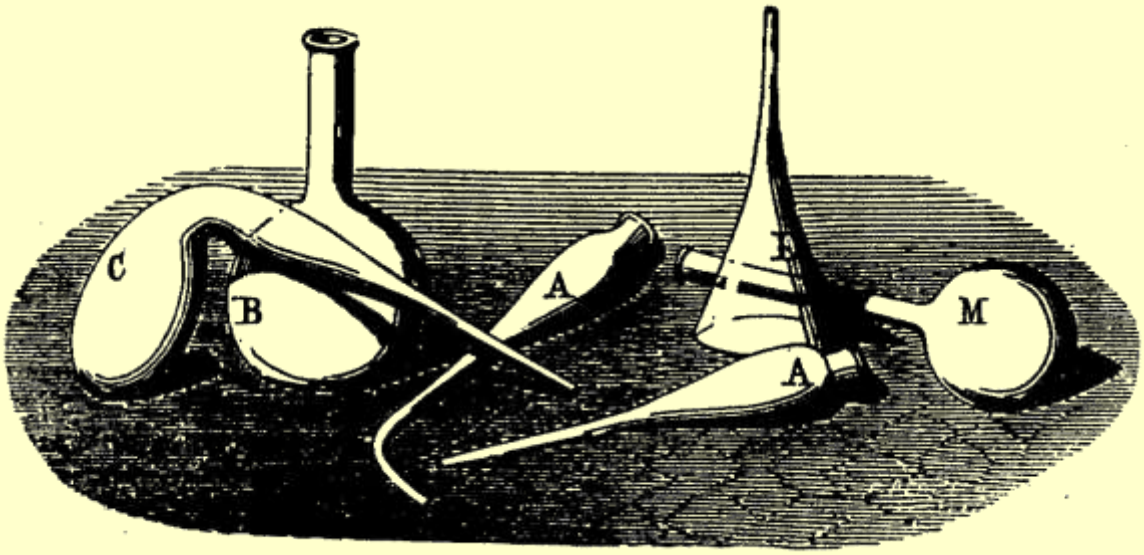
American Chemical Society

DIVISION OF THE HISTORY OF CHEMISTRY



PROGRAM & ABSTRACTS

253rd ACS National Meeting
San Francisco, CA
April 2-6, 2017

S. C. Rasmussen, Program Chair

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Final Program
HIST

DIVISION OF THE HISTORY OF CHEMISTRY

S. C. Rasmussen, *Program Chair*

SUNDAY MORNING

Section A

Grand Hyatt San Francisco - Warfield

General Papers

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

8:30 HIST 1: Concentration of power: Alchemy, mercantilism and the Vitrum Causticum of Ehrenfried Walter von Tschirnhaus. **N. Zumbulyadis**, A. F. Zumbulyadis

9:00 HIST 2: Pioneer of pyridine chemistry: Aleksei Yevgen'evich Chichibabin (1871-1945). **D. E. Lewis**

9:30 Intermission

9:45 HIST 3: Overview of the discovery of ruthenium. **P. Villarreal**, C. Hahn

10:15 HIST 4: Richard Willstätter in Munich. **M. O. Senge**

10:45 HIST 5: History of cuprene, part II: Polymerization of acetylene via electric discharge. **S. C. Rasmussen**

SUNDAY AFTERNOON

Section A

Grand Hyatt San Francisco - Warfield

Golden Age of Industrial Chemistry

Cosponsored by SCC and YCC
J. E. Simpson, *Organizer*
M. Grandbois, *Organizer, Presiding*

1:30 Introductory Remarks

1:45 HIST 6. Vladimir Nikolaevich Ipatieff: A sesquicentennial of contributions to the chemistry of high-pressure catalysis. **C. P. Nicholas**

2:15 HIST 7. J. B. F. Herreshoff and the expansion of the chemicals industry in early 20th century New York. **P. Spellane**

2:45 HIST 8. Golden age of chemistry: The miracle of instant! Polaroid and the amazing chemistry and innovations of instant photography. **J. C. Giordan**

3:15 Intermission

3:30 HIST 9. Evolution of innovation. **S. B. Butts**

4:00 HIST 10. R&D at Union Carbide Tarrytown Technical Center 1959 - 1990. **K. M. Lewis**

4:30 Concluding Remarks & Networking

Hollyweird Chemistry-- Invited, Oral

Sponsored by CPRC, Cosponsored by AGRO, CARB, CEI, ENFL, HIST, POLY, SCHB, SOCED and YCC

Textbooks & the Practice of Science: Before, During & After Gutenberg

Sponsored by CINF, Cosponsored by CHED and HIST‡

SUNDAY EVENING

Grand Hyatt San Francisco - Redwood B

5:00 - 8:00 HIST Executive Committee Meeting

MONDAY MORNING

Section A

Grand Hyatt San Francisco - Warfield

Chemistry through the Eyes of Non-Chemists: Evolution of the Public Perception of Chemistry

D. Rabinovich, N. V. Tsarevsky, *Organizers, Presiding*

8:25 Introductory Remarks

8:30 HIST 11. Public embracement of chemistry: An historical perspective. **H. A. Lawlor**

9:00 HIST 12. Chemistry's public image: A historical look through the pages of C&EN. **M. Torrice**

9:30 HIST 13. Eighteenth century textbook of chemistry for women: Compagnoni's La Chimica per le Donne. **G. S. Girolami**, V. V. Mainz

10:00 Intermission

10:20 HIST 14. Once upon a Christmas cheery in the lab of Shakhashiri: Public engagement for 47 years and counting.... **B. Z. Shakhashiri**

10:50 HIST 15. Image of chemistry in newspaper and magazine ads. **N. V. Tsarevsky**

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MONDAY AFTERNOON

Section A

Grand Hyatt San Francisco - Warfield

Chemistry through the Eyes of Non-Chemists: Evolution of the Public Perception of Chemistry

D. Rabinovich, N. V. Tsarevsky, *Organizers, Presiding*

1:30 HIST 16. Then and now: Art and the visual image of chemistry. **T. I. Spector**

2:00 HIST 17. Viewing chemistry through artists' eyes. **P. Goin**, A. De Bettencourt Dias

2:30 HIST 18. Guilt by association: Dietary recommendations and missed opportunities. **E. Schoffers**

3:00 Intermission

3:20 HIST 19. Changing images of chemistry in the public. **B. Bensaude Vincent**

3:50 HIST 20. Rashomon effect: Chemistry through the eyes of other chemists. **J. Seeman**

4:20 HIST 21. Unlikely popularizer of resonance theory in France. **P. Laszlo**

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MONDAY EVENING

Section A

Moscone Center - Hall D

Sci-Mix

S. C. Rasmussen, *Organizer*

8:00 - 10:00

HIST 26, HIST 28, HIST 30, HIST 32, HIST 33, HIST 34. See subsequent listings.

