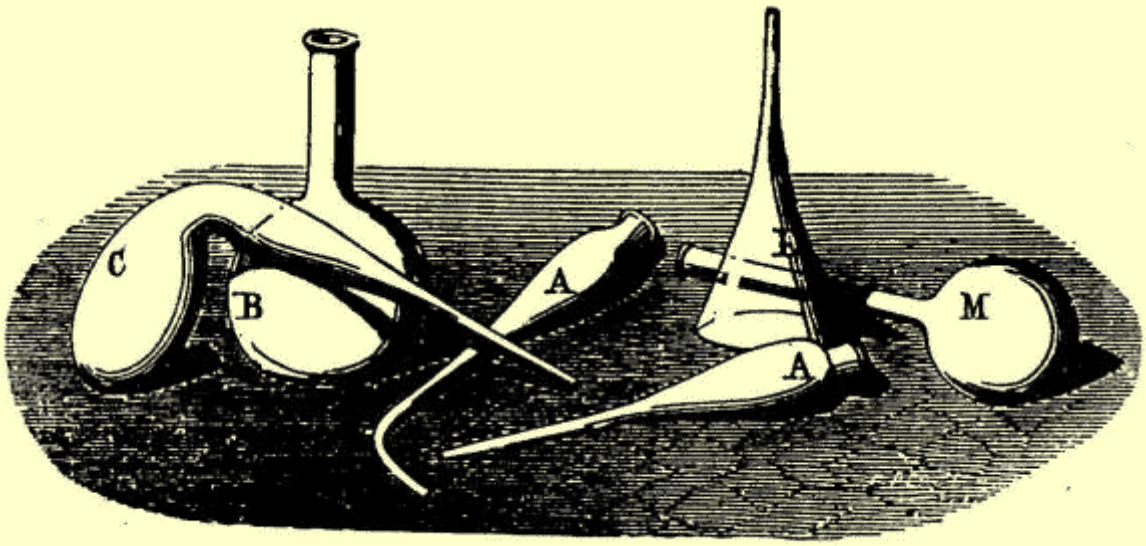
American Chemical Society

DIVISION OF THE HISTORY OF CHEMISTRY



PROGRAM & ABSTRACTS

255th ACS National Meeting
New Orleans, LA
March 18-22, 2018

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

Hilton New Orleans Riverside, Grand Salon D Sec 24

Tutorial & General Papers

N. V. Tsarevsky, *Organizer*
J. S. Jeffers, *Presiding*

8:00 HIST 1. Chemistry in America: Seventeenth century New England and John Winthrop, Jr.. **G.D. Patterson**

8:30 HIST 2. WITHDRAWN

9:00 HIST 3. Early German influences on women in chemistry. **R.C. White**

9:30 HIST 4. Solving crime mysteries using chemistry: The early days of forensic science. **N.V. Tsarevsky**

10:00 Intermission.

10:15 HIST 5. Bibliometric overview of drug repurposing using PubMed. **N. Baker**, A.J. Williams, S. Ekins, A. Tropsha

10:45 HIST 6. History of Ethyl Corporation in Baton Rouge, Louisiana and beyond. **C.D. Varnado**

11:15 HIST 7. History of cyclic polymers. **F.M. Haque**, S.M. Grayson

11:45 HIST 8. John Herschel as a chemist. **G.D. Patterson**

SUNDAY AFTERNOON

Section A

Hilton New Orleans Riverside, Grand Salon D Sec 24

Food at the Crossroads: Chemistry's Role in Sustainability, Past & Present

Cosponsored by AGFD, CHED, DAC, MPPG and PRES; Financially supported by ACS Louisiana Local Section
A. F. Bopp, *Organizer*
M. V. Orna, *Organizer, Presiding*

1:00 Introductory Remarks.

1:10 HIST 9. Impact of agriculture on food supply: A history. **L. Simon Sarkadi**

1:40 HIST 10. Critical impact of NaCl on global human history and development. **M. Duerst**

2:10 HIST 11. Sweet chemistry: A philatelic history of sugar. **D. Rabinovich**

2:40 Intermission.

3:00 HIST 12. History of sugar and sweeteners. **G. Eggleston**

3:30 HIST 13. Uncorking the past: Alcoholic beverages as the universal medicine before synthetics. **P.E. McGovern**

4:00 HIST 14. Why we do this to ourselves? The chemical/botanical history of chili peppers. **R. Mullin**

4:30 Concluding Remarks.

SUNDAY EVENING

Hilton New Orleans Riverside, Grand Salon B Sec 10

6:00 - 8:00 HIST Executive Committee Meeting

MONDAY MORNING

Section A

Hilton New Orleans Riverside
Grand Salon D Sec 24

Food at the Crossroads: Chemistry's Role in Sustainability, Past & Present

Cosponsored by AGFD, CHED, DAC, MPPG and PRES; Financially supported by ACS Louisiana Local Section
A. F. Bopp, M. V. Orna, *Organizers*
D. Rabinovich, *Presiding*

8:30 Introductory Remarks.

8:40 HIST 15. Cuisine and chemistry: From Liebig's "Dietetic Trinity" to molecular gastronomy. **L. Civitello**

9:10 HIST 16. Harvey Wiley and the transformation of the American diet. **J. Rees**

9:40 HIST 17. History of dietary guidelines and their impacts. **E. Schoffers**

10:10 Intermission.

10:30 HIST 18. Eating chemicals: The flavor industry and its chemical relations. **N. Berenstein**

11:00 HIST 19. Genetically modified organisms (GMOs) as part of our food sources: Are you what you eat? **P.L. Daubenmire**

11:30 HIST 20. Carotenoids, cochineal and copper: Food coloring through the ages. **M. V. Orna**

12:00 Concluding Remarks.

Molecules that Changed the World

Sponsored by YCC, Cosponsored by HIST and I&EC

MONDAY AFTERNOON

Section A

Hilton New Orleans Riverside
Grand Salon D Sec 24

Food at the Crossroads: Chemistry's Role in Sustainability, Past & Present

Cosponsored by AGFD, CHED, DAC, MPPG and PRES; Financially supported by ACS Louisiana Local Section
M. V. Orna, *Organizer*
A. F. Bopp, *Organizer, Presiding*

1:30 Introductory Remarks.

1:40 HIST 21. How food culture survives and thrives in a changing world. **P. Tooker**

2:40 HIST 22. Evolution of flour: From New England Graham to New Orleans Swans Down. **L. Civitello**

3:10 Intermission.

3:30 HIST 23. Effects of fertilizer on food supply. **L. Simon Sarkadi**

4:00 HIST 24. Role of chemical analysis in food safety and food authentication. **E. de Ronde**

4:30 HIST 25. What 18 inches could mean? Relative sea level rise and Louisiana. **A. Gaudé**

5:00 HIST 26. Student/teacher essay contest winners: The best in the chemical history of food. S.C. Rukes, **M. V. Orna**

5:30 Concluding Remarks.

Information Legacy of Eugene Garfield: From the Chicken Coop to the World Wide Web

Sponsored by CINF, Cosponsored by HIST and PRES

Tales of Chemistry & Cocktails

Sponsored by YCC, Cosponsored by HIST

MONDAY EVENING

Section A

Ernest N. Morial Convention Center
Halls D/E

Sci-Mix

N. V. Tsarevsky, *Organizer*

8:00 - 10:00

HIST 7. (See previous listings); HIST **31**, **45**, **48**-**49**. (See subsequent listings).

