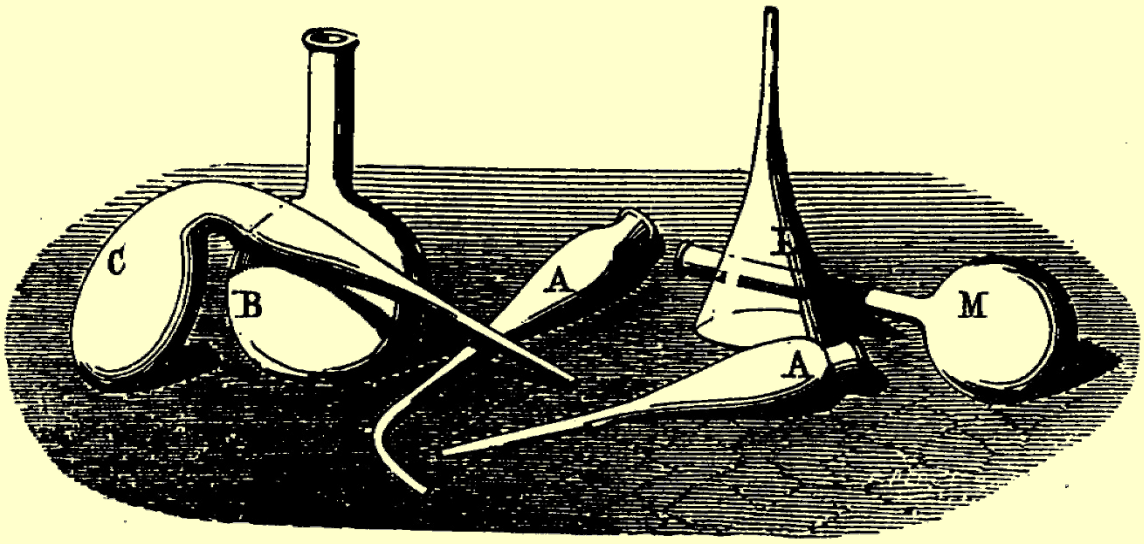
American Chemical Society

DIVISION OF THE HISTORY OF CHEMISTRY



PROGRAM & ABSTRACTS

Spring 2023 ACS National Meeting
Indianapolis, IN (Hybrid)
March 26-30, 2023

Nicolay V. Tsarevsky, Program Chair

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HIST Programming

Message from the HIST Program Chair

Dear HIST members, friends, and supporters, welcome to the spring 2023 ACS National Meeting and to Indianapolis! I hope you will take full advantage of as many learning and networking opportunities as you can during the meeting, and I invite you to join us and enjoy any or all of the over fifty oral and poster presentations we will offer as part of our busy four-day technical program. Yes, I am delighted to report that after some pandemic-related slowing-down of activities, we are back again and ready to move full steam. This time, our technical sessions will take place in the Convention Center, which we hope will make it easier for everyone to find and visit us. We will start bright and early on Sunday with a symposium, organized by Gary Patterson, on the HIST centennial. You will have the chance to learn about the history, the tortuous road, and the successes of what I hope is your favorite division. You will hear about the people involved in the activities that made and continues to make HIST attractive to chemists and chemical educators of all stripes. Sunday afternoon will be dedicated to the 1993 ACS president, Helen Free, and her multifaceted contributions to the Society and the profession. The symposium is organized by Jan Hayes. We will continue on Monday morning with a tutorial on the various methods for conducting historical research, which is organized by the former HIST program chair and division chair, Seth Rasmussen. This will be a full-day event and will conclude with a panel discussion. On Monday (and also Tuesday) evening, do pay a visit to our poster presenters and the HIST table at Division Row. As always, we would be happy to meet with you in an informal atmosphere, and exchange ideas on how to make the division more interesting and useful to you. Tuesday (the entire day) will feature the symposium organized by Mary Virginia Orna and Gregory Smith on science in support of technical art history. There will be talks related to artists' materials, analytical techniques, education, and much more. Being aware that everyone likes art, we are equally convinced you will be fascinated by the lectures offered. However, we will not be done yet! We will have a full and busy day on Wednesday when talks will be delivered that cover much of the history of chemistry-themed spectrum. As you can justifiably expect, our general papers will include talks on the development of methods and techniques used by chemists, as well as on some eminent chemists and educators, and the places where they worked. Whatever your favorite flavor of chemistry or history is, you will find relevant and exiting talks to attend.