TUESDAY MORNING

Section A

Grand Hyatt San Francisco - Warfield

Chemistry through the Eyes of Non-Chemists: Evolution of the Public Perception of Chemistry

D. Rabinovich, N. V. Tsarevsky, *Organizers, Presiding*

8:30 HIST 22. My experience as science advisor for Breaking Bad. **D. J. Nelson**

9:00 HIST 23. Stealing the limelight: interactions between theatre and chemistry. **K. Shepherd-Barr**

9:30 HIST 24. From the elements to the atomic fire: An operatic perception of chemistry. **J. Andre**

10:00 Intermission

10:20 HIST 25. Science communication: The evolving role of postage stamps. **D. Rabinovich**

10:50 HIST 26. Periodic table of comic books. **J. P. Selegue**, F.J. Holler

11:20 HIST 27. Public Perceptions of Chemistry and the Chemical Heritage Foundation. **R. S. Brashear**

11:50 Concluding Remarks

TUESDAY AFTERNOON

Section A

Grand Hyatt San Francisco - Warfield

Chemistry & the Design of Physical Objects: Innovation from 1950 to the Present

S. Vasko, *Organizer, Presiding*

1:00 HIST 28. 100 Years of aluminium pioneers: From chemists to architects (1808-1908). **M. Stacey**

1:30 HIST 29. Chemical Architecture: Experiments in urethane foam environments of the 1960s. **G. Converse**

2:00 HIST 30. Withdrawn

2:30 Intermission

2:45 HIST 31. Second skin: The science and cultural impact of stretch. **C. Schneider**

3:15 HIST 32. Ease: Using seam bonding technology to create durable shirts for a girl with autism. **C. Glover, E. Riley, U. Desai**, G. Jun

3:45 HIST 33. Trading innovation across chemistry and design: A content analysis of synthetic fiber advertisements. **S. Vasko**

4:15 Panel Discussion

WEDNESDAY MORNING

Grand Hyatt San Francisco - Warfield

General Papers

S. C. Rasmussen, *Organizer, Presiding*

8:30 HIST 34. Was Markovnikov's Rule an inspired guess? ...No! **D. E. Lewis**

9:00 HIST 35. Paul Dirac: A Man at the Intersection of Science and Philosophy. **T. J. Fuhrer**

9:30 HIST 36. Periodic footprints in history, literature and cinema. **L. R. Ohrstrom**

10:00 Intermission

10:15 HIST 37. Drug repurposing: A bibliometric analysis by text-mining PubMed. **N. Baker**, S. Ekins, A.J. Williams, A. Tropsha

10:45 HIST 38. History of water chemistry monitoring and education on the Yukon River Watershed. **L. DeWilde**

ABSTRACTS

HIST 1 - Concentration of power: Alchemy, mercantilism and the Vitrum Causticum of Ehrenfried Walter von Tschirnhaus

***Nicholas Zumbulyadis**, nickz@frontiernet.net, Alice F. Zumbulyadis. Independent Scholar, Rochester, New York, United States*

Ehrenfried Walther von Tschirnhaus (1651-1708) was a Saxon mathematician, scientist and inventor during the early modern era. He considered himself primarily a mathematician, though his main effort, the derivation of a universal solution for polynomial equations of any order was doomed to fail. Tschirnhaus' most memorable contribution was the building of large and powerful, yet relatively light and inexpensive mirrors and double-lens systems. These so-called burning mirrors and lenses generated hitherto unattainable temperatures and represented vast improvements over previous such devices. The higher temperatures led to insights into thermal transformations at high temperatures, and paved the way for new materials. Tschirnhaus published five papers on burning mirrors and lenses. The papers are written in Latin and appeared in Acta Eruditorum between 1687-1697. We have completed the first English translation of all five papers. Outside our work, there is only one German translation of the fifth paper in Tschirnhaus' own hand, partially transcribed by Curt Reinhardt in 1912. The primary objective of our study was to present an unfiltered account of the construction of these devices and the novel observations they enabled. To better place his work in the cultural context of his time, we have also examined two other primary sources on Tschirnhaus, his extensive correspondence with Gottfried Wilhelm Leibniz and the list of books in his library compiled at the time of his death, books that presumably shaped his thinking. Seventeenth century economic thought was dominated by mercantilism, a national economic policy aimed at maximizing the use of domestic resources. The potential contributions of Chymistry to a mercantilist economy had already been discussed in the writings of J. J. Becher and R. Glauber. We will argue that Tschirnhaus' development of burning mirrors and lenses was an attempt at producing marketable inventions in the spirit of mercantilism.

HIST 2 - Pioneer of pyridine chemistry: Aleksei Yevgen'evich Chichibabin (1871-1945)

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

Aleksei Yevgen'evich Chichbibabin led one of the most eventful lives of any Russian chemist of the late nineteenth and early twentieth centuries. He produced over 250 papers, including seminal papers in pyridine chemistry and triarylmethyl radical chemistry in his career. A student of Markovnikov, he was forced to support himself as a journalist after Markovnikov's ouster from the Chair at Moscow. It took over 18 months after he had submitted his dissertation for the degree of *M. Khim*. before the degree was awarded. At the beginning of World War 1, Chichibabin helped organize Russian pharmaceutical manufacture, and after the war he continued in a leadership role in the Soviet pharmaceutical industry. In 1930, he left Russia after the death of his daughter, Natasha, in an explosion in a sulfonation plant. He spent the reainder of his life in Paris, where he worked in the laboratory of Tiffeneau, and at the Hôtel Dieu. Chichibabin's contributions to the development of pyridine chemistry (the Chichibabin pyridine synthesis and the Chichibabin amination reaction) will be discussed.

HIST 3 - Overview of the discovery of ruthenium

***Pete Villarreal**, pete.villarreal@students.tamuk.edu, Christine Hahn. Texas A&M University Kingsville, Kingsville, Texas, United States*

It is of critical importance to understand not just the science behind important breakthroughs in chemistry, but also the method and story behind such discoveries. This research aims to explain the discovery of the element ruthenium and the contributions made by chemists such as Jedrzej Sniadecki, Gottfried Osann, Jons Berzelius, and Karl Ernst Claus during its discovery. While history often credits Claus with full credit for the discovery of the element, the focus of this research is to show the lesser known efforts of chemists whose work was of deep importance to this discovery. Analysis of the methods used to discover ruthenium as well as how those methods have changed will also be provided.

