, S.E. Lomo, D.E. Lewis

11:00 HIST 43. Borodin's contributions to organic chemistry. **M.C. Stefan**

11:30 HIST 44. Exploring the reactivity of halogen compounds: Gustavson's contributions to chemistry. **N.V. Tsarevsky**

WEDNESDAY AFTERNOON

Section A

Marriott Marquis San Diego Marina
Marriott Grand Ballroom Section 9

Tutorial & General Papers

N. V. Tsarevsky, *Organizer, Presiding*
S. C. Rasmussen, *Presiding*

1:00 HIST 45. Glass in the West: From forest glass to bohemian glass. **S.C. Rasmussen**

1:30 HIST 46. Lead in the human habitat: Historical perspective. **G.G. Melikyan**, S. Guarina, V. Abed

2:00 HIST 47. Rachael Bodley: Charter ACS member and medical education pioneer, part 2. **J. Hayes**

2:30 HIST 48. Withdrawn.

3:00 Intermission.

3:15 HIST 49. Withdrawn.

3:45 HIST 50. Withdrawn.

4:15 HIST 51. Clendenin, WV: Birthplace of the Chemical Valley and the efforts to document our history. **M.W. Fultz**, D. Stone

4:45 HIST 52. Withdrawn.

HIST 1

Collecting chemical knowledge: History of chemical bibliography and bibliophilism

Ronald S. Brashear, *rbrashear@sciencehistory.org. Othmer Library, Science History Institute, Philadelphia, Pennsylvania, United States*

While many practitioners have collected chemical texts for their own research, in the 19th century we see the beginnings of chemical bibliophilism, especially with the collecting activities of James Young and John Ferguson. Unlike the traditional practices of collecting religious, literary, and classic texts, scientific—in particular chemical—collecting was a field that was and today is still considered a small niche area. This paper will look at the nature of chemical book collecting in the last two hundred years and how these collections have been the basis of the great chemical bibliographies as well as to understand better the factors that have shaped some of the great collectors and collections of chemical history. Some of the collections under consideration will include those of Young, Ferguson, Henry Carrington Bolton, Edgar Fahs Smith, William Cole, Denis Duveen, Paul Mellon, Franz Sondheimer, Roy G. Neville, and Daniel Cevallos-Tovar, a rather unconventional collector.

HIST 2

Boyle's *Sceptical Chymist*, 1661: Current census

Vera V. Mainz[1], *mainz@illinois.edu, Gregory S. Girolami*[2]. *(1) School of Chemical Sciences, University of Illinois at Urbana-Champaign, Urbana, Illinois, United States (2) Univ of Illinois, Urbana, Illinois, United States*

A common question about rare and/or famous books is “how many copies of it were printed?” and “how rare is it?” One way to answer the second question is to take a census. This talk gives the results of a census we have conducted on one of the rarest and most valuable of all chemistry books: the first edition of the Robert Boyle's *Sceptical Chymist*. An earlier census conducted in 1960 found only 31 copies worldwide. As of today, we have definite information about the location of only 55 copies, with evidence of perhaps 5 more of unknown location from bookdealer and auction records. All in all, the book is far rarer than Copernicus's *De Revolutionibus*, Galileo's *Dialogo* and Newton's *Principia*, for example. It seems to be at least as rare as Harvey's *De Motu Cordis*, and the Gutenberg bible, two of the more famous ‘black tulips’ of the book collecting world.

HIST 3

Byron A Soule's library guide for the chemist: Guide to the use of the chemical literature

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

Byron A. Soule was a faculty member at the University of Michigan who taught a course in the use of the chemical literature to both undergraduate and graduate students. He was also an early chairman (1954) of the ACS Division of Chemical Literature, the forerunner to the current Division of Chemical Information. His "Library Guide for the Chemist" grew out of his course, and was a widely used reference to the searching of the chemical literature. While admittedly not a comprehensive chemical bibliography, it was for its time a very useful guide to the wider chemical literature. This paper will give some information about the career of Soule along with discussion of the contents of the book.

HIST 4

Different editions or different books? The *Regnum minerale* of "Valentin Krautermann"

***John A. Norris**, norrisjohn1@gmail.com. John A. Norris Rare Books, Alzingen, Luxembourg*

Christoph von Hellwig (1663-1721) worked as a physician in several German towns throughout his life. As a prolific author, editor, and compiler of medical and scientific information, Hellwig published numerous works within the subject areas of medicine and chemistry. Hellwig's books continued to be re-issued throughout the eighteenth century, some in expanded or otherwise altered editions. Others appeared in their first editions posthumously. Many of these works were published under the pseudonym Valentin Kräutermann. Recent scholarship has argued that numerous authors were involved in assembling these texts, even some of those published under Hellwig's own name. The work to be considered here is referred to generally as Hellwig's Regnum minerale, the contents of which concern the nature, properties, medical uses, and generation of minerals and metals. The first edition, 1717, was among the books first published under the Kräutermann pseudonym. A second edition appeared in 1726, five years after's Hellwig's death, with considerably altered contents. The third edition, 1747, is a reprinting of the second. I will briefly describe the main differences in content between the first and second editions, with remarks on the some of the different theoretical ideas regarding metals and minerals found in each. This comparison constitutes an interesting case in which two consecutive editions of a book are essentially different works. Furthermore, the case for ascribing these works to different authors will be evaluated.

HIST 5

Introduction to the bibliography of chemistry

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

Chemistry is a community concerned with matter and its changes. One of the evidences that such a community exists is the presence of a permanent record contained in books, journals, manuscripts and other forms of communication. The study of these artifacts comprises the field of chemical bibliography. Once it became clear that chemistry was a valuable human activity, rulers started to collect books that were written by chemists. Great libraries are associated with great civilizations. Wealthy individuals also created chemical libraries, and one of the most famous examples is the collection of John Dee (1527-1608), the physician to Queen Elizabeth I of England and a noted alchemist. Popular books were often either reprinted or revised many times both during the life of the author and even after his death. The full description of the publication history of a book can be a fascinating story. Not all written material ends up in fully printed form. The study of authenticated manuscripts has been one of the most profitable approaches for understanding polymaths such as Isaac Newton, a serious alchemist. Another modality for the study of chemistry is the epistolary corpus of famous chemists. While many volumes of *Life and Letters* have been published, there is still a treasure trove of letters to be read and curated. While the technical content of a scientific book remains a primary focus of both scientists and historians, the study of the actual physical book itself continues to provide interest to specialists. This symposium is a celebration of the field of chemical bibliography in all its aspects.