I use this space to welcome a new member of the HIST Executive committee, my dear friend and colleague Christine Hahn who, along with Mihaela Stefan, will be helping me with future programming. Christine brings not only great ideas and enthusiasm to the division but also experience. She has already co-organized two successful ACS Southwest Regional Meeting history of chemistry

symposia and has also been instrumental in attracting undergraduate students to HIST. There is hardly any need to state that we appreciate such efforts, for we are beyond thrilled to have student attendees and especially presenters at our events.

As we prepare for activities that will materialize in the fall and beyond, I invite you to share ideas about topics of interest for future HIST symposia. Perhaps you are interested in organizing a symposium? Talk to us and we'll enthusiastically provide all the help you need. If you are interested in ACS activities at the regional or local level, you can help HIST attain better visibility and appreciation by your community by organizing symposia in the history of chemistry at regional meetings. This provides excellent opportunities to create a strong intellectual network within your community, often with individuals who for may be unable to attend the larger national meetings. I assure you, HIST can and will support such endeavors. In addition, if you are organizing an event, please let us know and we will advertise it on the pages of the Newsletter and the HIST website. As ever, all of us would love to hear from you.

I close by wishing you a productive and fun meeting. Be well!

Nick Tsarevsky, *HIST Program Chair*

HIST SYMPOSIA, Spring 2023 ACS National Meeting (March 26-30, 2023)

Schedules and abstracts are listed at the end of this Newsletter.

UPCOMING MEETINGS AND HIST DEADLINES

Subject to change. Check the HIST website (http://www.scs.illinois.edu/~mainzv/HIST/) for updates.

Fall 2023 ACS National Meeting (San Francisco, CA, August 13-17, 2023)

HIST Award Symposium (Invited) Anne Johnson, Faculty of Science, Toronto Metropolitan University, Toronto, ON, Canada, email: anne.johnson@ryerson.ca

History of Organometallic Chemistry (Invited and contributed) Christine Hahn, Department of Chemistry, Texas A&M University-Kingsville, email: Christine.Hahn@tamuk.edu.

History of Energy and Fuels: Opportunities and Challenges (Co-organized by HIST and ENFL; Invited and contributed) Joe Jeffers, Ouachita Baptist University, email: jeffers@obu.edu; J. Louise Liu, Texas A&M University Energy Institute & Texas A&M University-Kingsville, email: jingbo.liu@tamuk.edu.

Tutorial and General Papers (Seeking contributions) Nicolay V. Tsarevsky, Department of Chemistry, Southern Methodist University, Dallas, TX 75275, Phone: 214-768-3259, email: nvt@smu.edu

2023 Southwest Regional Meeting (SWRM) of the ACS, Oklahoma City, OK, November 15-18, 2023

Lessons and Inspiration from the History of Chemistry (Invited and contributed) Nicolay V. Tsarevsky, Department of Chemistry, Southern Methodist University, Dallas, TX 75275, Phone: 214-768-3259, email: nvt@smu.edu; Christine Hahn, Department of Chemistry, Texas A&M University Kingsville, email: Christine.Hahn@tamuk.edu.