TUESDAY MORNING

Section A

Hilton New Orleans Riverside
Grand Salon D Sec 24

HIST Award Symposium Honoring Jeffrey I. Seeman

J. Gal, *Organizer, Presiding*

8:25 Introductory Remarks.

8:30 HIST 27. Seeman, Padwa, Gupton and five membered heterocycles: How organic chemistry brought us together. **J.T. Gupton**

9:00 HIST 28. Two examples of serendipity in my scientific career. **E. Juaristi**

9:30 HIST 29. My journey from a never-heard land to ... to the land of opportunities. **M. Hajaligol**

10:00 HIST 30. Thoughts on the relevance of history. **M. Caserio**

10:30 Intermission.

10:45 HIST 31. Publishing chemical history: Lessons learned. **E.E. Wille**

11:15 HIST 32. Resilience: When life hands you a lemon, make lemonade. **M. Rouhi**

11:45 HIST 33. History of and history in *Angewandte Chemie*. **P.K. Goelitz**

TUESDAY AFTERNOON

Section A

Hilton New Orleans Riverside
Grand Salon D Sec 24

HIST Award Symposium Honoring Jeffrey I. Seeman

J. Gal, *Organizer, Presiding*
M. V. Orna, J. Seeman, *Presiding*

1:00 HIST 34. Reflections on the relationships of error to discovery in chemistry. **C.J. Giunta**

1:30 HIST 35. Origins: God or no God, that is the question. **M.T. Bowers**

2:00 HIST 36. Chemical receptors and transduction events on the mammalian tongue. **S. Simon**

2:30 HIST 37. Three evocative ideas: The Matthew effect, post mature contributions and the role of the role model. **H. Zuckerman**

3:00 Intermission.

3:15 HIST 38. Best of all possible worlds. **R. Anderson**

3:45 HIST 39. "Go for it": Words of wisdom from my fathers. **L.M. Shea**

4:15 HIST 40. FDA history, drug inspection and compliance overview. **B. Higgins**

4:45 HIST 41. Emergence of molecular reaction dynamics. **D.R. Herschbach**

TUESDAY EVENING

HIST Award Banquet honoring Dr. Jeffrey I. Seeman

6:30 - 8:30 Banquet at Pigeon and Prince (129 Camp Street)

WEDNESDAY MORNING

Section A

Hilton New Orleans Riverside, Grand Salon D Sec 24

Tutorial & General Papers

N. V. Tsarevsky, *Organizer, Presiding*

8:15 HIST 42. History of the American chemical laboratory manual. **W.P. Palmer**

8:45 HIST 43. Victor Grignard (1871-1935) and Henry Gilman (1893-1986): Pioneers in organometallic chemistry. **R.K. Dieringer**, **H.K. North**, D.E. Lewis

9:15 HIST 44. Wolff-Kishner reduction: Biography, discovery and development. **D.E. Lewis**

9:45 HIST 45. Development of Butlerov's Structural Theory, 1859-1862. **C.S. Goedhart**, **D.R. Rothbauer**, S.N. Raspel, D.E. Lewis

10:15 Intermission.

10:30 HIST 46. Mining of elements versus discovery, analysis, and separation of elements. **C. Hahn**

11:00 HIST 47. August Michaelis: A pioneer of phosphorus chemistry. **D. Selent**

11:30 HIST 48. Markovnikov on isomerism in organic chemistry. **D.E. Lewis**

12:00 HIST 49. Mutual influence of atoms in chemical compounds—Markovnikov's Rule. **D.E. Lewis**

ABSTRACTS

HIST 1 Chemistry in America: Seventeenth century New England and John Winthrop, Jr.

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

While standard histories of New England focus on religious and political issues, the Massachusetts Bay Company was a commercial venture, capitalized by rich Puritans. They expected to make money, and recent treatments of this period in American history explain the "economic culture of Puritan New England." No one person exemplified this theme more than John Winthrop, Jr. His life and career as a chemist will be presented. There is now a large and growing corpus of books on Winthrop and his story is a landmark in the history of chemistry in America.

HIST 2 WITHDRAWN

HIST 3 Early German influences on women in chemistry

***Ricky C. White**, chm_rcw@shsu.edu. Sam Houston State Univ, Huntsville, Texas, United States*

The influences of August von Hofmann on female careers have been shown to be far reaching, from Clara immerwahr tp Marsarete von Wrangelle to Rachel Lloyd, to Ruth Okey and Alice Morgan. In this time, we shall explore some of the mysogeny (Wilhelm Ostwald) as well as the encouragement (Viktor Meyer) some females have seen. Many women have made incredible advances in Nutrition. Dorothea Erxleben, the first fmale MD, wrote on obstacles to women in education, citing housework and food preparation. Wilhelm Ostwald said that females "natural inclination is gto motherhood above any "unnatural freakish inclination to scientific discovery" Yet, once the Activation barrier was broken, scientific discoveries snowballed.

HIST 4 Solving crime mysteries using chemistry: The early days of forensic science

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

Advances in systematic chemical analysis, which involved the discovery of color and precipitation reactions, the development and improvement of instruments such as spectroscopes, microscopes, and colorimeters, and especially the use of these new methods and tools for qualitative determinations, were essential prerequisites for a new scientific field to emerge that could be used to solve criminal cases – forensic chemistry. One of the best known early examples of forensic chemical analysis that found uses in court cases (with mixed success) was the test described in 1836 by the Scottish chemist James Marsh (1794-1846) for the detection of minute amounts of arsenic in biological and other samples. However, there are several earlier books dedicated to the detection of (mostly metallic) poisons, including "Traite des Poisons" (1814-1815) by Mateu Orfila (1787-1853), A Manual of Toxicology" (2nd ed., 1823) by William Stowe, "A Treatise on Poisons" (1829) by Robert Christison (1797-1882), and "Kratkoe Izlozhenie Sudebnoy

Meditsiniy", i.e., "Brief Exposition of Forensic Medicine" (1832; 2nd ed., 1838) by Sergey Gromov (1774-1856). By the second half of the 19th Century, numerous reagents had been discovered for the detection of plant poisons, e.g., alkaloids, and books describing a variety of color and precipitation reactions were published, including the "Micro-Chemistry of Poisons" (1867) by Theodore George Wormley (1826-1897), which provides illustrations of the appearance (as seen under the microscope) of crystalline products formed between metallic complexes and alkaloids that could be used for the identification of the latter compounds. Some of the early works dedicated to the detection of toxic substances will be discussed in this presentation.

HIST 5 Bibliometric overview of drug repurposing using PubMed

Nancy Baker[2]*, baker.nancy@epa.gov, Antony J. Williams*[3]*, Sean Ekins*[1]*, Alexander Tropsha*[2]*. (1) Collaborations Pharmaceuticals, Fuquay Varina, North Carolina, United States (2) Univ of North Carolina, Chapel Hill, North Carolina, United States (3) ChemConnector, Wake Forest, North Carolina, United States*

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.