HIST 6

When books lie: Unravelling the bibliography of Lemery's *Cours de Chimie*

James R. Voelkel*, JVoelkel@sciencehistory.org. Science History Institute, Philadelphia, Pennsylvania, United States*

Nicolas Lemery's *Cours de chymie* was easily the most successful in the burgeoning field of French chemico-pharmaceutical textbooks in the 17^{th} and early 18^{th} centuries. From the first edition in 1675 until the author's death in 1715, it went through ten editions. But it didn't stop there. There were posthumous 11^{th} and even 12^{th} editions. Altogether, the book appeared in 32 different editions or imprints. Lemery's *Cours de chymie* is a bibliographical nightmare. There are two each of the second, third, fifth, seventh, eighth, ninth, and tenth editions, most—but not all—appearing in different years. And identical Lyons imprints often sport four or five different title pages with different imprints. Unraveling this mess will take us to the intersection of chemistry and the regulation of printing under the French absolutist state, and it will answer the question, Would a book lie? Yes, it most certainly would.

HIST 7

Chemistry books during the sixties: Renaissance-like flowering

***Pierre Laszlo**, clouds-rest@wanadoo.fr. Ecole polytechnique, Palaiseau, France*

The 1960s saw in the US a blossoming of books — monographs and textbooks both — many written by luminaries of academic chemistry. The decade saw conjunction of audacious new publishers and academic stars willing to write books. There was a plethora of novel topics to introduce students to, such as: mechanistic studies - NMR - conformational analysis and stereochemistry - chemical dynamics - molecular orbital theory - inorganic biochemistry - electrocyclic reactions - etc. Thus undergraduate and graduate studies learned reliably of the most recent accomplishments in research laboratories. Did such books help to open new fields of investigation? Was there something like a uniform format and style? Why were books such a choice means of science communication and popularization? What kind of economics were involved in their production and distribution? And what were some of the factors for such a productive, collective achievement? The post-Sputnik meteoric rise of the research university; the sheer size of the United States, with a small number of elite universities and a very large number of undergraduate colleges and Homestead institutions; presence of Jewish scientists, including recent immigrants, with a cultural tradition of affection and respect for books; paperback publishing; the Xerox photocopier; campus bookstores; the American tradition of do-it-yourself and how-to manuals. The talk will draw on my recollections and from the titles on my bookshelves. I'll mention also, time allowing, my personal experience of teaching at Princeton and of publishing, jointly with Peter J. Stang, Organic Spectroscopy (New York : Harper and Row, 1971).

HIST 8

Panel discussion: Role of booksellers in the history of chemistry

***Gary D. Patterson**[1], gp9a@andrew.cmu.edu, John A. Norris[2]. (1) Carnegie Mellon University, Pittsburgh, Pennsylvania, United States (2) John A. Norris Rare Books, Alzingen, Luxembourg*

With the invention of the printing press, chemists started to publish works of chemistry. In order to distribute these books to the interested parties, booksellers played an active role. They sought out available titles and publicized them to chemists and interested natural philosophers and physicians. In this session we will conduct a panel discussion on the role of booksellers in the history of chemistry. Without actual archival materials, historians would have little or no material with which to work. Please think about this topic and be prepared to bring examples to the discussion.

HIST 9

Trouble with triads

***William Jensen**, jensenwb@ucmail.uc.edu. University of Cincinnati, Cincinnati, Ohio, United States*

After first reviewing the origins of the triad concept and its role in early element classificiation, the author will analyze the recent revival this concept in a modified form by several contemporary authors and will mathematically demonstrate why this newer version, like the original, is worthless as a criterion for classifying the chemical elements and for determining the proper form of the periodic table. This analysis will be further applied to the historical question of whether Mendeleev used triads to predict the properties of eka-boron, eka-silicon, and eka-aluminum.

HIST 10

Vis tellurique of Alexandre-Émile Béguyer de Chancourtois

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

Alexandre-Émile Béguyer de Chancourtois (1820-1886) was the first of the independent discoverers of chemical periodicity. He presented his system, the Vis tellurique, to the Académie des Sciences in a series of memoirs in 1862 and 1863. Published under the heading of general chemistry in the Académie's *Comptes Rendus* without the helical graph that illustrates the system, these papers attracted little attention at the time. Not long after his death, attention was drawn to his priority in a discovery for which Mendeleev, Meyer, and Newlands had received accolades. This presentation will review his career and look in detail at the Vis tellurique, including its graphical embodiment.

HIST 11

Periodicity in Britain: Periodic tables of Odling and Newlands

***Julianna Poole-Sawyer**, j_poole-sawyer@acs.org. American Chemical Society, Columbus, Ohio, United States*

Before Mendeleev published his periodic system of the elements in 1869, two British chemists independently published periodic tables of their own. In 1863, John A. R. Newlands published his periodic table in an article titled “On Relations among the Equivalents” [*Chem. News J. Phys. Sci.*, **1863**, *7*, 70], and in 1864, William Odling published his periodic table in his article “On the Proportional Numbers of the Elements” [*Q. J. Sci.*, **1864**, *1*, 642]. In the next two decades, Newlands would publish 10 more articles expounding and defending his classification of the elements and the underlying periodic law, whereas Odling barely wrote more on the subject. Neither periodic table received the acceptance Mendeleev’s table received, and Newlands was recognized only after Mendeleev’s system gained acclaim. This talk will demonstrate the

innovativeness of their classifications of the elements and what their fellow chemists in nineteenth-century Britain thought of their ideas.

HIST 12

Gustavus Detlef Hinrichs and his chart of the elements

***Gregory S. Girolami**, girolami@scs.uiuc.edu. Univ of Illinois, Urbana, Illinois, United States*

Of the many scientists who tried to find order in the properties of the chemical elements, perhaps the most unusual and eccentric was Gustav Detlef Hinrichs (1836-1923). Born in northern Germany, then part of Denmark, Hinrichs was educated in Copenhagen and emigrated to the United States in 1861, where he was appointed professor of Modern Languages, Natural Philosophy, and Chemistry at the University of Iowa. Hinrichs published the first of his schemes for the classification of elements in his 1867 book *Programme der Atomechanik*, which was lithographed from a hand-written 44 page manuscript. The book contains a chart, variously described by later commentators as circular or spiral, in which families of elements occupy separate radial spokes. Although the spokes are mostly in modern periodic order (e.g., alkali metals next to alkaline earths), some are not: the halogen spoke is next to that for the pnictogens (N, P, etc.) instead of chalcogens. In addition, Hinrichs separated the elements into "trigonoids" and "tetragonoids", based on what he called his "panatom" theory of atomic structure. The present paper will analyze Hinrichs's 1867 chart as well as the revised tabular versions he published in the summer of 1869, before he became aware of the work of Mendeleev.