Spring 2024 ACS National Meeting (New Orleans, LA, March 17-21, 2024)

The Birth of the 3rd Dimension in Chemistry (Invited and seeking contributions) Arthur Greenberg, Department of Chemistry, University of New Hampshire, Durham, New Hampshire 03824, Phone: 603-862-1180, email: art.greenberg@unh.edu; David E. Lewis, Department of Chemistry and Biochemistry, UW-Eau Claire, Eau Claire, WI 54702, Phone: 715-836-4744, email: lewisd@uwec.edu

Tutorial and General Papers (Seeking contributions) Nicolay V. Tsarevsky, Department of Chemistry, Southern Methodist University, Dallas, TX 75275, Phone: 214-768-3259, email: nvt@smu.edu

Fall 2024 ACS National Meeting (Denver, CO, August 18-22, 2024)

HIST Award Symposium (Invited) TBA

History of Forensic Chemistry (Invited and contributed) Nicolay V. Tsarevsky, Department of Chemistry, Southern Methodist University, Dallas, TX 75275, Phone: 214-768-3259, email: nvt@smu.edu

150th Anniversary of the Priestley House (Invited and contributed) Roger Egolf, Department of Chemistry, Pennsylvania State University - Lehigh Valley, Center Valley, PA 18034, Phone: 610-285-5110, Email: rae4@psu.edu

Tutorial and General Papers (Seeking contributions) Nicolay V. Tsarevsky, Department of Chemistry, Southern Methodist University, Dallas, TX 75275, Phone: 214-768-3259, email: nvt@smu.edu

Final Program

DIVISION OF THE HISTORY OF CHEMISTRY (HIST)

N. V. Tsarevsky, *Program Chair*

Sunday, March 26, 2023: Morning session

Location: Indiana Convention Center, Room 122

HIST Anniversary

G. D. Patterson, *Organizer, Presiding*

8:00 Centennial history of HIST. **G.D. Patterson**

8:25 Charles Albert Browne, Jr.: Co-founder of the division of the history of chemistry. **R.A. Egolf**

8:50 Historians of HIST. **G.D. Patterson**

9:15 HIST's sixty years of sponsored publications. **M. V. Orna**

9:40 Intermission

9:55 HIST's journal: The bulletin for the history of chemistry. **C.J. Giunta**

10:20 William Barry Jensen: Founder of the *Bulletin for the History of Chemistry*. **G.D. Patterson**

10:45 Treasures from the HIST archives. **G.D. Patterson**

Sunday, March 26, 2023: Afternoon session

Location: Indiana Convention Center, Room 122

Memories of Helen Free: Innovator, Leader, Humanitarian

Cosponsored by CPRC and SCC

J. Hayes, *Organizer, Presiding*

2:00 Introductory Remarks.

2:10 Helen Free: A doer. **V.J. Kuck**

2:30 Dr. Helen Free: Role model and trailblazer. **D.J. Phillips**

2:55 Tough act to follow: Helen Murray Free (ACS President 1993) as viewed by her successor. **N.D. Heindel**

3:20 Remembering Helen Free. **J.M. Sophos**

3:45 Intermission

3:55 Helen Free: Scientist, leader, humanitarian, and friend. **E.A. Nalley**

4:20 Helen M. Free Award for Public Outreach: Recognizing innovative volunteers. **K.A. Thrush Shaginaw**

4:40 Guardian angels, mentors and passion. **F.K. Wood-Black**

5:05 Science cafes, STEM journeys, and science in your swimsuit, oh my! **J.L. Maclachlan**

5:25 Recipient of the 2022 Helen M. Free Award for Public Outreach: Sharing my evolution of over 20 years of community outreach at the Helen Free Symposium. **K. Hilton**

5:45 Discussion

Sunday, March 26, 2023: Evening

Location: Indiana Convention Center, Room 137

05:30-7:30 pm HIST Executive Committee meeting

Monday, March 27, 2023: Morning session

Location: Indiana Convention Center, Room 122

Workshop on Traditional Research Methods in History

S. C. Rasmussen, *Organizer, Presiding*

8:00 Introductory Remarks.

8:05 Finding and framing a historical question. **P.J. Ramberg**

9:00 Finding historical primary sources. **E. Hepler-Smith**

9:55 Intermission

10:10 For historians, the "secondary literature" is primary: A user guide for chemists. **A.J. Rocke**

11:05 Surveying the current state of historical research on chemical sciences. **M. Bowden**

Insulin: 100 Years of Life Saving Science and Technology

Sponsored by MEDI, Cosponsored by HIST

Monday, March 27, 2023: Afternoon session

Location: Indiana Convention Center, Room 122

Workshop on Traditional Research Methods in History

S. C. Rasmussen, *Organizer, Presiding*

2:00 Creating primary sources for historical study: Oral history and capturing the unwritten record. **D. Caruso**

2:55 . Putting the chemical text into political and social context. **M. Gordin**

3:50 Intermission.