HIST 6 History of Ethyl Corporation in Baton Rouge, Louisiana and beyond

C. D. Varnado[1,2]*, daniel.varnado@albemarle.com. (1) Albemarle Corporation, Baton Rouge, Louisiana, United States (2) Chemistry, Louisiana State University, Baton Rouge, Louisiana, United States*

Ethyl Corporation was a joint venture created by Standard Oil and General Motors to manufacture tetraethyllead (TEL), the anti-knock gasoline additive that enabled development of the higher-powered engines which drove the transformation of society in the 20th Century, the age of the automobile. In 1937, Ethyl constructed a flagship TEL manufacturing plant in Baton Rouge, Louisiana. Excerpts from 1940s issues of the monthly employee bulletin provide snapshots of various aspects of working for Ethyl and life in Baton Rouge during that era. In 1962, Albemarle Paper Company, with the ambitious F. D. Gottwald at the helm, made Wall Street history by orchestrating what was then the largest-ever leveraged corporate buyout, acquiring Ethyl, a company 18 times its size. Gottwald then leveraged Ethyl's substantial cash flow and technical expertise to build a diversified chemical manufacturing empire that kept growing despite the phase out of its namesake product. Ultimately, in the 1990s, the huge conglomerate split into

several smaller and more specialized companies. The specialty chemicals business was spun off as Albemarle Corporation, which maintains an R&D presence in the footprint of the former TEL manufacturing plant in Baton Rouge. Gottwald's passion for strategic acquisitions lives on in the company today, as evidenced by the recent acquisition of Rockwood Holdings. Albemarle is poised to continue its growth story in the years to come as a top producer of lithium.

HIST 7 History of cyclic polymers

***Farihah M. Haque**, fhaque@tulane.edu, Scott M. Grayson. Chemistry, Tulane University, New Orleans, Louisiana, United States*

The earliest discovery of cyclic polymers is credited to Freifelder *et al.* for findings of cyclic DNA (1964), an idea originally hypothesized by Jacob and Wollman (1958). Since then, a number of cyclic biomacromolecules have been discovered, including cyclic lipids and polypeptides. The cyclic architecture has been attributed to many exotic properties including enhanced stability as demonstrated by a resistance to degradation under thermal and enzymatic conditions. Such biological studies foreshadow decades of research both meticulously synthesizing and characterizing cyclic polymers. Early examples of cyclic polymers were formed using the ring-chain equilibrium approach, typically yielding highly impure samples requiring extensive forms of purification. Since then, a number of optimized methods have been established, namely the ring expansion and ring closure approaches. These recent synthetic advances are finally allowing researchers to study many of the unknown and unique materials and biological properties of synthetic cyclic polymers. The body of work presented will provide an overview of the synthetic advances toward forming the novel cyclic topology that was once merely hypothesized, while also highlighting some potential applications.

HIST 8 John Herschel as a chemist

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

While Sir John F.W. Herschel (1792-1871) will be remembered as the great astronomer that he was, one of his great loves was chemistry. He learned it as a child from his redoubtable aunt, Caroline Herschel, the sister of Sir William Herschel. When Smithson Tennant, who held the Chair of Chemistry at Cambridge, died in 1815, John Herschel applied for the position. While he did not obtain it (at the age of 23), he did maintain a lifelong interest in chemistry and made major contributions. He is the father of photochemistry. He understood light better than anyone in the 19th century (and published a great article on it), and he developed the field of chemical spectroscopy in the prism spectrometer age. At the end of his scientific career, he was the President of the Chemistry Section of the British Association for the Advancement of Science. And, like his idol, Isaac Newton, he was Master of the Mint and is buried next to Newton in Westminster Abbey. (Yes, Newton was a great chemist too!)

HIST 9 Impact of agriculture on food supply: A history

***Livia Simon Sarkadi**, livia.sarkadi@uni-corvinus.hu. Food Chemistry and Nutrition, Szent István University, Budapest, Hungary*

Agriculture was an established reality by at least 10,000 years ago, and has played a key role in the development of human civilization. Agriculture provides the basic essentials for living: the food, the beverages, the clothing, and the materials for our homes. Agriculture has undergone significant developments since the time of the earliest cultivation. Until the Industrial Revolution, the vast majority of the human population labored in agriculture. Development of agricultural techniques has steadily increased agricultural productivity. Modern agronomy and agricultural chemistry have allowed for crops to be produced in areas that previously were unsuitable for agriculture and appropriate use of fertilizers has helped to create higher yields to counterbalance the loss of available agricultural land. Population growth, increasing life expectancy, and economic growth are expanding the demand for food products. It is estimated that the world's population will have increased to over eight billion by 2050. A rapidly expanding world population, increasing affluence in the developing world, climate volatility and limited land and water availability mean we have no alternative but to significantly and sustainably increase agricultural productivity to provide food and feed.

HIST 10 Critical impact of NaCl on global human history and development

***Marilyn Duerst**, marilyn.d.duerst@uwrf.edu. Dept Chem, University of Wisconsin, River Falls, Wisconsin, United States*

Ordinary table salt has been one of the most critical factors in the social, geographic, cultural, economic, and technological development of human societies and cultures, reaching far beyond simply being a food flavoring and food supplement for humans and animals. This fascinating study of salt begins in ancient times, and brings us into the 21st century, addressing modern controversies about the role of salt in the human diet, and the chemistry of the most important alkali halide in history.

HIST 11 Sweet chemistry: A philatelic history of sugar

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

Sugar, the ubiquitous sweet stuff that we enjoy in our foods and drinks (sometimes too much!) is an important source of dietary carbohydrate, mainly sucrose, and is commercially produced in a very large scale from sugar cane or sugar beets. Although it is produced today in more than 80 countries, about 50% of the world's annual output, currently estimated at 180 million tonnes, comes from only four: Brazil, India, China, and Thailand. The extraction of sugar from cane has been practiced in India and Southeast Asia for centuries and the plant was taken by Columbus to the West Indies, where it flourished due to the tropical weather in the region. However, it was only in 1747 that a German analytical chemist, Andreas Sigismund Marggraf (1709-1782) announced the discovery of sugar in beets and verified that its composition was essentially the same as that of sugar isolated from cane. The growth of beets as a source of sugar is favored in regions with more tempered climate, especially since it requires four times less water that sugar

cane. This presentation will use postage stamps and related philatelic materials to illustrate the history of sugar, including various aspects of its industrial production.

HIST 12 History of sugar and sweeteners

***Gillian Eggleston**, gillian.eggleston@ars.usda.gov. ARS USDA SRRC, New Orleans, Louisiana, United States*

Commercial sugar (sucrose) is manufactured worldwide from either sugarcane or sugar beets. There are seven main phases in the history of sugar and sweeteners: (1) 8000 BC to 0 AD: The extraction of juice from the sugarcane plant and domestication of sugarcane in Tropical Southeast Asia. (2) Early centuries AD: invention of making sugar crystals from sugarcane juice in India; improvements in sugar processing to make it more pure. (3) 700 to 1500 AD: The spread of cultivation and manufacture of sugarcane sugar to the medieval Islamic world as well as improvements in production methods. (4) 16th to 19th centuries: Sugar cultivation and manufacture in the New World. (5) 19 century: Production of sugar from sugar beets precipitated by the Napoleonic wars, and the introduction of mechanization and modern processing technology. (6) Late 20th century: High fructose corn syrup introduced. (7) 21st century: new natural sweeteners and other uses for sugar. All these phases will be discussed.