HIST 13

Mendeleev in St. Petersburg: Marginality of the periodic system

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

Dmitrii Ivanovich Mendeleev (1834-1907) is of course most famous today for his development of a periodic system of chemical elements in 1869, the 150th anniversary of which is being celebrated this year. While this tabular arrangement was an important part of his reputation in his lifetime both in Russia and abroad, it took some time for that fame to cement itself as the table gained adherents over the ensuing decades, and it was always more central to Mendeleev's image in Western Europe than it was in Imperial Russia. That is not because Mendeleev had no chemical supporters in St. Petersburg — far from it: he was a principal architect of the Russian Chemical Society and a mainstay of the chemical community from the early 1860s until his death. Rather, it speaks to Mendeleev's centrality as a public intellectual in many other areas of cultural life. For Russians, the periodic system was just one of many reasons why Mendeleev was a famous name. This talk will discuss the reputation Mendeleev established among Russians over the course of his long career, a notoriety that was at first relatively distinct from the periodic table, but that over time grew more intimately connected with it. His public campaign against Spiritualism, controversy with the Academy of Sciences, economic consulting for the

Ministry of Finances, and pioneering of the metric system will be juxtaposed with his visibility as a colorful personality at St. Petersburg University for many decades.

HIST 14

Lothar Meyer's path to periodicity

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

Over the past 150 years, the origin and development of Dmitrii Mendeleev's investigative pathway to the discovery and elaboration of the periodic system of the elements has justifiably been the subject of extensive scholarly interest and writing. The same cannot be said of his chief rival in this story, Lothar Meyer. The speaker will suggest how Meyer came to be interested in the subject, and what concerns drove him toward the composition, some months after the publication of Mendeleev's first periodic table, of his crucial 1869-70 article, with its atomic weight table and atomic volumes line chart, a paper that constitutes his chief subsequent claim to have been co-discoverer of the periodic system of the elements. The presentation is not concerned directly to provide an answer to the question of priority, but rather to understand Meyer's developing ideas in connection with his and others' ongoing research. This sesquicentennial year of the periodic table is a fitting moment to offer further insight into these important events.

HIST 15

Discovery of the elements predicted by Dmitri Mendeleev's table: Scandium, gallium, and germanium

***Mary Virginia Orna**[1], maryvirginiaorna@gmail.com, Marco Fontani[2]. (1) Chemistry, The College of New Rochelle, New Rochelle, New York, United States (2) Universita Degli Studi Di Firenze, Sesto Fiorentino, Italy*

Dmitri Mendeleev (1834-1907), in organizing his periodic table, realized that there were three obviously missing elements provisionally designated eka-boron, eka-aluminum, and eka-germanium. These theoretical "discoveries" eventually led to the detection and isolation, respectively, of scandium, gallium, and germanium. Can we give credit to Mendeleev for these discoveries? Did Mendeleev ever claim these elements as his own? Can we really assign their discoveries to, in turn, to Lars Fredrik Nilson (1840-1899), Paul-Émile Lecoq de Boisbaudran (1838-1912), and Clemens Alexander Winkler (1838-1904)? Would these elements have been found when they were if Mendeleev had not pointed the way? These are not idle questions. Nowadays, people tend to give the guide just as much credit as the explorer. But Mendeleev made no such claim – all he wanted, and somewhat ferociously, was credit for the organizing principle that chiefly bears his name, although he, too, stands on the shoulders of many others – and even perhaps should share the platform with Julius Lothar Meyer (1830-1895).

HIST 16

Rare earth elements

***Ana De Bettencourt Dias**, abd@unr.edu. University of Nevada, Reno, Reno, Nevada, United States*

Perhaps no other topic regarding the periodic table, as we know it today, is as hotly debated as the position of the lanthanides and more specifically the placement of the elements La, Ac and Lu and Lr. For different reasons, the placement of these elements, the six that were known at the time, in his *Attempted System* also puzzled Mendeleev. In this presentation, Mendeleev's work around the Rare Earths, their nature and attempted placement in the early version of the periodic table, along with insights gained by some of his contemporaries to solve this question.

HIST 17

History (and pre-history) of the discovery and chemistry of the noble gases

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

Cavendish's 1783 measurements showing that around 1/120 of the volume of air appeared to be neither nitrogen or oxygen, along with Lockyer's 1868 observation of a solar spectral line that corresponded to no known element on earth, were early but unrecognized hints of elements that could not be accommodated in Mendeleev's Periodic Table. Following a series of painstaking experiments, in 1895 Lord Rayleigh and William Ramsay announced the isolation of a new element, which they called argon. Their claim was widely challenged — not least by Mendeleev himself — with alternate interpretations, particularly that the substance was actually N_3, an allotrope of nitrogen analogous to ozone. Within the next few years, though, Ramsay demonstrated the existence of four more such inert gases: He, isolated from minerals and shown to exhibit the mystery solar spectral line; and Ne, Kr, and Xe, by cryogenic fractionation of air. Ramsay inserted a place in the Periodic Table for this new group in 1896; Frederick Soddy added Rn in 1903; and Ramsay received the chemistry Nobel Prize in 1904. Attempts to induce reactivity began almost immediately, but with no (reproducible) success. Friedrich Paneth proclaimed in 1924 that the unreactivity of the noble gases "belongs to the surest of experimental results," while others — notably Linus Pauling — insisted that they should form compounds under the right conditions. In 1933, at Pauling's instigation, Caltech chemist Don Yost carried out an unsuccessful assault on xenon's inertness, which was finally overcome three decades later. Neil Bartlett's discovery of "$Xe^+[PtF_6]^-$" was followed quickly by extensive demonstrations of chemical reactivity, along with considerable speculation on the reasons for Yost's failure. I will very briefly summarize the former, and offer my own interpretation of the latter.