HIST 4 - Richard Willstätter in Munich

***Mathias O. Senge**, sengem@tcd.ie. School of Chemistry, Trinity College Dublin, Dublin, Ireland*

Richard Willstätter (1872–1942) a German chemist, received the Nobel prize for Chemistry in 1915 for his work on the constitution of chlorophyll and other plant pigments. He was also a pioneer in enzyme research and developed the first synthesis of cocaine. Using organic chemistry to investigate natural processes he used an approach still in use today in the biological sciences and laid the groundwork for biochemistry.

Much of his academic career was spend in Munich, where he took over Adolf von Baeyer's chair at the Ludwigs-Maximillians Universität in 1916. The approaching rise of the Nazi party and the earlier death of his wife and a son overshadowed his scientific work in the early 1920ties and he felt compelled to resign his chair in 1925, eight years before the NSDAP took power, to protest against the rise in anti-Jewish sentiment in German academia. Although almost 100 years ago, a prominent fundamental scientist taking a political stance, and being supported in this by many students, makes this an illuminating example for today's apolitical scientists.

HIST 5 - History of cuprene, part II: Polymerization of acetylene via electric discharge

***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. Continued studies on this material led to it ultimately being named cuprene by Sabatier in 1900 and it is generally characterized as a yellowish to brown material with an elemental composition near that of acetylene. In a recent presentation, I detailed the history of these efforts up through the early 1900s. Those efforts presented focused primarily on thermal polymerizations, usually catalyzed by species such as copper or copper oxide. However, recently discovered sources have revealed that the production of this material by electric discharge occurred earlier than generally recognized, dating back to the early 1870s with the work of Paul and Arnould Thenard. As such, the current presentation will detail the various reports of acetylene polymerization via electric discharge from 1874 to the early 1920s, with comparisons to the results of the previously discussed thermal polymerizations.

HIST 6 - Vladimir Nikolaevich Ipatieff: A sesquicentennial of contributions to the chemistry of high-pressure catalysis

***Christopher P. Nicholas**, Christopher.Nicholas@uop.com. UOP, Des Plaines, Illinois, United States*

2017 marks the 150th anniversary of the birth of Vladimir Ipatieff, a linchpin in the development of catalysis as a method of organic synthesis. Born in Moscow, Russia on November 21, 1867, he studied math and science at military academies before instructing at the Mikhail Artillery Academy in St. Petersberg. Ipatieff finished a dissertation in 1895 with Favorskii in St. Petersberg on reactions of bromine with tertiary alcohols. The following year, he was sent abroad to study terpene derivatives, in Munich, Germany with Adolf van Bayer. Before returning to St. Petersberg in 1897 as Professor in the Artillery Academy, Ipatieff spent time in other locations in Germany and France, forging connections with other chemists.

At this point, the stage was set for the rest of his career: exploring the use of steel, particularly at pressure, in catalytic reactions; the use of Russian, German, French, and later English as languages in which to communicate scientific ideas; and the study of terpenes, both as molecules of interest and as probes to explore reaction mechanisms.

By 1928, Ipatieff had risen considerably with promotions to lieutenant general and as director of the Central Chemistry Laboratories, however, political problems loomed and he and his wife Barbara left for Germany in 1930, never again returning to the USSR. While in Germany that year, he met Gustav Egloff of Universal Oil Products (UOP) who, along with Hiram Halle, convinced Ipatieff to come to Chicago part-time as the Director of Chemical Research. By 1931, with the help of Northwestern University, where he was named lecturer, and later Professor, the Ipatieff's were living permanently in Chicago.

Ipatieff enjoyed twenty years of success in Chicago, building catalysis research at both UOP and Northwestern, including discoveries such as solid phosphoric acid (SPA), a heterogeneous catalyst still used today for acid catalyzed reactions such as olefin oligomerization. The talk will focus on Ipatieff's life and achievements, including the establishment of the Ipatieff Prize, given by the ACS every third year since 1947 to a researcher under the age of 40 for achievements in catalysis.

HIST 7 - J. B. F. Herreshoff and the expansion of the chemicals industry in early 20th century New York

***Peter Spellane**, pspellane@citytech.cuny.edu. Chemistry Dept, NYC College of Technology CUNY, Brooklyn, New York, United States*

Newtown Creek, an industrial waterway in New York City, was a center for production of materials before the Civil War. Most of the production there involved the refining of raw materials or natural products; refined products included sugar, fertilizers, hide glue, glass, liquor, and hardwood dyes. Following the Civil War, the production at Newtown Creek increasingly relied on chemical reagents. In the early 1870s, William Nichols acquired and reorganized the Laurel Hill Chemical Company. Sulfuric acid would be the principal product of the new Nichols Chemical Company. The company's production and economic significance grew steadily after J. B. F. Herreshoff joined the company. Francis Herreshoff had studied of chemistry at Brown University and taught there before moving to New York, where he sought employment in industry. Nichols hired Herreshoff in 1876 when both men were roughly 25 years of age. Their work together, businessman trained in chemistry and chemical engineer with limited experience, continued for 40 years. Herreshoff's contributions to the fortunes of the Nichols Company and to the advancement of country's sophistication in chemical technology included methods for production of concentrated sulfuric acid, for production of sulfuric acid from pyrite ores, and for electrolytic production of high purity copper metal. This talk concerns J. B. F. Herreshoff's technologies relating to the production of pure copper and concentrated sulfuric acid.

HIST 8 - Golden age of chemistry: The miracle of instant! Polaroid and the amazing chemistry and innovations of instant photography

***Judith C. Giordan**, judy@jgiordan.com. ecosVC, Amherst, Massachusetts, United States*

Considered one of the hottest start-ups in the time of large companies, Polaroid's science of instant photography grabbed the imagination of the public as much as did the marketing showmanship of its charismatic founder, Dr. Edwin Land. Join Judy Giordan, co-leader of the team to develop the last traditional integral color instant film product, SPECTRA, and Larry Friedman, who led developing the last color peel-apart Polaroid color film, POLACOLOR– think driver's licenses and 20x24 art prints – for a description of the science, innovations and magic of the Golder Days of Polaroid instant photography!

HIST 9 - Evolution of innovation

***Susan B. Butts**, sbbuttsdc@gmail.com. Susan Butts Consulting, Midland, Michigan, United States*

Innovation, which can be described as the process of turning inventions into products, is a cornerstone of technology-based industries. Like many companies, Dow has experimented with various models for fostering and managing innovation. These approaches range from science-driven to business-driven, from single investigator activities to large team enterprises to collaborative endeavors with university faculty. Advantages and pitfalls of various innovation models will be explored through examples from my career at Dow in Central Research, Corporate R&D, and External Technology.