HIST 13 Uncorking the past: Alcoholic beverages as the universal medicine before synthetics

***Patrick E. McGovern**, mcgovern@upenn.edu. Biomolecular Archaeology Project for Cuisine, Fermented Beverages, and Health, University of Pennsylvania Museum, Philadelphia, Pennsylvania, United States*

To substantiate and illustrate the centrality of Molecular Archaeology in bridging the divide between the natural sciences and the humanities, I draw upon my laboratory's research on "fermentation" and "ancient medicine." Fermentation is probably the first energy system on Earth, which is embodied in the physiology of all animals, including humans. It is probably the first biotechnology discovered and put to use by our species. In short, we coevolved with microorganisms, then harnessed them to our purposes in many innovative ways—to provide alcohol as an energy source and for dissolving botanical compounds which have medicinal properties. Arguably, the most important fermentation system used by humankind was to make fermented beverages. As the universal medicine, social lubricant, mind-altering substance, religious symbol, artistic inspiration, and highly valued commodity, fermented beverages around the world became the focus of religious cults, pharmacopoeias, cuisines, economies, and society. The products of fermentation likely had much to do with the evolution of our bodies, brains, and cultures, including more advanced civilizations based on the domestication of cereals and other plants that provided the basis for permanent settlements. The speaker will show how a range of

increasingly more precise chemical techniques are essential to resolving key archaeological questions, including why fermented beverages are so central to human cultures around the world and as far back in time as we can detect them.

HIST 14 Why we do this to ourselves? The chemical/botanical history of chili peppers

***Rick Mullin**, r_mullin@acs.org. Chemical and Engineering News, American Chemical Society, New York, New York, United States*

This talk will cover the botanical and chemical histories of chilies and capsaicin touching on my experience growing a few varieties of "peppers" and making hot sauce. On the botanical side, I will describe the fruit, explaining where and why capsaicin and capsaicinoids are found. I will discuss the origin of chilies, how they have been dispersed globally, and why they are called peppers. On the chemical side, I will explicate the molecule and means of its extraction as well as safety concerns when dealing with pure capsaicin. I will discuss the work of scientists and pseudoscientists who have worked with chilies and capsaicin: P.A. Bucholtz, who discovered the means of extracting the pungent principle of peppers in 1816, L.T. Thresh who described the principal chemical component, crystallized it and named it capsaicin in 1846, S. Kosuge and Y. Inagaki, who identified related compounds, capsaicinoids, in 1964, and Wilbur Scoville, whose eminently unscientific means of measuring potency of chilies—the Scoville unit/scale of 1912—is widely used, making him more famous than the scientists. I will wrap up by discussing new breeds of chilies, the range of heat, and the culinary importance of hot peppers, with some regional (New Orleans) flavor.

HIST 15 Cuisine and chemistry: From Liebig's "Dietetic Trinity" to molecular gastronomy

***Linda Civitello**, lcivitello@ucla.edu. Independent Scholar, Los Angeles, California, United States*

In 1984, when Harold McGee wrote his groundbreaking book On Food and Cooking: The Science and Lore of the Kitchen, he had to explain what food science was and how cooking was related to chemistry. For the second edition, in 2004, the explanation was no longer necessary.
In the twenty years between the two editions, terroir was determined with spectrometry; gas chromatography provided precise measurements of the capsaicin levels in a famous Louisiana product, Tabasco sauce; flavonoids, Maillard reaction, umami, and supertaster had become common terms. And the Nobel Prize in Physiology or Medicine was awarded for the discovery of "odorant receptors and the organization of the olfactory system." These developments were the continuation of the massive changes that began in 1848, when Justus von Liebig posited his Dietetic Trinity—that humans need only protein, fats, and carbohydrates—which began the shift away from humoral theory to science-based nutrition. Some of the other changes included: (1) the creation of the Cold Chain—the commodification of natural ice, then ammonia-based mechanical refrigeration. (2) Electricity, beginning with hydroelectric. (3) Advances in metallurgy that created aluminum and stainless steel. In 1988, Molecular Gastronomy (now known as Experimental Cooking) brought scientific inquiry to cooking processes; it destroyed what chefs for centuries had considered common knowledge. All of these changes combined to create kitchens, cooking, and food as we know them today. And cocktails, in which New Orleans plays no small part.

HIST 16 Harvey Wiley and the transformation of the American diet

***Jonathan Rees**, drjonathanrees@gmail.com. History, Colorado State University, Pueblo, Colorado, United States*

Harvey Washington Wiley was a leading agricultural chemist, a pioneering consumer advocate, and the head of the Bureau of Chemistry at the United States Department of Agriculture for almost three decades. In that capacity, he became widely known as the "Father of the Pure Food and Drug Act" because of his lobbying activities on behalf of that legislation. This paper will examine Wiley's impact on different classes of foods by tracing his changing ideas of what pure food was. Wiley would come to believe that the pure food law had been a failure because of lax enforcement, but Wiley's ideas of how that law should have been enforced evolved a great deal between the time he started lobbying for it at the turn of the twentieth century and his death in 1930. Wiley's ideas about purity changed because food itself changed drastically over that same time period. While Wiley's preferred philosophy of strict enforcement never won the day in Washington, his championing of foods without preservatives or additives of any kind influenced countless manufacturers across many industries and consumers too. Meat, milk, honey, baking powder, and whiskey are just a few of the foods that Wiley's impacted in some way that will be considered in this paper.

HIST 17 History of dietary guidelines and their impacts

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

This presentation will address the broader impacts of human food consumption, past and present. The phrase "you are what you eat" has long embodied the connection between the food we eat on overall health. However, dietary choices have many more externalities, ranging from water and energy resources to broader environmental impact.

HIST 18 Eating chemicals: The flavor industry and its chemical relations

***Nadia Berenstein**, nadia.aymone@gmail.com. Independent Scholar, New York, New York, United States*

While comprising a distinct branch of chemical research and manufacturing, since its origins in the second half of the nineteenth century, the flavor chemical industry has been intimately connected with other chemical industries, most prominently pharmaceuticals and petrochemicals. Developments in the broader chemical marketplace have had profound consequences for synthetic flavor production; for instance, the expanding range of chemical intermediates produced by the postwar petrochemical industry dramatically broadened the chemical palette available to flavor manufacturers. Flavor research has also contributed to chemistry, as in the case of the refinement of GC-MS technologies. Although these relations have been productive, they have also been problematic. Indeed, the "chemical" identity of flavor additives continues to be one of the most potent charges against these substances among a public increasingly concerned with "eating clean." This paper examines several key moments of historical entanglement between flavor chemicals and the products of other chemical industries as a way of making sense of the place of this unique industry in the industrial food system. While primarily a

history of science and technology, this paper will also consider broader cultural contexts and responses.

HIST 19 Genetically modified organisms (GMOs) as part of our food sources: Are you what you eat?

***Patrick L. Daubenmire**, pdauben@luc.edu. Dept of Chemistry, Loyola University Chicago, Chicago, Illinois, United States*

The debate about genetically modified organisms (GMOs) is alive and real in the United States. Those debates range from what are the effects of modified organisms on our own and environmental health to is it necessary to label GMOs in our markets. This presentation will trace the pertinent history of GMOs as well as how both critical science understanding and informed public dialog are imperative to making decisions about genetically modifying organisms and using these organisms. Embedded within the curriculum *Chemistry in Context*, several instructional resources will be surveyed: (1) presentation of techniques, (2) comparison and contrasting of selective breeding with genetic modification, (3) broad examples of GMOs, and (4) presentation of debated material.