HIST 18

Sir John F.W. Herschel and the concept of periodicity

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

The notion that Chemistry could be a true example of Natural Philosophy was initiated by virtuosi such as Robert Boyle and Isaac Newton in the 17th century. The 19th century was the great age of Natural Philosophy and one of the best examples of this genre was the *Preliminary Discourse on the Study of Natural Philosophy* (1851) by Sir John F.W. Herschel, Bart. K.H. (1792-1871). Although he was one of the greatest astronomers of all time, his ability to carefully examine real data and to discern patterns also helped him reach conclusions in chemistry that remain true today. By the middle of the 19th century, there were between 50 and 60 elements acknowledged by the world of chemistry. It was already known that the chemical properties of distinct groups of elements were similar. Herschel was also a celebrated mineralogist, and he observed that certain elements formed salts with crystal forms that were similar, a result proposed by Mitscherlich. Herschel accepted the Daltonian notion that crystals were composed of atoms located on a lattice. The law of isomorphism (similarity) is one of the notions that support the paradigm of periodicity. Herschel believed that Chemistry should be founded on the best data, and insisted that fellow chemists establish precise values for elemental properties like atomic weight. But, as a Natural Philosopher, he valued bold speculative conclusions, as long as they were thoroughly tested by actual data. Each substance required detailed quantitative characterization. For Sir John Herschel, science was hard work, but well worth the effort when properly conducted. He was the President of the Chemistry Section of the British Association for the Advancement of Science in 1858 and delivered the plenary address that year. He cited Josiah Parsons Cooke of Harvard University as his inspiration for recognizing the chemical organizing principle for the elements. This had been presented in 1854 and published in the *Memoirs of the American Academy of Arts and Sciences* in 1855. While Cooke was still working with a bad set of atomic weights and he did not know the correct empirical formulae for many compounds, he did organize the elements into groups that had similar chemistry. C.S. Peirce, the Harvard polymath, argued for recognition of the work of Cooke in 1892. There was still much work to be done in 1858 when Herschel praised the work of Cooke, but a major step had been taken.

HIST 19

Hydrogen, helium, and metals: When astronomy met the periodic table

Virginia L. Trimble, *vtrimble@astro.umd.edu. Univ of California Irvine, Irvine, California, United States*

This presentation will focus on the "discoveries" of (in chronological order) nebulium, helium, and coronium (with very brief excursions to asterium, newtonium, and a few others). The three discoveries occurred in a narrow temporal cluster, 1864, 1868, and 1869. All three attracted attention through a single emission line in the yellow-green part of the spectrum, and this occurred just before photographic emulsions on spectrographs began replacing human eyes at

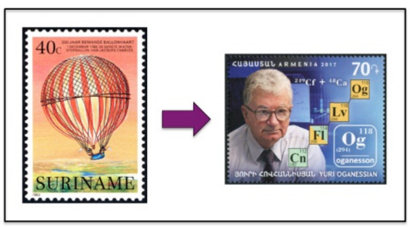
spectroscopes. Note: The discoveries could not have happened with early photographic emulsions, which have almost no sensitivity at those wavelengths, so that the standard stellar spectra for many years extended only a bit redward of H-beta. All three are "interesting" atomic transitions.

HIST 20

Hydrogen to oganesson: Philatelic celebration of the periodic table

***Daniel Rabinovich**, drabinov@uncc.edu. Dept. of Chemistry, UNC Charlotte, Charlotte, North Carolina, United States*

Postage stamps are an inexpensive and effective way of communicating ideas and are often issued by governments or postal authorities to commemorate events and engage the general public on a variety of topics, ranging from history and geography to art and literature. A number of stamps have also been issued to celebrate scientific discoveries or to honor well-known scientists and can be used as simple yet powerful teaching tools in the classroom or to illustrate technical presentations. The International Year of the Periodic Table (IYTP 2019) presents a unique opportunity to highlight the value of chemistry to society through its most recognizable source of information. This talk will feature an overview of postage stamps and other philatelic materials related to the history of chemistry and the development of the periodic table, from the four classical elements in Greece to the recent addition of superheavy elements. An array of fascinating stories pertaining to the discovery (or not) of several chemical elements will also be related in this presentation.



HIST 21

Impact of 20th century physics on the periodic table and questions still outstanding in the 21st century

***Eric R. Scerri**, scerri@chem.ucla.edu. Dept of Chem And Biochem, UCLA, Los Angeles, California, United States*

Physics began to ‘invade’ the periodic table following the discovery of the electron, X-rays and radioactivity at the turn of the 20th century. This was followed by the discovery of atomic number, and the assignment of electronic configurations, initially by Bohr using one quantum number but rapidly augmented by a further three quantum numbers. The talk will conclude with some still remaining issues concerning the periodic table and its relationship with quantum mechanics.

HIST 22

Uses of the periodic system after radioactivity and the discovery of the neutron: Contrasting views of Lise Meitner and Ida Noddack

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1934 marked the centenary of Mendeleev's birth, and many scientists took the opportunity to share their views on the evolution and future of the Periodic System in light of the recent developments in the understanding and conception of matter. In June of that same year, Enrico Fermi published the result of a nuclear process he interpreted as having produced two transuranic elements, which eventually led to the discovery of nuclear fission but also initiated the quest for transuranic elements with nuclear means.
More than chemists situating themselves or their community in the history, the fascinating feature is how much it reveals of the diversity in use and users of the Periodic System and its graphical representations. This paper aims at throwing light on these local appropriation process, and will draw on publications authored by Lise Meitner and Ida Noddack devoted to the Periodic System and its future, written from the perspectives of a nuclear physicist and a chemist experienced in searching for undiscovered elements, respectively.

HIST 23

Mary Elvira Weeks and *The Discovery of the Elements*

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In the 2019 International Year of the Periodic Table, it seems appropriate to revisit Mary Elvira Weeks's contributions to the history of chemistry through her publication of the "Discovery of the Elements." Weeks (1892-1975) was born in Lyons, Wisconsin, received her B.A. degree in 1913 from Ripon College, Wisconsin, and finished her M.A. in 1914 from the University of Wisconsin. In 1921, she became an instructor in chemistry at the University of Kansas, where she simultaneously worked on her PhD, finishing her degree in 1927. In 1932, Weeks started publishing a series of twenty-one articles in the *Journal of Chemical Education* on the discovery of the elements. In 1933, she combined these published articles in book form: the first edition of "The Discovery of the Elements" was published by the Chemical Education Publishing Company of Easton, PA. Six editions followed, ending with the 7th edition in 1968 with co-author Henry M. Leicester. These books were heavily illustrated with photos of chemists collected by her Kansas colleague, Frank B. Dains. The style of the books and changes between the editions will be discussed.

HIST 24

From neptunium to mendelevium: Element discovery and the birth of the atomic age

***Kit Chapman**, chris.chapman174@gmail.com. n/a, Cambridge, United Kingdom*

The first transuranium elements changed our world forever. The story of their creation is filled with serendipity, strange characters and maverick breakthroughs in an effort to end to the bloodiest conflict in human history. But this was only the start of an astonishing golden age in synthetic element discovery. This talk charts the scientists and personnel who expanded the periodic table beyond its supposed boundaries in the 1940s and 1950s, leading to atomic weapons, lifesaving devices and today's superheavy elements, and tells forgotten tales at the edges of known science based on first-hand accounts, reports and interviews.