HIST 10 - R&D at Union Carbide Tarrytown Technical Center 1959 - 1990

***Kenrick M. Lewis**, kenrick.lewis@momentive.com. Momentive Performance Material, Tarrytown, New York, United States*

Situated on the site of the former Butler Farm in East View, NY, the Union Carbide Technical Center was a large diversified, campus-style research and office complex. At its peak in the mid-1980's, there were about two thousand employees, approximately half of whom were engaged in laboratory-related research and development. The Center was established in 1959 when Carbide-sponsored researchers at The Mellon Institute were relocated to Tarrytown. The first building was a Technical Service Laboratory (later called the Chemicals Building). In the period, 1961 – 1969, construction was completed of the Union Carbide Research Institute (Corporate Research Laboratory), Home and Automotive Products Laboratory, Silicones R&D Laboratory, Spine Building and Linde Laboratory.

These buildings and the Center's infrastructure and supportive technical managers provided an environment conducive to productive research by committed visionary scientists. Research activities in the different laboratories included work on cryogenics, superconductivity, metallurgy, welding, gas separations, molecular sieve synthesis and catalysis, silanes and silicones, vinyl resins, phosphorimetry, carbon clusters and flash vacuum pyrolysis. My

presentation will highlight the research and scientific contributions of Edith Flanigen (Molecular Sieves), Lawrence Litz (Advanced Gas Reactors), Bernard Kanner (Silane Coupling Agents and Silicone Surfactants for Polyurethane Foams) and my collaboration with Donald McLeod in the discovery of methylchlorosilylene (CH_3SiCl) as the key intermediate in the Rochow-Müller Direct Synthesis of Methylchlorosilanes.

HIST 11 - Public embracement of chemistry: An historical perspective

***Helen A. Lawlor**, chescot@aol.com. Retired, Radnor, Pennsylvania, United States*

It is hard to believe in today's world that there was actually a time when Chemistry was embraced by the public from a completely positive perspective. A time when society avidly attended lectures on key chemistry experiments and actively chose to bring the science into their own homes and into their own hands. This era is demonstrated best through the history and evolution of chemistry sets (most recently presented in an innovative exhibit created by the Chemical Heritage Foundation). What generated the public love of chemistry? What killed that love? And can anything be done to make that excitement, interest, and support, like the Phoenix, rise from the ashes?

HIST 12 - Chemistry's public image: A historical look through the pages of C&EN

***Michael Torrice**, m_torrice@acs.org. American Chemical Society, Pasadena, California, United States*

For decades, chemists have worried about what the public thinks of their work. In the pages of Chemical & Engineering News through the years, ACS presidents and others have written about what they perceive as chemistry's image problem—in particular, these pieces express a feeling that the public views chemistry and chemicals in a negative light. In this talk, I'll take a historical look at these articles and the solutions the authors proposed to fix the problem. I'll also present data collected about chemistry's image and open up a discussion about the reality of the situation and how chemists might address it.

HIST 13 - Eighteenth century textbook of chemistry for women: Compagnoni's La Chimica per le Donne

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

Since the mid-1600s, an important way in which the public learned about chemistry was through textbooks written explicitly for women and girls. Often presented in the manner of a conversation, these books were only partly intended to educate women; an important additional motivation was to enable women to explain scientific knowledge to their children. Two relatively well-known books in this tradition were Marie Meurdrac's *La Chymie Charitable et Facile, en Faveur des Dames* (first edition, 1666) and Jane Marcet's *Conversations on Chemistry* (first edition, 1806). Far less known, however, but the first in this genre to present the new chemistry of Lavoisier, was *La Chimica per le Donne* (first edition, 1796) written by the Italian author and statesman Giuseppe Compagnoni (1754-1833). Based on a series of 101 letters written by Compagnoni to the Countess Marianna Rossi of Ferrara (née Gnudi; ca. 1755-1801), and closely modeled on a recently published book by the chemist Vincenzo Dandolo, Compagnoni's book covers the history of chemistry, elements and compounds, attraction, affinity, caloric, fire and light, the phlogistic versus the new chemistry, gases, combustion, acids and alkalis, salts, the old and new nomenclature, minerals, etc. Expressing skepticism over a woman's desire to learn a subject as dry and difficult as chemistry, Compagnoni is reassured by the countess that she indeed wishes to be initiated into the mysteries of Lavoisier's new ideas because chemistry 'has become the fashionable science.' The first Venetian edition of 1796 was followed by a second in 1797 and a third in 1805, as well as by an edition published in Naples in 1804 and a translation into Spanish (Barcelona, 1802).

HIST 14 - Once upon a Christmas cheery in the lab of Shakhashiri: Public engagement for 47 years and counting...

***Bassam Z. Shakhashiri**, bassam@chem.wisc.edu. Dept of Chemistry, Univ of Wisconsin-Madison, Madison, Wisconsin, United States*

Michael Faraday, the noted English physicist and chemist, lived from 1791 to 1867. He was a gifted lecturer who began giving his Christmas Lectures for children and their families at the Royal Institution of Great Britain in the 1840s. Faraday loved simplicity, and he had a strong sense of the dramatic. His audience entered wholeheartedly into the world of science with his guidance. His ideas were considered very unorthodox at that time, and children,

who had not yet adopted conventional ideas, would react enthusiastically to the ones he presented. Throughout the 19 annual Christmas Lectures that he presented, Faraday did all he could to urge his listeners to see and judge for themselves, to experiment, and to question nature directly whenever anyone discovered something out of the ordinary. In December 1970, my first year on the faculty, I gave the first Wisconsin Christmas Lecture to students in my first-year chemistry class. Colorful displays and exciting chemical transformations were presented. Word spread that the Christmas Lecture was a fun event and the following year the lecture hall overflowed with students and their friends. In 1972 the Christmas Lecture was given in two evening sessions open to the public. In 1973 Wisconsin Public Television offered to videotape the program for broadcast during the week of Christmas. Thus began an uninterrupted collaboration between the Chemistry Department and UW-Extension to bring science to audiences throughout Wisconsin and on PBS stations. Since then, versions of the show have played to packed houses elsewhere across the country and around the world. The goal of the Christmas Lecture has remained the same over the years and around the globe: connectivity with the audience. The ultimate purpose is to trigger cerebral and emotional engagement to heighten the audience's joy in learning.