HIST 20 Carotenoids, cochineal and copper: Food coloring through the ages

***Mary Virginia Orna**, maryvirginiaorna@gmail.com. Chemistry, The College of New Rochelle, New Rochelle, New York, United States*

Colorants used in food were of natural origin up until the middle of the 19th century. Artificial colors began to be used after W. H. Perkin's discovery of mauve. However, colorants were not always beneficial: some were fraudulently used to disguise poor quality, rottenness, and identity. Some were downright poisonous. Although there were movements to require governmental regulation and oversight as a result of reported illnesses and deaths due to some foods, monitoring was slow in coming and strictures varied from country to country. This paper will document the evolution of the modern regulations for the safe coloring of food and the labeling requirements.

HIST 21 How food culture survives and thrives in a changing world

***Poppy Tooker**, poppy@poppytooker.com. Louisiana Eats!, New Orleans, Louisiana, United States*

One of the great treasures of New Orleans' 300-year history is the indigenous food culture – a product of the many immigrant nations which have helped to shape our city. How does tradition stand in the light of the rapidly changing 21st century world? Why is it of value? We will explore those topics while reflecting on climate change and both natural and manmade disasters which threaten the bedrock daily.

HIST 22 Evolution of flour: From New England Graham to New Orleans Swans Down

***Linda Civitello**, lcivitello@ucla.edu. Independent Scholar, Los Angeles, California, United States*

What is a recipe that first appeared in a Boston cookbook in 1830 doing on a box of 21st century New Orleans cake flour? What is Graham flour? All purpose? Cake? Soft? Hard? How has flour changed since that 1830 recipe for Cup Cake? Eben Horsford's 1875 "Report on Vienna Bread" was something new: an in-depth chemical analysis of wheat, flour, milling technology, and leavening. Horsford's report detailed the impact of climate and rainfall on various types of wheat around the world. He discussed the importance of gluten, the composition of bran, the pressure of the millstones, how bread baking differed in the United States and Europe. He also detailed the controversy over yeast. In 1859, Pasteur had stunned the world by using the microscope to observe yeast for the first time; he and Liebig were at odds as to what it was and what it did. At the end of the 19th century, American flour shifted from whole wheat to refined white in a concerted campaign by Minneapolis milling giants. Bleaching flour resulted in a lawsuit that went to the U.S. Supreme Court in 1914. Today, modern growers concerned about sustainability and taste have revived landrace and heirloom strains of wheat milled with high rates of extraction. Southern flours are unique in the types of wheat they are milled from and the levels of protein and gluten they contain. These flours are used to produce the light and fluffy pride of Southern baking: chiffon cakes, baking powder biscuits, and cobblers.

HIST 23 Effects of fertilizer on food supply

***Livia Simon Sarkadi**, livia.sarkadi@uni-corvinus.hu. Food Chemistry and Nutrition, Szent István University, Budapest, Hungary*

Maintaining good soil structure and fertility are important to ensure high agricultural productivity. The use of fertilizers has been pivotal to securing long-term food supplies in the midst of a growing global population. Modern chemical fertilizers include one or more of the three elements that are most important in plant nutrition: nitrogen, phosphorus, and potassium. Chemical engineers have applied their expertise to chemically synthesize fertilizers, herbicides, and pesticides that promote crop growth and protect crops from weeds, insects, and other pests. Today, the use of these products is more important than ever to meet the needs of an ever-expanding population. Almost 40-60% of agricultural crops are grown with the use of different types of fertilizers (synthetic or organic) which contain different chemicals and minerals. These components, although a help in boosting the growth of plants, also have their negative side effects in the long run. Over-fertilization of soils used for agricultural and horticultural purposes is a growing environmental concern, as evidenced by the dead zones created by fertilizer runoff into the Gulf of Mexico. Therefore, it is very important to apply fertilizers in an efficient way to minimize loss and to improve their nutrient efficiency. Managing agricultural nutrients to provide a safe food supply and secure the environment remains one of the immense challenges of the 21st century.

HIST 24 Role of chemical analysis in food safety and food authentication

***Eric de Ronde**, ericderonde@eurofinsus.com. Eurofins Inc., New Orleans, Louisiana, United States*

Overview of how the methods of analytical chemistry can maintain food safety and guarantee its authenticity.

HIST 25 What 18 inches could mean? Relative sea level rise and Louisiana

***Albert Gaudé**, agaude@agcenter.lsu.edu. Ag Center, Louisiana State University, Jefferson, Louisiana, United States*

With the mid-Louisiana coast being projected as "ground zero" for relative sea level rise (RSL), our State is destined to have a number of profound changes to both the human and faunal components. With these changes, history is somewhat reverting on itself and setting the stage for southern citizens to fall back on two polarities of food sources: seasonal wild harvest and consistently supplied cultured fishery products. The carbon footprint of these two sources will ultimately determine the consumer costs and acceptance.

HIST 26 Student/teacher essay contest winners: The best in the chemical history of food

*Sherri C. Rukes[1], **Mary Virginia Orna**[2], maryvirginiaorna@gmail.com. (1) Libertyville High School, Libertyville, Illinois, United States (2) Chemistry, The College of New Rochelle, New Rochelle, New York, United States*

Student/teacher teams were invited to contribute brief, but research-quality, essays on any chemistry of food topic from an historical point of view. The winning essays are presented here along with a brief introduction of each of the winning teams.

HIST 27 Seeman, Padwa, Gupton and five membered heterocycles: How organic chemistry brought us together

***John T. Gupton**, jgupton@richmond.edu. Univ of Richmond, Univ of Rich, Virginia, United States*

A chronological perspective will be presented on how the author came to be involved in heterocyclic synthesis and how the interaction with crucial colleagues and friends influenced and facilitated the development of new chemistry and professional development.

HIST 28 Two examples of serendipity in my scientific career

Eusebio Juaristi[1,2]*, ejuarist@cinvestav.mx. (1) Chemistry, Centro de Investigación y de Estudios Avanzados., Mexico City, Mexico (2) El Colegio Nacional, Mexico City, Mexico*