HIST 25

Transactinide elements: How the 7th row of the periodic table was discovered

***Dawn A. Shaughnessy**, shaughnessy2@llnl.gov. Nuclear and Chemical Sciences Division, Lawrence Livermore National Laboratory, Livermore, California, United States*

With the discovery of element 118 (oganesson) in 2002, the first row of the transactinide elements in the Periodic Table was finished. The discovery of these 15 elements began with element 104 (rutherfordium) in the 1960s and spanned over five decades of experimental research conducted across the globe. Consisting of all synthetic elements, the transactinides began steeped in controversy surrounding competing claims of discovery, alternate names, and retracted data. After the controversies surrounding the discoveries of the early transactinides, the majority of the elements were subsequently created by multi-national teams of scientists, working for months at a time to produce only a few atoms each of these elusive and short-lived elements. These experiments require large particle accelerators, targets comprised of rare and difficult-to-come-by materials, and fast detectors and electronics capable of detecting sub-second decay of a single atom. In this presentation, I will present an overview of the discovery of the transactinide elements, the last of which were named in 2016. The future of element discovery now depends on scientists making the next advances in technology that will enable us to pursue the start of the eighth row of the Periodic Table.

HIST 26

Periodic table after period 7

***Veli P. Pyykko**, Pekka.Pyykko@helsinki.fi. Dept of Chem Univ of Helsinki, Helsinki, Finland*

The (pre-)history of the Periodic Table (PT) is briefly discussed, starting from Döbereiner's 'triads' and ending today. In addition to Mendeleev's 1869 publications, the 'secondary periodicity' of Biron (1914) is mentioned. The first analysis of the Ytterby mineral by Gadolin (1794), leading to

the identification of rare-earth oxides, essentially Y_2O_3, is quoted. The elements 1-118 are now experimentally known and the studies of the chemical properties of the newest ones have begun. Up to the element _{118}Og, the PT seems well established, especially if one places the lanthanides and actinides, f^0-to--f^{14} for the trivalent ions, on lines of 15 elements. These lines plug the holes,left in Group 3, Periods 6-7. For the subsequent elements 119-172 there are two proposals: 1) The long rows proposal by Fricke et al.(1971) and 2) The short rows proposal by Pyykkö(2011). They were based on Dirac-Slater calculations on neutral atoms, and Dirac-Fock calculations on ions, respectively. Both have their merits. Little is still known about the chemistry of these elements and the PT is about Chemistry. A small beginning was the study of hypothetical octahedral hexafluorides, MF_6, supporting the present placement of E125-E129 in a 6g-series. The foundations of the theory at the Dirac-Fock-Breit level, including simple estimates of the Lamb shift (i.e. QED effects) appear to be under control. There are numerous reviews on the consequences of these effects in Inorganic Chemistry and their qualitative description is included in most textbooks. What can we explain? The key message is that a large part of the chemical differences between the Periods 5 and 6 comes from relativity. Examples are Ag/Au, Cd/Hg, Sn/Pb. Most of the voltage of the lead battery comes from relativistic effects.

Periodic Table 1-172

Period	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Orbitals
1	1 H																	2 He	1s
2	3 Li	4 Be											5 B	6 C	7 N	8 O	9 F	10 Ne	2s2p
3	11 Na	12 Mg											13 Al	14 Si	15 P	16 S	17 Cl	18 Ar	3s3p
4	19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	4s3d4p
5	37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	5s4d5p
6	55 Cs	56 Ba	57-71	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	6s5d6p
7	87 Fr	88 Ra	89-103	104 Rf	105 Db	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Rg	112 Cn	113 Nh	114 Fl	115 Mc	116 Lv	117 Ts	118 Og	7s6d7p
8	119	120	121-	156	157	158	159	160	161	162	163	164	139	140	169	170	171	172	8s7d8p
9	165	166											167	168					9s9p

6	57 La	58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu	4f
7	89 Ac	90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr	5f
8	141	142	143	144	145	146	147	148	149	150	151	152	153	154	155	6f

8	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	5g

The PT proposed by Pyykkö (2011). Modified by adding the latest names, and by emphasizing the non-monotonous cases by color. Note the nominal 5g series for Z = 121-138, starting in Group 3.

HIST 27

Personal reflection on Ted Benfey's early contributions to chemical education

***Larry E. Overman**, leoverma@uci.edu. Chemistry, UC Irvine, Irvine, California, United States*

In 1959 a group of nine high school teachers and nine college chemistry teachers established the Chemical Bond Approach Project with the aim of transforming introductory education in chemistry. I was fortunate to enter Earlham College in 1961 where the eventual text of the CBA Project, *Chemical Systems*, was under development by Earlham faculty Ted Benfey and Larry Strong. This modern approach to chemistry captured my imagination and started me on a career in chemistry. It is with great pleasure that I participate in this symposium recognizing the remarkable contributions of Otto T. Benfey to chemical education and his outstanding contributions to the history of chemistry.

HIST 28

Ted Benfey and the Chemical Heritage Foundation

***Ned D. Heindel**, ndh0@lehigh.edu. Lehigh Univ, Bethlehem, Pennsylvania, United States*

My compatriots in this Symposium are focusing on Ted Benfey -- the chemist, the educator, the father, the pioneering author of an innovative high school course, the editor, the science historian, and the congenial colleague in research. But let's turn our attention to that period (1988-1996) in Ted's extraordinarily productive career during which he was most directly involved with the Chemical Heritage Foundation (now the Science History Institute). That institution, created by an initiative of the ACS Div. of the History of Chemistry (HIST), was barely 6 years old when Ted joined its tiny staff. It had been launched as The Center for the History of Chemistry (CHOC) in 1981 on the University of Pennsylvania campus. From the very beginning, the HIST founders of CHOC anticipated future Ted Benfeys and built support for scholars into the budgets. As CHOC has grown and evolved (from CHOC to BCHOC, NFHC, CHF, and now SHI) it has become the largest grantor of research fellowships in the history of science. By his role as editor of the magazine, scholarly researcher in residence, and publisher of CHOC's pamphlets, traveling exhibits, and books, Ted Benfey was a key player at a critical time in the Center's development. This presentation will deal with the creation of what is now the Science History Institute and with Ted Benfey's role in blessing it with a future.