HIST 15 - Image of chemistry in newspaper and magazine ads

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

Newspaper and magazine ads are a special art form, the aim of which is to promote and increase the appeal and sales rates of specific products or services. Ads target a very diverse (in terms of interests, taste, cultural background, and education) audience, and the message they deliver, and – as part of that – the images they present, should attract the attention of a maximum fraction of potential customers. Chemistry-related images, which include depictions of chemical equipment and processes, (al)chemists at work, chemical reaction equations, molecular structures, etc., have long been employed as powerful tools to make a very large variety of items – often completely unrelated to the chemical industry – appear more attractive to buyers. A number of such images, extracted from newspapers and magazines dating from the very early XXth century to today, will be presented in historical context, and their educational value will be discussed.

HIST 16 - Rashomon effect: Chemistry through the eyes of other chemists

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

The theme of this symposium is "to trace the capricious evolution of the public image of chemistry and related scientific disciplines." This may be due, at least in part, to the Rashomon effect, "the circumstance when the same event[s] is given contradictory interpretations by the individuals involved." The Rashomon effect not only pertains to the general public but also to individual chemists pursuing their professional pathways. Several recent and controversial examples of this phenomenon will be given and explored including E. J. Corey's claim of plagiarism against R. B. Woodward in the development of the Woodward-Hoffmann rules.

HIST 17 - Viewing chemistry through artists' eyes

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

The future of STEM will include the letter 'a,' = STEAM. As art, science, and technology converge, artists and scientists not only will, but have examined how these various areas of knowledge influence one another. Foundation Professor of Art (photography) Peter Goin presents an overview of how practitioners in the Fine Arts have perceived the science of chemistry.

HIST 18 - Guilt by association: Dietary recommendations and missed opportunities

***Elke Schoffers**, elke.schoffers@wmich.edu. Chemistry Mailstop 5413, Western Michigan University, Kalamazoo, Michigan, United States*

The phrase "You are what you eat" has many precursors. It was first attributed, word-by-word, to English nutritionist Victor Lindlahr. The quote was part of a longer statement in 1923, namely "Ninety per cent of the diseases known to man are caused by cheap foodstuffs. You are what you eat." Lindlahr was promoting a weight-loss diet based on "catabolic foods." His view was prescient.

Chemists know what the structures of food and their macronutrients look like. They are the carbohydrates, proteins and fats we find in supermarkets and kitchen pantries. Foods and the molecules they contain represent an

easy avenue to relate to the general public. We now have access to abundant data, including food labels with chemical names. At the same time, the United States and large parts of the world suffer from the consequences of food excess despite abundant health advisories. This presentation will focus on the confusing messages of dietary recommendations, especially those advocated over the last 60 years. Should we eat eggs? Or should we avoid eggs because of cholesterol? It appears that science still does not have the answer. However, the science is very clear now. Unfortunately, the confusion has contributed to a perfect storm that has grown into a "diobesety" (diabetes+obesity) crisis. This presentation will outline how chemistry and its reputation are affected.

HIST 19 - Changing images of chemistry in the public

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This paper will focus on one specific aspect of chemistry which has deeply shaped the its public image: the ambition to create life in a laboratory. The competition between the laboratory and the creator of life is a mythical image (Faust, Frankenstein) rooted in the alchemical tradition. was still the hardcore of literary portraits of chemists in the early 19th century. This image which has created an association of chemistry with witchcraft, magics and charlatanerie has travelled through the centuries. In the 18th century the public image of chemistry has radically changed thanks to many successful and useful products issued from the chemistry laboratories. Chemistry came to be celebrated as a useful science, contributing to public welfare and the wealth of nations. Chemists were no longer perceived as dangerous people. Rather they became respectable professionals enjoying social recognition, often being in charge of political responsibilities. However the development of synthetic chemistry and more recently of synthetic biology revived the competition between chemistry and life. One purpose of this paper is to help understand how it turned out that the term “synthetic” became synonym of “chemical” and the antonym of natural or organics in the popular language.

HIST 20 - Then and now: Art and the visual image of chemistry

***Tami I. Spector**, spector@usfca.edu. Chemistry, University of San Francisco, San Francisco, California, United States*

This talk employs an art historical lens to investigate the visual stereotypes of chemistry found in current portraits of chemists, depictions of chemical plants, and images of chemical glassware and the periodic table. Such images play a significant part in communicating the chemical profession to the public. They portray a visual image of chemistry that simultaneously conveys its negative cultural associations and aestheticizes chemistry by framing it within classical ideals of beauty and borrowing from revered motifs of modern and contemporary art.

HIST 21 - Unlikely popularizer of resonance theory in France

***Pierre Laszlo**[1,2], pierrelaszlo@usa.net. (1) Chemistry, Ecole Polytechnique, Senergues, France (2) University of Liège, Liège, Belgium*

Gaston Bachelard, in France during the late Forties and early Fifties, had a major role in introducing and popularizing Linus Pauling’s contributions and his book The Nature of the Chemical Bond, to French philosophers and intellectuals. In so doing, he bypassed the indifference and even downright hostility of those French chemists who, at the time, were in positions of power. Prior to having been called to teach philosophy at the Sorbonne, he had been a secondary school teacher for a number of years and had taught chemistry. Accordingly, he understood well Pauling’s ideas. My talk will stress the irony of a philosopher acquainting the French public with the New Chemistry, while prominent chemists kept an hostile silence. Moreover, the political context was the profound influence of the French Communist Party and the hostility of Stalinist USSR to Pauling’s Resonance Theory.

HIST 22 - My experience as science advisor for Breaking Bad

***Donna J. Nelson**, djnelson@ou.edu. Chemistry, University of Oklahoma, Norman, Oklahoma, United States*

Dr. Nelson will relate her experiences serving as a science advisor for the TV show Breaking Bad. This will include how she became their advisor, some specific clips that she influenced, and impressions learned about Hollywood from the interactions.

HIST 23 - Stealing the limelight: Interactions between theatre and chemistry

***Kirsten Shepherd-Barr**, kirsten.shepherd-barr@ell.ox.ac.uk. English, University of Oxford, Oxford, United Kingdom*

Theatre and chemistry have had a long and fascinating relationship, both in terms of how theatre has used chemical effects and materials and how it has depicted chemists and chemistry. This talk will explore both kinds of interactions in order to address the broader implications about theatrical engagements with science in light of the increasing popularity of “science plays.”

HIST 24 - From the elements to the atomic fire: An operatic perception of chemistry

***Joao Paulo Andre**, jandre@quimica.uminho.pt. Chemistry, University of Minho, Braga, Portugal*

Throughout more than four hundred years of existence, the opera repertoire has been traditionally regarded as a repository of love, seduction, betrayal and vengeance stories. Nevertheless, opera plots often display numerous ideas, concepts and even personalities that belong to the domain of science, with special relevance for chemistry. From the four cosmogenic elements (water, fire, earth and air) to alchemy and from the ancient Greek Atomist School to the atomic bomb, this communication will be an operatic trip covering a time gap of nearly 2500 years.