In 1980, my first research project as an independent researcher in Mexico consisted in the synthesis of a novel Wittig-Horner/Corey-Seebach reagent, 2-diphenylphosphinoyl-1,3-dithiane. The original goal was to develop a novel method for the homologation of aldehydes and ketones. While this idea turned out to be successful, the unexpected finding of a rather large difference in the chemical shifts for the axial and equatorial hydrogens at C(4,6) in 2-diphenylphosphinoyl-1,3-dithiane led to the discovery of an unusual anomeric effect involving the S-C-P segment. This finding attracted considerable attention from both experimental and theoretical physical organic chemists, and gave way to numerous studies, the publication of influential reviews, as well as the preparation of a fundamental book on the anomeric effect. Interestingly, a "definite" interpretation of the anomeric effect in S-C-P segment was reported by Juaristi & Notario only two years ago.
In 1985 a sabbatical year spent in the group of D. Seebach at the ETH-Zurich, provided the author with the capacity to master efficient asymmetric syntheses of α-amino acids. Upon his return to Mexico, Juaristi had the idea to use similar strategies for the enantioselective preparation of β-amino acids – an essentially virgin area of research at the time. Again, X-ray diffraction crystallography exhibited an unexpected axial orientation of the *t*-butyl group of the chiral pyrimidinone substrate, and this allowed the highly stereoselective addition of electrophilic reagents, leading then to the enantioselective synthesis of α-substituted β-amino acids. This strategy has had an extraordinary impact, so that whereas only 5 pertinent literature entries on this subject were registered prior to 1980, and 11 for the period 1980-1990, more than 2000 have appeared during 1991-2017.Indeed, incorporation of β-amino acids in unnatural peptides has been shown to elicit rather interesting and useful properties such as increased resistance to enzymatic hydrolysis, which has proved to have enormous potential in the development of more efficient pharmacological drugs. In this context, β-homo-tryptophan was prepared and exhibited interesting biological activity when replacing its a analogue in hormone peptides present in the mosquito that transmits dengue. Because the β-peptide is more resistant to enzymatic hydrolysis, this affects the physiological diuresis/antidiuresis balance in the insect leading to death by dehydration.

HIST 29 My journey from a never-heard land to ... to the land of opportunities

Mohammad Hajaligol*, hajaligol@yahoo.com. None, Leesburg, Virginia, United States*

An autobiographical tour will review the steps in my life that transformed me from a village-boy in Iran to an active and happy scientist in the land of opportunities. I will also discuss the role of friendship and scientific collaboration that I experienced around the world.

HIST 30 Thoughts on the relevance of history

Marjorie Caserio*, mcaserio@ucsd.edu. Department of Chemistry and Biochemistry, University of California, La Jolla, California, United States*

History is discussed primarily but not exclusively in the context of chemistry. Relevance is discussed in the context of my own career as a chemist. History seemed irrelevant to me as a

student and junior level chemist, but, on reflection, it assumed greater importance as time passed – a transition of which I was mostly unaware. The heart of the discussion in my presentation centers on how and why the influence of history appears to grow as one's career matures, yet collectively we seem to overlook it.

HIST 31 Publishing chemical history: Lessons learned

***Eva E. E. Wille**, ewille@wiley.com. Wiley-VCH, Weinheim, Germany*

Publishing works on history of science, and on particular chemical history, is very important, as we all can learn from history. Publishing history works falls into two equally important parts: works by historians of science for their fellow colleagues is one and publishing history for lay historians (i.e. for every scientist and students), for leisure reading or for their entertainment is the other. Case studies collected over the period of more than three decades will be presented with an emphasis on publishing at Verlag Chemie/VCH/Wiley-VCH/Wiley.

HIST 32 Resilience: When life hands you a lemon, make lemonade

***Maureen Rouhi**, maureen.rouhi@cos.gatech.edu. College of Sciences, Georgia Institute of Technology, Atlanta, Georgia, United States*

My career path was set: Finish a Ph.D. and return to an academic career in the Philippines. What I did not anticipate was marrying a foreigner and living in a country at war. I could not have anticipated what happened next with the lemons my husband and I turned into lemonades.

HIST 33 History of and history in *Angewandte Chemie*

***Peter K. Goelitz**, pgoelitz@wiley-vch.de. Angewandte Chemie, Weinheim, Germany*

Angewandte Chemie was founded in 1887 as a journal for industrial chemistry; basic science played only a marginal role in the first half of its history. The transformation of the journal into a world-class forum for all sub-disciplines of chemistry will be illuminated. The history of chemistry had always a home in the journal and even more so today through the Essays section and regular contributions by Jeff Seeman.

HIST 34 Reflections on the relationships of error to discovery in chemistry

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

Awards provide an opportunity for reflection as well as for celebration, as I have frequently been reminded by the 2017 HIST Award winner, Jeff Seeman. In light of such advice, this presentation will revisit one of the historical topics in chemistry which first engaged my interest, namely the role of errors in the development of the science. The result of that earlier focus was less a serious examination of the actual role of errors in the development of chemistry than a recognition that

errors could illustrate useful pedagogical and motivational precepts. A very preliminary survey upon revisiting the topic of error suggests a great diversity of relationships to discovery: error can be a spur to discovery, a hindrance to it, a subordinate companion of it, or a dominant companion disguised as a discovery. Examples of each kind will be examined.

HIST 35 Origins: God or no God, that is the question

Michael T. Bowers*, bowers@chem.uscb.edu. Chemistry and Biochemistry, Univ of Californ Santa Barbara, Santa Barbara, California, United States*

In this short talk we will focus on three origins: The Universe, Life, and Human Consciousness. There are also three rules we will follow: 1) The Socratic Principle "to follow the truth where ever it leads you"; 2) Ockham's razor "that the best way forward is the simplest that deals with all of the facts"; and finally 3) The advice my PhD mentor Bill Flygare gave way back when "Mike, remember the molecule is always right". We will approach these subjects primarily using scientific data and methods but will also bring important philosophical and if time permits theological perspectives to bear. All 3 of the "origins" involve unique, one-of-a-kind events to initiate them followed by extraordinary evolutionary processes. We will comment both on the unique events and their consequences and how all are totally central to our understanding of who we are and perhaps involve implications of how we should respond. I will also note there is a hierarchy involved with the physical universe and its emergent properties providing the base of a pyramid; life forming the central part of the pyramid, dependent on but radically different than the inanimate universe; and finally at the top of the pyramid, human consciousness, dependent on the other two but transcendent in character extending beyond both the physical universe and simple life.

Emergent Properties Pyramid

HIST 36 Chemical receptors and transduction events on the mammalian tongue

Sidney Simon*, sas@neuro.duke.edu. Department of Neurobiology, Duke University, Durham, North Carolina, United States*

Being omnivores, humans eat a wide variety of foods. Historically, it was thought there are only four primary tastes salt, acid, sweet and bitter and that sweet is perceived on the front of the tongue and bitter on the back. I will show that both these ideas need to be revised. Foods are composed of many types of chemicals including, ions , acids, saccharides, peptides alkaloids , fats, polymers , proteins as well as other organic and inorganic molecules that the body may need or want. Placing such molecules on the tongue can produce salty (NaCl), sweet (sucrose) , bitter (quinine) and even burning (capsaicin) sensations. I will identify the receptors and

subsequent pathways in taste cells on the tongue including for the above mentioned chemicals. This information will yield the coding logic at the periphery. An important event in my taste research occurred when Dr. Jeff Seeman, who was then at Philip Morris, contacted me and asked me if the bitter tasting alkaloid, nicotine, had a unique taste in the sense that it would be different from other alkaloids, such as qunine. I told him I do not know how to do this since I was a biophysicist who never did behavioral work nor any work in the brain. What was so memorable, and life changing, is that Jeff said to me , " We think you will be able to figure it out.". Several years later we did and found that nicotine can be distinguished from quinine as I will describe.

HIST 37 Three evocative ideas: The Matthew effect, post mature contributions and the role of the role model

***Harriet Zuckerman**, haz1@columbia.edu. Department of Sociology, Columbia University, New York, New York, United States*

Originating in sociological research, the "Matthew Effect," " Post Mature Discoveries," and "The Role of the Role Model," shed light successively on the allocation of credit in science, the somewhat disorderly development of scientific knowledge, and the down sides of being chosen as a role model in science and other domains.