HIST 29

My "TED Talk": Tribute to Ted Benfey and *Chemistry*

***Mary Virginia Orna**, maryvirginiaorna@gmail.com. 39 Willow Drive, ChemSource, Inc., New Rochelle, New York, United States*

In January, 1964, Ted Benfey assumed the editorship of *Chemistry* magazine, and for the following fifteen years regaled the chemical world with his monthly wisdom and the work of world class scholars. The magazine intended expressly for "the better high school chemistry students and their teachers," initially circulated to about 6,500 readers, and under his watch, the readership rose to over 30,000. And let me assure you that *Chemistry*'s audience comprised many a college student and *their* teachers, eager to learn cutting edge chemistry and timely topics in a refreshing, but profound, way. This paper will document highlights in *Chemistry*'s journey until mid-1978, when Ted relinquished the editorship with his editorial, "Not Farewell, but Fare Forward." For many of us in the trenches during those years, the arrival of *Chemistry* in the mail was the bright spot of every month. For me, at least, it formed my teaching style and undergirded my own intellectual development. Kudos, Ted, for the many hours of thought and planning that made us better teachers.

HIST 30

Traveling with Ted Benfey: Greensboro, Munich, and Newton

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

The world of Newton scholarship changed dramatically with the publication of B. J. T. Dobbs's *Foundations of Newton's Alchemy* in 1975. Interestingly, Dobbs completed the book as her UNC Chapel Hill dissertation only a year or so before that. Meanwhile, some fifty miles away I would soon begin studying the history of alchemy under the aegis of Ted Benfey, and the two of us would in due course meet the other major scholar of Newton's alchemical involvement, Karin Figala, in Munich. It is appropriate, then, to give a recounting of the mutations in the historiography of Newton's alchemy, especially since my own book on the subject appeared in the last few months.

HIST 31

Periodicals, periodical elements, and structures of periodicity: Perspective on the work of Ted Benfey

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

It is well known that in 1964 Ted Benfey introduced a revealing new kind of periodic table of the spiral type (sometimes called a "snail") in the ACS magazine that he then edited, a periodical that was entitled simply Chemistry. Since that time, Benfey has written widely on the history of the periodic table, especially the work of the mid-nineteenth-century German theoretical chemist Lothar Meyer. The speaker will provide a perspective on the Benfey periodic table and on his work on Lothar Meyer; he will then connect both of these subjects to another of Benfey's important contriburtions to the history of chemistry, namely the historical development of the theory of chemical structure.

HIST 32

Ingold, Bartlett, and the status of physical organic chemistry

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

Ted Benfey received his PhD at the epicenter of physical organic chemistry, UCL, under the legendary Christopher Ingold (1893-1970). Ingold's unflagging aim was to present organic chemistry as a "science ... rather than an art." In line with that ambition, he distanced himself from industry and undertook almost no applied chemistry, even during World War II. Ingold's closest American counterpart was Paul Bartlett of Harvard University. In the 1930s Bartlett echoed Ingold, declaring that his work had no application. However, during the war Bartlett published mechanisms for paraffin alkylation, which provided high-octane aviation gasoline, and vinyl polymerization, which provided plastics for use in military aircraft. This latter project was supported by the Office of Naval Research, for which Bartlett evaluated proposals in the postwar period. He also undertook consulting for chemical industry. My talk will conclude with discussions of the diverging stances of Ingold and Bartlett toward physical organic chemistry and their personal relations.

HIST 33

German prince and the encouragement of trade, culture, and chemistry in Victorian Britain

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Prince Albert of Saxe-Coburg and Gotha (1819-1861) married Queen Victoria in 1840. He was involved with the establishment of the Royal College of Chemistry in 1845, with the employment of A W Hofmann and with the career of Lyon Playfair. Though remaining in many ways German in attitude, Prince Albert had a major effect on British cultural life, his influence spreading much further afield through his nurturing of the Great Exhibition of 1851. It was he who was responsible for developing the concept of creating a cultural quarter in London, which has become known as Albertopolis. By the time of his early death, the South Kensington Museum had been established, the progenitor of today's Science Museum. It could be argued that he was the last significant intellectual to marry into the British monarchy.

Prince Albert of Saxe-Coburg and Gotha (1819-1861) and husband of Queen Victoria (1840 to death).

HIST 34

From Armstrong's reversed electrolysis and heuristic teaching method to O. T. Benfey's solvent salt effects in hydrolysis and the changing American chemistry curriculum

***William Brock**, william.brock@btinternet.com. Department of History of Science, University of Leicester, UK , Eastbourne, United Kingdom*

Chemistry historians are familiar with genealogies that link contemporary chemists to their (more famous?) forebears. A variation of this would be to take a modern PhD thesis and explore its historical roots. This paper seeks to link Henry Edward Armstrong's 1886 conception that all chemical change is reversed electrolysis, with O. T. Benfey's 1946 thesis on the solvent and salt effects in hydrolysis. Armstrong was also involved in educational reforms (heurism). Can this also be linked with Benfey's role in changing the American High School curriculum?

HIST 35

Recent advances in the history of chemistry

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

Selections from the speakers recent studies in the history of chemistry will be presented, chosen to reveal the speaker's relationship with Ted Benfey, the Division of History of Chemistry's 2019 Awardee of the HIST Award for his "outstanding career of contributions to the history of chemistry."

HIST 36

Ted Benfey: Friend to colleges, chemistry, and art

***James Fernandes**, fernandesjim@guilford.edu. Guilford College, Greensboro, North Carolina, United States*

After he became a "convinced" Friend, Ted Benfey devoted much of his stellar career in the service of three Quaker colleges, where his legacy and influence continue.

HIST 37

Remarks and reminiscences

*Christopher Benfey[2], **Philip Benfey**[1], philip.benfey@duke.edu, Stephen Benfey[3]. (1) Biology, Duke University, Durham, North Carolina, United States (2) Mount Holyoke College, South Hadley, Massachusetts, United States (3) None, Tokyo, Japan*

Dr. Benfey's three sons will share reminiscences and remarks concerning their father’s varied life, as a chemist, historian, educator, editor, and parent. They will touch on the various locales in which that life has played out, in Germany, England, Japan, and the United States.