HIST 25 - Science communication: The evolving role of postage stamps

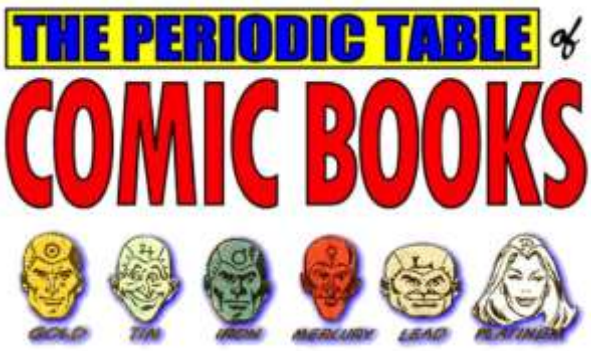
***Daniel Rabinovich**, drabinov@uncc.edu. UNC Charlotte Chemistry, Charlotte, North Carolina, United States*

Postage stamps were introduced in Great Britain in 1840 as an expedient way to prepay for the mailing of a letter or package, a service that until then had to be paid by the recipient, not the sender. By the turn of the 20th century, stamps also became a simple yet effective medium to commemorate events and describe the history and culture of a country. The portrayal of topics in astronomy, biology, chemistry, geology, physics, and other sciences came a little later, and eventually stamps became an effective way to publicize a country’s achievements in these fields. In this presentation, several stamps related to chemistry will be described, including their use to underscore industrial prowess, advance political agendas, or recognize individuals who have made lasting contributions to the chemical enterprise. In a similar vein, an overview of how the depiction of chemistry for the general public has evolved over time will be presented.

HIST 26 - Periodic table of comic books

***John P. Selegue**, selegue@uky.edu, Floyd J. Holler. Department of Chemistry, University of Kentucky, Lexington, Kentucky, United States*

The current spate of Hollywood blockbusters based on superheroes has drawn increased scrutiny of their comic-book origins. Comic books have created an American mythology of super-powered beings "with powers and abilities far beyond those of mortal men." This presentation will address how the public perception of science, in particular chemistry, has steered the development of the popular (and lucrative) comic-book medium. Examples drawn from the comics themselves will demonstrate how comic books have both reveled in and exploited public misconceptions of science since Superman’s arrival in 1938.



HIST 27 - Public perceptions of chemistry and the Chemical Heritage Foundation

***Ronald S. Brashear**, rbrashear@chemheritage.org. Chemical Heritage Foundation, Philadelphia, Pennsylvania, United States*

This paper will look at how chemistry has been presented to various audiences at the Chemical Heritage Foundation, a museum, library, and center for research in the history of chemistry, chemical engineering, and related sciences and technologies. The depiction of chemistry and its impact on society is a core element of CHF's mission, but there are many ways that such a presentation can be done. As an independent institution that receives a great deal of support from the chemical community and wants to be a trusted voice to the public, CHF has to be very cognizant of how its messages are received and understood. Much like the Science Museum in London, CHF has spent a great deal of time presenting chemistry as a skillful science and the benefits of chemistry's products on the world with less emphasis on controversy. However, the times CHF has dealt with controversial issues, like asbestos, the reaction has been quite unexpected and informative. CHF's body of work will be informative in helping us understand chemistry's legacy and how to accurately present the science and its technologies in a way that people will take us seriously.

HIST 28 - 100 Years of aluminium pioneers: From chemists to architects (1808-1908)

***Michael Stacey**, michaelstaceys4aa@icloud.com. Architecture & Product Design, Michael Stacey Architects, London, United Kingdom*

This paper explores the development of the chemistry of aluminium (Al), from its identification by Sir Humphry Davy in England, 1808, to the simultaneous discovery of the Hall-Héroult electrolytic process, for the reduction of alumina into liquid aluminium, in USA and France,1886, by Charles M. Hall and Paul Héroult. Charles M. Hall was ably assisted by his sister Julia B. Hall whose contribution should be more clearly recognized. This scientific progress is paralleled by the uptake of Al in art and architecture. The paper observes that the development of the chemistry of Al was an international process. H. C. Ørsted in Denmark, 1825, produces significant quantities of Al. In Germany,1827, F. Wolher's develops a better process for the isolation of Al. In France, 1854, Henri Étienne Sainte-Claire Deville enhances Wölher's method of isolating Al and the chemical production of Al commences in significant qualities, but it is expensive. This starts the decorative age of aluminium, for example the casting of Diane de Gabies by Paul Morin et Cie, in France, 1850-60. 1884, a cast Al pyramid caps the Washington Monument, USA. 1892, a cast aluminium sculpture of Eros is erected in Piccadilly Circus, London. The oldest extant aluminium in architecture is a ceiling installed at the Church of St Edmund, King & Martyr, Derbyshire, England. Aluminium sheet cladding of the dome of San Gioacchino, Rome, architect Raphel Ingami,1897, and is still preforming well today. 1903, the first powered flight was achieved in by Wright brothers at Kill Devil Hills, USA, using a cast aluminium engine. In Germany Alfred Wilm invents Duraluminium and Otto Wagner designs the Postsparkasse, Vienna. The first world class work of architecture that extensively uses Al, sheet, spinnings and castings, it's decoartive and modern. Al is used by architects and aircraft designers, a case of a common technology, not technology transfer.

HIST 29 - Chemical architecture: Experiments in urethane foam environments of the 1960s

***Grace Converse**, grace.converse@gmail.com. University of Southern California, Venice, California, United States*

Innovations in urethane foam technology in the 1960s piqued the interest of architects, designers, artists, and curators eager to test the aesthetic and functional possibilities of the material. In 1968, architect Ralph Drury and three graduate students from the Yale School of Architecture began what that they called “An Experiment in Chemical Architecture.” Drury and the students constructed multiple igloo-like urethane foam structures at Yale to test the material’s potential to take multiple architectural forms and its capacity withstand the elements. The prospects of urethane architecture spurred curator and museum director, Paul J. Smith, to feature “Chemical Architecture” in the 1968 exhibition, PLASTICS as Plastics at the Museum of Contemporary Crafts in New York. For Smith, the project was an unprecedented use of urethane foam and an exemplary creative use of plastics. My research examines the archival record of “Chemical Architecture” including the processes and questions set forth by architects in project descriptions, the critical and public response, corporate investment in the projects, and the history of urethane foam. I propose that urethane foam architecture exemplifies a merger between the arts, sciences, and industry that generated new forms in architecture and, in turn, perpetuated utopian ideas of modern living in the 1960s.