4:10 . Hidden figures in the history of chemical sciences: Why write their history and how? **B. Van Tiggelen**

5:05 Panel Discussion

Monday, March 27, 2023: Evening

Location: Indiana Convention Center, Hall F-H

HIST Sci-Mix (Poster Session)

8:00 – 10:00 pm

HIST's journal: The bulletin for the history of chemistry. **C.J. Giunta**

Investigating carbon-based black pigments with a nonlinear microscopy technique. **H. Kastenholz**, M. Topper, D. Grass, M.C. Fischer, W.S. Warren

Analysis of organic dyes on historical textiles in a museum setting by liquid chromatography with detection by diode array and mass spectrometry (LC-DAD-MS).. **V.J. Chen**, G.D. Smith

Why did Linus Pauling publish only one paper on the theory of strong electrolytes? **J.J. Spitzer**

Betty Wood: Scientist and educator at Bell Labs and beyond. **M.E. Schott**

Barry Shapiro's NMR newletters from 1958 to 2001: The story of NMR in 516 volumes. **C. Anklin**

Tuesday, March 28, 2023: Morning session

Location: Indiana Convention Center, Room 122

Science in Support of Technical Art History

M. V. Orna, *Organizer*
G. D. Smith, *Organizer, Presiding*

8:00 Introductory Remarks.

8:05 Microspectroscopy in art conservation and archaeology: Early applications from the MML. **P.A. Smith**, P.L. Lang

8:30 Exploring cultural heritage with portable MRI. **B. Bluemich**

8:55 Hearthstone project: Combining formal art analysis & analytical chemistry. **K.L. Steelman**, C.E. Boyd

9:20 Chemical connoisseurship: How scientific techniques help us better understand the age-old questions of attribution. **R. Sperber**, **G.D. Smith**

9:45 Intermission.

10:00 Spectroscopic investigation and dating of a painted wooden Cristo crucificado sculpture. **A.C. Bowman**, S. Ries, A. Larkspur

10:25 Hand-painted magic lantern glass slides: Influence of the light source and materials on the projected images. **M.G. Vilarigues**, Â. Santos, C. Machado, V. Otero

10:50 Role of archival recipes in interpreting the chemistry of early Meissen porcelain technology. **N. Zumbulyadis**, E.S. Uffelman, R. Fuchs

11:15 Hidden secrets in 18^{th}-to-20^{th} century glassmaking: The contribution of science for the past and the present of the Portuguese historical glasses. **C. Santos**, I. Coutinho, A. Carneiro

Tuesday, March 28, 2023: Afternoon session

Location: Indiana Convention Center, Room 122

Science in Support of Technical Art History

M. V. Orna, *Organizer*
G. D. Smith, *Organizer, Presiding*

2:00 Introductory Remarks.

2:05 Pigments: Poster children of technical art history. **M. V. Orna**

2:30 Bluer than blue: Defining Pliny's Egyptian blues. **H. Becker**, G.D. Smith

2:55 Analysis of organic dyes on historical textiles in a museum setting by liquid chromatography with detection by diode array and mass spectrometry (LC-DAD-MS). **V.J. Chen**, G.D. Smith

3:20 Investigating carbon-based black pigments with a nonlinear microscopy technique. **H. Kastenholz**, M. Topper, D. Grass, M.C. Fischer, W.S. Warren

3:45 Intermission.