HIST 38 Best of all possible worlds

***Robert Anderson**, rgwa2@cam.ac.uk. Chemical Heritage Foundation, Philadelphia, Pennsylvania, United States*

Is life a series of accidents, or is it a succession of carefully laid plans? To me, it has lain in-between these two extremes, but closer to the former than the latter. Chemistry always fascinated me - I think because of its taxonomic qualities. But then so did history. In England, the decision to specialize in the arts or sciences had to be made at the age of 14. If the sciences were chosen, then one could continue developing one's knowledge of the humanities. The converse was unlikely. I was determined to read chemistry at Oxford University, where the humanities flourish in England as nowhere else. So I undertook my required chemistry courses but slipped off to Nikolaus Pevsner's lectures on architectural history, A J P Taylor's series on Lord Beaverbrook, and Edmund Blunden's poetry talks. Perhaps more significant was my becoming a friend of the Ashmolean Museum. I stayed on in Oxford to carry out research for a D.Phil. in neutron scattering. All this came to an end in 1970: I wanted to interact with a wider circle than chemists alone, so I went to the Royal Scottish Museum in Edinburgh as curator of the history of chemistry and physics. That there was such a job was Accident Number 1. The second was a vacancy in the Chemistry Department of the Science Museum in London a few years later. Number 3 was that the headship of my first museum became available and I became Director of the National Museums of Scotland. Number 4 was the Directorship of the British Museum, until 2002. Chemistry never slipped out of my life, except that my fascination with the subject moved backwards to the 18th century. I published whenever I could find an odd moment to write. After leaving the British Museum I had a dream year at the Institute for Advanced Study at Princeton after which I went to Cambridge University as the fellow of a college. Shortly after I was made a board member of the Chemical Heritage Foundation and I now serve as its President. Other aspects of cultural life remain equally important. I cannot imagine being content without art and classical music. This abstract is being written at the close of a conference in Paris on science museums and scientific objects. While in Paris, I slipped down to visit the Chateau of

Fontainebleau for the first time. And just after I returned to Philadelphia, I was at the Kimmel Center listening to Haydn's Seven Last Words. For me, the Arts and Sciences are united in a very satisfactory way.

HIST 39 "Go for it": Words of wisdom from my fathers

***Lauren M. Shea**, lauren.shea@yahoo.com. Education, American University, Bethesda, Maryland, United States*

In pivotal moments in one's life, often times the path of least resistance can take you far. Other times, making that big leap in the opposite direction can take you further and teach you more. When your goals in life are to educate others, sometimes conversing with others is the best way to make important decisions. Dr. Jeff Seeman was one of those others in my life. This presentation will discuss how my life's educational goals were influenced by the support of those around me. We will explore an overview of my practical and empirical work regarding effective methodologies for developing the next generation of scientists and science educators. Additionally, the presentation will model impactful examples of my work that can be used for deeper science learning and meaningful academic communication in universities and industrial settings.

HIST 40 FDA history, drug inspection and compliance overview

***Brooke Higgins**, brooke.higgins@vt.edu. Food and Drug Administration, Richmond, Virginia, United States*

Products regulated by the Food and Drug Administration account for approximately 20-25% of all U.S. consumer spending. This lecture will focus on the history of the pharmaceutical regulations and provide insight into the inspection and compliance work currently performed by the agency. Examples will be provided based on the speaker's 15-year employment with the FDA, both as a pharmaceutical investigator and a compliance officer.

HIST 41 Emergence of molecular reaction dynamics

***Dudley R. Herschbach**, dherschbach@gmail.com. Chemistry and Chemical Biology, Harvard University, Cambridge, Massachusetts, United States*

Nowadays, chemical kinetics of gas phase and gas-surface reactions has access to intimate molecular dynamics of individual reactive collisions. Here I'll revisit some episodes from its infancy. About 60 years ago, only a few chemists were seeking means to observe molecular reaction dynamics. Some somber chemists dismissed the prospect of "single-collision" chemistry as "a lunatic fringe." My entry to the fringe came as a first-year graduate student in 1955 at Stanford, in a physics course. The professor, Walter Meyerhof, made a brief digression to mention Otto Stern's 1919 experiment using a molecular beam to test the Maxwell-Boltzmann velocity distribution. For me, it was love at first sight. Crossed beams ought to be an unequivocal way to confirm a reaction is elementary and to study directly its dynamical properties. My mentor, Harold Johnston, had imbued me with his passion for kinetics and a sense for historical imperative. From him I'd learned about the reactions of alkali atoms with halogen containing

molecules, explored in the 1920s by Michael Polanyi, who found some had unusually high yields of alkali halide products. In 1960, I was an assistant professor at Berkeley, with two students. We carried out crossed beam experiments with simple apparatus adequate for facile alkali reactions. The sought after dynamical bounty was attained, the first observation of angular and velocity distributions of reaction products. Moreover, we had the pleasure of showing the results to Otto Stern (1888-1969) himself; he had retired to Berkeley. Soon after, Michael Polanyi (1891-1976) also visited Berkeley. Much more was to come. Historical destiny is intriguing. E.g., Meyerhof had to emigrate in the Nazi era. Otherwise, very likely he would not have been in a Stanford classroom, captivating a susceptible student.

HIST 42 History of the American chemical laboratory manual

***William P. Palmer**, drspalmer@optusnet.com.au. Faculty of Education (SMEC), Curtin University of Technology, Brighton, Victoria, Australia*

It may not be realised in the United States that the American chemical laboratory manual is unique to the United States, certainly within the English-speaking world. This study will attempt to discover the chemical laboratory manual's history. Manuals are of two types (i) those in which students write the answers to questions posed in the manual in the manual itself. (ii) those in which students write the answers to questions posed in the manual in a separate blank notebook. Students from all countries record their practical work as this is seen as part of the training necessary to become a scientist. The usage of a printed text in which students record their results can only be found in America. It is the usage of this form of manual and its varieties that will be the focus of this study.

HIST 43 Victor Grignard (1871-1935) and Henry Gilman (1893-1986): Pioneers in organometallic chemistry

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The earliest organometallic compounds used in organic synthesis were the dialkylzinc and alkylzinc halide reagents discovered by Frankland at Marburg, and developed by the Russians Butlerov, Zaitsev and Vagner, at Kazan. In 1900, Victor Grignard discovered that using magnesium in place of the zinc provided a much less pyrophoric, easier to use organometallic nucleophile. Within ten years, the Grignard reagent had completely supplanted the earlier organozinc reagents, and assured Grignard of his Nobel Prize. American chemist Henry Gilman at Iowa State University expanded the reagents available to organic chemists by exploring the formation and reactivity of simple alkylmetal derivatives of most of the transition metals. In this presentation, the men behind the chemistry will be discussed, along with some of their early work.