HIST 38

My path from organic research chemistry to becoming a science historian

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

Given my life and background it would have been hard for me, a research chemist, to avoid becoming a science historian. My father’s family had been a Goettingen, Germany, family for generations and that’s where organic chemistry began – with Friedrich Woehler’s accidental synthesis of urea. An earlier Theodor Benfey, a founder of comparative folklore, was a Woehler colleague. I will tell about my father, his career, his departure - flight - from Nazi Germany; then about my mother's background, the huge Ullstein publishing firm which the Nazis needed and took for their purposes. In 1936 I left as a ten-year old for England because the Mendl family invited me to join them. They had been friends of my family in Berlin who had fled Germany a few months earlier and had a son of my age whom I knew well. I stayed in England throughout WWII completing Watford Grammar School, and both college and the doctorate with C.K. Ingold at University College London in chemistry before coming to the US.
Having to choose between science and the humanities at the beginning of high school, I chose the sciences but continued my interest in history, Being bilingual, I also started translating. After a year at Columbia with L.P. Hammett, and teaching at three Quaker colleges, Haverford, Earlham, and Guilford, I became the editor at the Chemical Heritage Foundation (now the Science History Institute) on the invitation of Arnold Thackray.. During a sabbatical I spent a year with Frank Westheimer in Chemistry and a summer with J. B. Conant both at Harvard, the latter working on case studies in history of chemistry. Soon after Columbia I encountered my wife Rachel at Haverford and we began our family which keeps on growing.

HIST 39

Foundation and early activities of the Russian Chemical Society

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

On the evening of January 3, 1868, the members of the Chemical Section of the Russian Naturalist Congress raised the question of establishing a Russian Chemical Society, similar to Societies that were active in several other European countries. Following further important meetings on February 15 and September 19, during which the by-laws were discussed, a formal project was penned and submitted to the Minister of Education for approval, which was granted on October 26. Within two weeks, on November 6, a meeting of the newly founded Society was held, which was chaired by Dmitriy Ivanovich Mendeleev (1834-1907), and during which several important committees were formed and candidates for President, Secretary, and Treasurer were announced. Nikolai Nikolaevich Zinin (1812-1880) emerged as the President of the Society. At the same meeting, the first three scientific reports were given, namely on the reaction of potassium cyanide with aromatic amides, on toluidines, and on the composition of the solids formed after burning of gunpowder, respectively by Nikolai Aleksandrovich Menshutkin (1842-1907), Fedor Fedorovich Beilstein (1838-1906), and Nikolai Pavlovich Fedorov. In 1869, the first issue of the Zhurnal Russkogo Himicheskogo Obshtestva (Journal of the Russian Chemical Society) was published (edited by Menshutkin), which listed 47 Society members, provided details about the by-laws and important meetings, and contained over 20 research publications, including a paper on the relationship between the atomic weight and properties of the chemical elements by Mendeleev as well as several other noteworthy articles. The discussions that took place at meetings of the Russian Chemical Society and some of the most influential papers, which appeared on the pages of the Journal of the Society during its first decade will be presented.

HIST 40

Russia's first professional chemical journal: *Zhurnal Russkogo Khimicheskogo Obshchestva*

***David E. Lewis**, lewisd@uwec.edu. Chemistry Department, UW-Eau Claire, Eau Claire, Wisconsin, United States*

The year 1869 was a banner year for chemistry in Russia. In that year, the newly-founded Russian Chemical Society issued the first volume of its *Zhurnal*, Dmitrii Ivanovich Mendeleev (1834-1907) first disclosed his iconic Periodic System of the Elements, and Vladimir Vasil'evich Markovnikov (1838-1904) disclosed his empirical rule for predicting reaction regiochemistry—the first such paper to do so.
The Russian Chemical Society (now the Mendeleev Russian Chemical Society) was established by members of the Chemistry Division of the 1st Congress of Russian Naturalists and Physicians, in St. Petersburg on January 4, 1868. Of those present at this meeting, seven (including Markovnikov) were not actually signatories to the Charter of the Society. A year after its founding, the Society began to publish its journal. In that first volume, many eminent Russian chemists

published updates of their research in Russian. Among these were Borodin, who updated the readership on his oxidative decarboxylation of carboxylic acids through their silver salts, Butlerov, who published an update on his work with methylene chloride and his work obtaining butylene isomers from alcohols, Engel'gardt (whose students were responsible for nine papers in the new journal), and Beilstein, whose students also published prolifically in the new journal. The two stand-out papers, however, were those published by Mendeleev and Markovnikov. The content of the first volume of the journal will be discussed.

HIST 41

Volkova effect: Women in and behind the pages of the Journal of the Russian Chemical Society

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

The first few decades of the *Journal of the Russian Chemical Society* are marked by an interesting feature, especially when compared relative to contemporary Western European chemical societies: the steady presence of women in its pages. While by no means a large cohort, it is nonetheless striking that women joined the Russian Chemical Society, attended its meetings, published papers in the *Journal*, and even on occasion served as the acting chair of meetings when the elected President was absent. This talk will track — as far as we can from the historical record — the careers of these women chemists, with an emphasis on two features: first, the pedagogical and professional connection, especially in the early years, of these women to specific leaders of the Russian Chemical Society, such as D. I. Mendeleev and A. P. Borodin; and, second, the context of women's chemical education in Russia in the 1870s, during a period when higher education for women was formally proscribed in the Russian Empire.

HIST 42

Salvaging the past: Conversion of low-resolution historical images to line art

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Frequently, the historical images of important organic chemists are of very poor quality due to their small size, fading and the graininess of the black and white images. Even with the computational enhancements available from modern image-processing software, the digitization of these images can do only so much to improve the resolution, and frequently this is unacceptable for publication. Nineteenth-century and early twentieth-century images of Russian chemists are often available online, but many of these are reproduced as halftone images whose resolution is limited by the size of the dots used. We have begun a program of rescuing such images based on converting them to new line art. The usefulness of this will be illustrated by

images of Russian organic chemists that have been the subject of this program, such as the portrait of Nikolai Matveevich Kizhner (1867-1935), drawn by Matthew A. Bergs, that is shown here.


Nikolai Matveevich Kizhner (1867-1935). Image ©2019 Matthew A. Bergs. All rights reserved.

HIST 43

Borodin's contributions to organic chemistry

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Aleksandr Porfirevich Borodin (1833-1887) was a chemist and musician who had essential contributions to the field of organic chemistry. He was a student at the Academy of Medicine and Surgery in St. Petersburg, and he specialized in chemistry due to the influence of chemist Nikolai Zinin whom Borodin admired. In 1856 he was appointed an assistant to the professor of pathology and therapeutics. He presented his thesis entitled "The Analogies between Arsenious Acid and Phosphorous Acid" to the Academy and he received the degree of Doctor in Medicine in May 1858. He decided not to be a practicing physician but to dedicate his time to research in chemistry. In 1859 he went to study abroad, and he spent one winter in Heidelberg working with Emil Erlenmeyer. In 1862 Borodin was appointed an assistant professor of organic chemistry at the Academy of Medicine and Surgery, and he became a professor in 1864, Borodin communicated the synthesis of monobrominated derivatives of valeric and butyric acids to the Société Chimique de Paris on November 23, 1860. Eighty years later, Heinz and Clare Hunsdiecker re-discovered Borodin's reaction which they also patented. Borodin reported the aldol reaction in 1869. Charles Adolphe Wurtz also reported the aldol reaction in 1872, and generally, the aldol reaction is credited to both Brodin and Wurtz. One less known contribution of Borodin to chemistry is the development of a method to determine the nitrogen content of clinical samples which is based on the oxidation of present urea using a mixture of bromine and sodium hydroxide. This method was adopted and used in clinical laboratories. In this talk, Borodin's essential contributions to organic chemistry will be discussed by carefully analyzing the first reports of Borodin-Hunsdiecker and aldol reactions.