By using urethane foam as a primary building material architects created a new aesthetic for habitable spaces. In contrast to the sleek, hard-edged modernist architectural styles that became prominent in the US around the mid-twentieth century, chemical architecture appeared soft and had few flat surfaces or right angles. Foam was quickly sprayed into place rather than sawed, cut, nailed, or soldered, affording new formal qualities. Although architects

were responsible for the creative production with urethane foam, chemical companies who manufactured the material supported architectural experiments. The Union Carbide Corporation supplied the material in the first iteration of the project at Yale, and at the museum, the Durez Division of Hooker Chemical Company (a subsidiary of Occidental Petroleum Corporation) provided materials, funds, and technical assistance. The experimental architectural projects I examine demonstrate a shared vision among chemical companies, architects, and the public that urethane foam could radically change the way we live.

HIST 30 - Adaptive clothing utilizing advanced textiles for female lymphedema patients

Grace Jun[1]*, Gjun00@gmail.com, Vanessa Sanchez2. (1) Parsons School of Design, New York, New York, United States (2) Wyss, Harvard University, Cambridge, Massachusetts, United States*

Adaptive clothing specially designed for those with disabilities is transforming fashion for the differently-abled user. From modified jeans for wheelchair users to tailored jackets for people with sclerosis, clothing offers the wearer several functions such as, comfort, a sense of empowerment and independence as well as social conformity. With an estimated $250 billion industry in the United States for adaptive wear, research in this area is combining the fields of apparel design and textile chemistry with the new. Benefits of adaptive clothing for people with disabilities include closure modifications and patterning alterations used to simplify donning or doffing clothing. These changes are of particular benefit to those with limited range of motion in the arms and chest area, as seen with female lymphedema patients, resulting from breast cancer surgery.

Recently, advanced textiles, created by optimizing chemical properties and fabric structure, have provided designers an array of functional materials for adaptive wear applications. Our investigation focuses on the use of such materials to provide mechanical compression and cooling properties on apparel design for women with lymphedema. Due to removal or damage of lymph nodes, it is recommended to "[apply] pressure to area so, the lymph moves in the correct direction." By selectively varying textile properties throughout the garment using fabric structures, fiber chemistry and film bonding processes, a functional compression system can deliver targeted pressure to the body. This can provide relief and aid in the lymph drainage process while preventing range of motion restrictions often seen in high compression garments. The additional need for cooling during recovery causes many women to place ice packs in the underarm near the incision area. Moisture wicking qualities either inherent to the fiber or though chemical finishes can provide relief while maximizing comfort, due to reduced bulk and weight. With a client-centered design approach, a functional and adaptive garment is created for our user in this case study.

HIST 31 - Second skin: The science and cultural impact of stretch

Christina Schneider*, cschneider@chemheritage.org. Chemical Heritage Foundation, Philadelphia, Pennsylvania, United States*

How do you get the body you want or need? You can clothe it in a second skin. This presentation focuses on Second Skin: The Science of Stretch, a current exhibition at the Chemical Heritage Foundation in Philadelphia that features garments and textile devices that stretch and compress to fulfill our aspirations and needs, and shift our sense of self. A second skin can reveal, cover, or allow the body to move in new ways. When an Olympic swimmer glides to victory in a fast, compressive suit, they are clothed in the innovative but often unseen work of chemists, chemical engineers, fashion designers, and garment workers. The science, technology, and history of stretchy second skins have changed how we move through the world. Once, stretch was primarily produced by knitting—a thousand-year-old technology. Today, high-tech micro-knit spandex surrounds us at the gym, and conductive threads and digital knitting machines lead us into a future of wearable technologies. *Second Skin: The Science of Stretch* was developed with a variety of partnerships and object loans from corporate and university sources including Bolt Threads, INVISTA, the University of Delaware Historic Costume and Textile Collection, Hagley Museum and Library, the Shima Seiki Haute Technology Laboratory at Drexel University, and University of Delaware Move to Learn Innovation Lab. This range of partners allows an exploration of the past, present, and future of stretch materials on the body. Exhibition programming has included a presentation on the history of swimsuits, a gender and science panel led by students at a local charter school, a DIY wearables workshop, and Knit-Ins with local crafting groups. This ACS presentation will discuss the science and cultural content of the exhibition, and related strategies for interpretation and audience engagement. And, after viewing the dazzling image of a purple Jazzercise suit featured in the exhibition, you might want to try some new aerobics stretches.

HIST 32 - Ease: Using seam bonding technology to create durable shirts for a girl with autism

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Ease is a line of durable, seamless, and stylish t-shirts created during MIT's Open Style Lab 2016 summer program. The Open Style Lab exists to raise awareness for universal design and adaptive fashion. Teams of designers, engineers, and occupational therapists create functional yet stylish wearable solutions with and for individuals with specific clothing challenges. Ease was developed for Eliza, an 11-year-old girl with Autism Spectrum Disorder (ASD) and Obsessive-Compulsive Disorder (OCD). She perseverates on the seams of her clothes, and enjoys picking at threads until her clothes are completely torn apart. Therefore, she needed a clothing solution that would be durable enough to stand up to her ripping. In addition, Eliza has sensory preferences that favor proprioceptive input, necessitating that the garment fit tightly to her body. Since Eliza's shirts have the shortest lifespan of all her garments due to their proximity to her hands and the nature of t-shirts to be flimsily made, a durable, compressive shirt was found to be the best solution for Eliza in this preliminary study. The shirts were made using bonded seam technology – a process where chemically engineered adhesives bond with the fibers of the fabrics through the application of high levels of heat - and a variety of comfortable, synthetic stretch fabrics in activewear-inspired shapes that accommodate for Eliza's activity level. In addition, a custom pattern was designed from Eliza's artwork and digitally printed onto fabric to personalize the shirts. The style is ideal for the everyday athleisure aesthetic and lifestyle, making Ease the ideal garment for effortless modern style and optimal performance.

Ease prototypes

HIST 33 - Trading innovation across chemistry and design: A content analysis of synthetic fiber advertisements

Stephanie Vasko*, stephanie.vasko@gmail.com. AgBioResearch & Philosophy, Michigan State University, East Lansing, Michigan, United States*

This talk will cover my current scholarship on the intertwined histories of innovation in the chemistry and design, focusing on fashion as a space that represents multiple representative intersections including industry/innovation and the American chemical/design industries. While the industries related to fashion are myriad, and include dyes, fibers, finishes, patterns, and finished garments, this talk will focus on fibers as a case study. Specifically, I investigate the manufacture and marketing of synthetic fibers by DuPont in the post-World War II using a combination of grounded theory, content analysis, and discourse analysis. The content for this investigation comes from trade journal advertisements, specifically in a trade journal targeted to the chemical, design, and fashion industries. I also touch upon the histories of innovation in chemistry and design, the history of DuPont, additional marketing documents, and previous scholarship on fashion intermediaries (specifically Dorothy Liebes). I will highlight the importance of archival work to the history of chemistry and innovation and underscore archival opportunities available to interdisciplinary researchers.