HIST 44 Wolff-Kishner reduction: Biography, discovery and development

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

In a series of papers published between 1911 and 1914 in the *Zhurnal Russkogo Fiziko-Khimicheskogo Obshchestva [Jornal of the Russian Physical-Chemical Society]* by Russian chemist Nikolai Matveevich Kizhner (1867-1935), Professor of Organic Chemistry at the Tomsk Technological Institute in Siberia, described the base-promoted decomposition of aldehyde and ketone hydrazones with potassium hydroxide at high temperature. In 1912, a year after Kizhner's first report, German chemist Ludwig Wolff (1857-1919), Extraordinary Professor and head of the Department of of Analytical and Inorganic Chemistry at the Chemical Institute of the University of Jena, described a similar base-promoted decomposition of semicarbazones by heating with aqueous or alcoholic base in a single paper. A brief biographical view of the two protagonists, and how they resolved the priority dispute for discovery of the reaction will be presented, along with a brief discussion of the development of the modern versions of the reaction.

HIST 45 Development of Butlerov's Structural Theory, 1859-1862

***Carly S. Goedhart**, goedhacs@uwec.edu, **Dylan R. Rothbauer**, rothbad@uwec.edu, Sergei N. Raspel, David E. Lewis. Chemistry Department, UW-Eau Claire, Eau Claire, Wisconsin, United States*

In 1859, Aleksandr Mikhailovich Butlerov (1828-1886) had just returned to Kazan after spending a *komandirivka* (official study leave) in the laboratory of Charles Adolphe Wurtz (1817-1884) in Paris, where he became a member of the fledgling Société chimique de Paris. At this time, the young Scotsman, Archibald Scott Couper (1831-1892) had just developed his theory of chemical structure, so Butlerov was exposed to this new way of thinking at its inception. In 1859, he wrote a paper in which he declared that Couper had gone too far, and exceeded what the experimental facts would allow. However, his opinions changed after his return to Russia, and by 1862 he was a champion of structural theory, taking up Couper's mantle. The gradual shift of his opinion is revealed in two sets of lecture notes from his class in organic chemistry taken in 1859 by student Vladimir Markovnikov, and in 1862 by student Ivan Bukhvostov. Taken together with Butlerov's "Speyer paper" in the *Zeitschrift für Chemie* in 1861, these documents provide insights into Butlerov's transition from skeptic to protagonist. Our progress in transcribing and translating these notes will be discussed.

HIST 46 Mining of elements versus discovery, analysis, and separation of elements

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

The Mansfelder copper mines are unique in Europe regarding the diversity of elements contained in the copper ores. From historical point of view it is interesting to compare the dates of discovery and begin of actual mining of a certain element. The promptness or delay of recovery of elements upon its discovery depended on the availability of analytical methods and separation techniques which have been developed over the time in Inorganic-Analytical Institutes of Universities of Halle, Leipzig, Berlin, Göttingen, and other universities located near the Mansfeld

area. In the 18th centuries several mining schools were established in Germany, which impacted the progress of smelting and purification technologies of metals. The foundation of the Fresenius Institute in 1848 has been a milestone in the history of analytical chemistry and played a leading role in qualitative and quantitative analysis of elements occurring in nature.

HIST 47 August Michaelis: A pioneer of phosphorus chemistry

***Detlef Selent**, detlef.selent@catalysis.de. Leibniz Institute of Catalysis, Rostock, Germany*

After holding the first professorship in organic chemistry at the Technische Hochschule in Aachen from 1880 until 1890, August Michaelis changed to the University of Rostock to hold the chair of chemistry and pharmacy at the faculty of philosophy. In Rostock, he continued his research in phosphorus chemistry. Michaelis has conducted investigations on several classes of P-compounds, such as triarylphosphines and the respective N- and As analogues, mixed alkyl aryl phosphine oxides, primary phosphines, phosphorus halogen compounds, phosphorus trisamides, phosphonium salts, and others. He found that the reaction of phosphorus acid esters with alkyl halogenides does not lead to stable phosphonium compounds but to alkyl phosphinic acid derivatives after aqueous workup. A. E. Arbuzov showed this reaction, which is now known as the Michaelis Arbuzov rearrangement, to be a more general one. Michaelis also provided proof for the formula $HP(O)(OH)_2$ of phosphorous acid, thus explaining why the respective triesters are not available from the acid directly but from P(III) halogen compounds. For a collection of his compounds, he received a gold medal at the world exhibition in St. Louis, Louisiana, in 1904. Michaelis also served the University of Rostock as a president. He has been a dedicated chemistry teacher. From the 1870's on he delt with revising and publishing issues of the *Graham-Ottos Lehrbuch der Anorganischen Chemie* (F. Vieweg und Sohn, Braunschweig). Michaelis received the Cothenius medal from the Leopoldinisch-Carolinische Akademie der Naturforscher (Leopoldina) and was nominated Geheimer Hofrat in 1913 because of his merits. Michaelis died in 1916. In 1941, Paul Walden named him 'a big one' of classical chemistry. Nowadays, phosphorus chemistry plays an important role at the University of Rostock. With regard to Michaelis, phosphaaza compounds which still offer interesting challenges and surprises are investigated at the Department of Chemistry. At the Leibniz-Institute of Catalysis, P(III) and P(V) compounds are synthesized and tested with respect to their applicability for catalytic transformations. The Leibniz Science Campus 'Phosphorus Research' has been established, which is dedicated to the facets of phosphorus utilization in daily life. It is worth mentioning, that the famous triphenylphosphine is still prepared today from chlorobenzene, phosphorus trichloride and sodium, a synthetic procedure developed by Michaelis more than 100 years ago.

HIST 48 Markovnikov on isomerism in organic chemistry

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

Vladimir Vasil'evich Markovnikov (1838-1904) was one of only a few Russian organic chemists of the 19th century who achieved international stature during their lives. As a student in economics at Kazan University, Markovnikov studied organic chemistry under the great Aleksandr Mikhailovich Butlerov (1828-1886) at the time when Butlerov was beginning to develop his version of the structural theory of organic chemistry. The reason for Markovnikov being in a chemistry class at all stems from the decision by Russia to adopt the German cameral system; this meant that all students intending a career in government service were required to take two

years of chemistry (we could certainly use that requirement these days!). Markovnikov's dissertation for the *Magistr Khimii* degree, "Ob izomerii organicheskikh soedinenii [Concerning the isomerism of organic compounds]," was submitted to Kazan University in 1865. In it, Markovnikov discusses the concept of isomerism in organic chemistry; the discussion reveals the incredibly logical mind of its author, and reveals Markovnikov as a genuine genius. This dissertation, which has never appeared in complete form in any language but Russian, contains ideas that were decades ahead of their time.


Markovnikov

Butlerov

HIST 49 Mutual influence of atoms in chemical compounds—Markovnikov's Rule

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

In 1869, Vladimir Vasil'evich Markovnikov (1838-1904) submitted his dissertation for the degree of *Doktor Khimii* to Kazan University. This dissertation, whose title appears above, took the unprecedented step of using structural theory as developed by Markovnikov's mentor, Aleksandr Mikhailovich Butlerov (1828-1886) to predict not only the structures of compounds, but also the regiochemistry of their reactions. In other words, Markovnikov took a theory that had up to then been concerned with static molecular structure, and made it applicable to dynamic organic reactions. During this work, Markovnikov found strong evidence that the alkene unsaturation was due to "free affinities" on adjacent carbon atoms. He also formulated his rule for addition to alkenes. This dissertation has never appeared in full in any language but Russian, so, as with his *Magistr Khimii* dissertation, many of the pioneering conclusions remained unknown until their rediscovery decades later.