HIST 44

Exploring the reactivity of halogen compounds: Gustavson's contributions to chemistry

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Gavriil Gavrilovich Gustavson (1842-1908) was a chemist whose name is rarely, if ever, mentioned in organic chemistry textbooks (at least in the English-speaking world). However, a close examination of his work, performed under very humble conditions, reveals that he made several important discoveries with lasting impact in the fields of inorganic, organic, and agricultural chemistry. Gustavson was born, educated, and spent the first (until the 1870s) and last parts (starting in the 1890s) of his scientific career in Saint Petersburg. In the interim period, he took several short trips abroad and also to Kiev and Kazan, and worked in Moscow. When the Russian Chemical Society was founded and approved in 1868, he was one of the first 47 members, and a prolific contributor to the Zhurnal Russkogo Himicheskogo (since 1873 – Himicheskogo i Fizicheskogo) Obshchestva, where, just over the first decade (1869-1879) of the Journal, he published 14 papers, the total number of which eventually grew to 43. As part of his dissertation, he first studied "double decomposition" or exchange reactions between halides and oxides and his results were essential for the understanding of the relative halo- and oxophilicities of the elements. He then turned his attention to what would later be named electrophilic halogenation of aromatic compounds in the presence of aluminum halides and published his findings in 1877, i.e., just at the time when Friedel and Crafts announced their discovery of aromatic electrophilic alkylation using alkyl halides and aluminum halides. Gustavson dedicated a lot of effort to studying the mechanism of aluminum halide-catalyzed reactions. Another chemical transformation discovered by Gustavson and still used today was the elimination of halogen from vicinal dihaloalkanes in the presence of zinc. Using this approach, he and Nikolay Demyanov (1861-1938) synthesized allene in 1888. The reaction between dihaloalkenes and zinc was employed to prepare a number of cycloalkenes. Gutavson taught and published a textbook on agricultural chemistry, in which he described not only mineral fertilizers but also the action of soil microorganisms. Last but not least, he was a brilliant lecturer who taught chemistry at schools for women for many years.

HIST 45

Glass in the West: From forest glass to bohemian glass

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In a final effort to stabilize the crumbling Roman Empire, it was divided it into western and eastern halves Shortly before 300 CE. As a consequence, Roman centralized glass production came to an end, with glassmakers within the two halves becoming isolated such that eastern and western glassware gradually acquired distinct characteristics. Glass in the east developed into well-known glass industry of Venice, which then dominated glass for the next several centuries. The Western Empire fell to the German tribes by 500 CE, after which glassmaking essentially ceased in the west for a time. The knowledge of glass production was not completely lost, however, and surviving glasshouses ultimately developed independent glass types. Reduced access to the previously used raw materials caused the necessity to use local materials, resulting in a glass that was commonly dark green or brown in color as a result of the impurities present. Such northern glass produced in the Middle Ages was sometimes referred to as ‘‘waldglas’’ (forest glass), and marked the new beginning of glass development in the west. The history of glass production in the west will be presented, beginning with forest glass and tracing its development to the well-known Bohemian glass that ultimately was able to effectively compete with the previous dominance of Venetian glass.

HIST 46

Lead in the human habitat: Historical perspective

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Lead contamination of the human habitat represents a serious societal problem that has immediate and long-term ramifications for public health. Being one of the most toxic heavy metals, lead exhibits the distinct ability to proliferate throughout the human body by circulating in the blood stream, breaking a blood-brain barrier, and depositing in bones, as well as in multiple organs and tissues. Data on lead toxicity have been accumulating throughout the history of mankind, spanning from ancient eras to medieval centuries to modern times. Concurrently, the worldwide production volumes have been steadily increasing, driven by the ever-expanding practical applications. The 20th century contributed the most to the current level of lead contamination due to widespread use of lead-based gasoline, water pipes, and paints. Detoxification methods for human bodies and remediation of the contaminated soil remain strikingly inadequate even at the advent of the 21st century, indicative of the complex nature of lead disposition in the human body and its persistent chemical nature that lacks the ability to undergo biodegradation under natural conditions. Thus, a historical perspective on lead intervention into the human environment spanning several millennia will be presented, focusing on key industrial applications, regulatory actions by the authoritative bodies (1909-2019), dynamics of scientific debate dating back to the 1920s, and the demonstrated inability of the general public to protect its own habitat.

HIST 47

Rachael Bodley: Charter ACS member and medical education pioneer, part 2

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A previous paper introducted Rachael Bodley as a pioneer in the education of medical students in Philadelphia. This paper will continue with a discussion of her impact on the Drexel University College of Medicine. Included will be a series of her efforts as the first woman dean of Woman's Medical College of Philadelphia which became part of the Drexel University College of Medicine. Many examples of her leadersip in chemical and medical education have been obtained from the

Drexel University Library. In addition, it has been realized that she was one of the original members in the formation of the American Chemical Society. International impact on STEM education of women will also be presented.

HIST 48-50

WITHDRAWN

HIST 51

Clendenin, WV: Birthplace of the Chemical Valley and the efforts to document our history

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Almost a hundred years ago the world's first commercial ethane cracker was built in Clendenin, WV. From those humble beginnings began the birth of the Chemical Valley and led to an economic engine that propelled West Virginia's economy for many years. From this plant manufacturing, research, and development thrived throughout the Kanawha Valley and billions of dollars in patents were derived from the chemists who called this place home. The Kanawha Valley Section is working on developing a proposal to list this site on the National Chemical Historical Landmarks to provide the chemists who spent years building this site the recognition and honor our predecessors deserve. We intend to point out the developments of this site, the breakthroughs from chemists from both industry and academy who called West Virginia home as well as the insights from working to develop a strong application for the landmarks proposal set to be submitted this year.

HIST 52

WITHDRAWN