HIST 34 - Was Markovnikov's Rule an inspired guess? ...No!

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

Although most organic chemistry students do not know much about Vladimir Vasil'evich Markovnikov (1838-1904), every one of them has been exposed to his Rule for addition, that when a hydrogen halide adds to an unsymmetrical alkene, the hydrogen atom is added to the carbon atom possessing the greater number of hydrogens already. Over

the century and a half since its proposal by Markovnikov in his *Doktor Khimii* dissertation, the basis for the rule has been clarified based on the relative stabilities of the intermediate carbocations. Markovnikov's original paper (under the name, Morkovnikov) appeared in the first issue of the new *Zhurnal Russkago Fiziko-Khimicheskago Obshchestva*, in 1969. In it, Markovnikov published the results of his investigations of addition reactions with 1-butene and isobutylene, which gave rise to his Rule. When the work was published in German, this part was relegated to a short section at the end of the paper, but in Russian, it was the first part of his dissertation to be published. Based on its less-than-prominent position in the German paper, it has been suggested that Markovnikov's Rule was an inspired guess. A re-evaluation based on the Russian-language originals suggests that this is, in fact, not the case.

HIST 35 - Paul Dirac: A man at the intersection of science and philosophy

***Timothy J. Fuhrer**, tfuhrer@radford.edu. Chemistry/Physics Department, Radford University, Radford, Virginia, United States*

Paul Dirac was one of the most influential minds of the twentieth century on the fields of both chemistry and physics. The combination of his genius, his unusual personality, and his unusual family life caused him to be one of the most interesting scientists of all time, both scientifically and philosophically. In this presentation, we explore the effects of science, world events, family life and religion on who Paul Dirac was, and the effects of his work and who he was on contemporary thought in science, philosophy and religion.

HIST 36 - Periodic footprints in history, literature and cinema

***Lars R. Ohrstrom**, ohrstrom@chalmers.se. Dept. of Chem. & Chem. Eng., Chalmers Univ. Tech., Gothenburg, Sweden*

This is not the story of the elements, nor of their discoverers or of the amazing properties of the 118 basic building blocks of our world that make up the Periodic Table as of November 2016. These are stories of people crossing paths with an element, and the resulting impact giving lasting effects on their lives and sometimes impact on history. So, I will not tell you about the wonderful colours you get from uranium tinted glass, but about a couple in love and a British government public relations nightmare of the 1950's. We will venture into biochemistry meeting the dreaded petermen and going out on the high seas with a future president and also learn how an elemental deficiency affecting 800 million people is related to a famous comic book hero. On the more serious side we may learn of some biologically related chemistry of elements as diverse as potassium and rhodium, and even discuss science communication. Perhaps you will even learn the truth about Napoleon losing his trousers in Moscow.

HIST 37 - Drug repurposing: A bibliometric analysis by text-mining PubMed

***Nancy Baker**[1,2], baker.nancy@epa.gov, Sean Ekins4,5, Antony J. Williams3, Alexander Tropsha1. (1) Univ of North Carolina, Chapel Hill, North Carolina, United States (2) ParlezChem, Hillsborough, North Carolina, United States (3) ChemConnector, Wake Forest, North Carolina, United States (4) Collaborations in Chemistry, Fuquay Varina, North Carolina, United States (5) Collaborative Drug Discovery, Burlingame, California, United States*

There are many thousands of diseases that do not have a treatment, including many rare and neglected diseases. Streamlining ways to find a potential treatment for such diseases could dramatically change the patient outlook for millions of people. Finding new uses for existing drugs is called drug reprofiling, repositioning, redirecting, or repurposing and it is increasingly recognized as a way to find new disease treatments at lower cost. We provide a bibliometric overview of the practice of repurposing by analyzing drug–disease relationships text-mined from PubMed. Our analysis extends back to drug treatments from the 1940's and provides a historical overview up to the present day. While the attention to repurposing may be new, we find that the practice is certainly not. Most drugs have indeed been tested as treatments against more than one disease and some compounds have been tried in hundreds of diseases. Three of these highly reprofiled drugs – the antipsychotic chlorpromazine, the antimalarial chloroquine, and the antiulcer medicine cimetidine were examined in depth by looking at their repurposing activity over time, starting with the first annotation of the drug in the literature up through recent publications. We characterized the diseases and therapeutic areas these drugs were directed at and what evidence motivated researchers to redirect the drugs. While in the majority of cases these drugs were tried on diseases in therapeutic areas close to their original use, there

are striking, and perhaps instructive repurposing attempts where drugs have been tried in unexpectedly novel therapeutic areas. Findings of this study provide instructional inspiration for continuing to apply human intuition and reasoning to identify new treatments of disease by the means of drug repurposing.

HIST 38 - History of water chemistry monitoring and education on the Yukon River Watershed

***La'ona DeWilde**, ldewilde2@alaska.edu. Interdisciplinary, University of Alaska Fairbanks, Fairbanks, Alaska, United States*

Is the salmon population decline on the Yukon and Tanana Rivers due to (1) climate change (water temperature, sedimentation, and water discharge); (2) effects of urban pollution or mining on spawning habitat (3) infection by *Ichthyphoniasis*; and (4) overharvest in the ocean (commercial harvest and bycatch) or specific parts of the river system? What field and laboratory techniques were used to evaluate the chemistry of the Yukon River and enumerate the numbers and types of salmon species on the river and its tributaries 60 years ago and how has this changed? The first western science research conducted on the Yukon River watershed did not incorporate local knowledge due to language and cultural perspective barriers. This is a collection of the traditional local knowledge from before western contact to the present, along with the earlies western scientific water chemistry data and salmon population numbers compiled. What is the variability and accuracy of the earliest scientific water chemistry data collected and how has this changed over time? What parameters are most useful in this dataset for understanding salmon habitat health and potential impacts due to anthropogenic pollution and climate change? What are the challenges associated with performing regression and other statistical analysis with historical water chemistry data compiled with current data sets? How has local traditional knowledge and western science converged over the years and what is the continued suggested work to continue this process? How have the Athabaskan tribe's view and capabilities to perform western science and understand chemistry changed?