4:00 Winsor & Newton's 19th-century manufacturing processes: How science unveils the artists' colorman choices. **V. Otero**, T. Veiga, M. Vilarigues, M.J. Melo

4:25 Technical art history and the chromatic history of Portuguese *azulejos*: The case of yellow. **U. Veronesi**, S. Coentro, M. Bandiera, M. Vilarigues, A. Ruivo, M. Manso

4:50 Teaching at the crossroads of chemistry and art: Using interdisciplinary activities to increase student engagement in a non-majors course on the chemistry of art. **S.E. Hubbard**

5:15 Unraveling the creative process of an artist through a non-invasive multianalytical study. **E. Del Federico**, A. Yong, A. Jerschow, L. Banner, R. Miracco

Tuesday, March 28, 2023: Evening

Location: Indiana Convention Center, Hall F-H

Poster Session

7:00 – 9:00 pm

Barry Shapiro's NMR newletters from 1958 to 2001: The story of NMR in 516 volumes. **C. Anklin**

Wednesday, March 29, 2023: Morning session

Location: Indiana Convention Center, Room 122

General Papers and Tutorial

N. V. Tsarevsky, *Organizer, Presiding*

M. C. Stefan, *Presiding*

8:00 Paper and papermaking: Expansion of the chemical technology from China to worldwide use in the modern era. **K.L. Konkol**

8:30 Withdrawn

9:00 . Science communication: Wit and humor have a dramatic impact. **M. Chorghade**

9:30 Milestones in the history of colorimetry. **N.V. Tsarevsky**

10:00 Intermission.

10:20 Legendary rivalry between Sir Christopher Ingold and Sir Robert Robinson. **M.C. Stefan**, M.C. Biewer

10:50 Carl Schorlemmer: Co-founder of organic chemistry and contributor to the history of chemistry. **C. Hahn**

11:20 Chemistry lectures (ca 1785-7) by the Reverend William Broadbent: A manuscript in shorthand. **A. Greenberg**

Wednesday, March 29, 2023: Afternoon session

Location: Indiana Convention Center, Room 122

General Papers and Tutorial

N. V. Tsarevsky, *Organizer, Presiding*

M. C. Stefan, *Presiding*

2:00 Justus von Liebig (1803-1873) and Russia's first organic chemists. **D.E. Lewis**

2:30 Sergiy Mikolayovich Reformats'kii (Sergei Nikolaevich Reformatskii, 1860-1934): A founding father of Ukranian organic chemistry. **D.E. Lewis**

3:00 Betty Wood: Scientist and educator at Bell Labs and beyond. **M.E. Schott**

3:30 Alfred Bernhard Nobel: The man, prizes and the element. **K. Kostecka**

4:00 Intermission

4:20 Why did Linus Pauling publish only one paper on the theory of strong electrolytes? **J.J. Spitzer**

4:50 Is there a place for the periodic table as chemistry embraces multi-disciplinary science and quantum field theory? **J.O. Roberts**

5:20 Adeline De Sale Link (1892-1943): Chemist, communicator, and chemistry manual author. **W. Palmer**

ABSTRACTS

PAPER 3801504

Centennial history of HIST

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

The Division of the History of Chemistry was founded as a Section more than 100 years ago, in 1922. Since then, it has grown, both in numbers and in strength. Today it is an international force in the History of Chemistry community. Members of HIST contribute to all the international subcommunities in this scholarly world. To celebrate this achievement, HIST is assembling a Centennial History of HIST. It is instantiated as a link on the HIST website. This talk will give an overview of the project as it stands at the time of the Indianapolis ACS Meeting. The American Chemical Society was founded with history in its blood. Henry Carrington Bolton and Benjamin Silliman Jr. kept the history of American chemistry very visible to the assembled chemists at Northumberland. John Draper, the 1st President of the American Chemical Society was known as much for his work as a historian as for his academic chemistry. Edgar Fahs Smith, one of the founders of HIST, was President of the ACS, both in 1895 and in 1921 and 1922. Ned Heindel, one of the pillars of HIST, was ACS President in 1994. In addition to chronicling the history of HIST, the goal of the project is to help keep HIST at the center of the ACS.

PAPER 3823193

Charles Albert Browne, Jr.: Co-founder of the division of the history of chemistry

Roger A. Egolf*, rae4@psu.edu.* Department of Chemistry, Pennsylvania State University, Center Valley, Pennsylvania, United States

This paper will describe the life and career of Charles A. Browne Jr., a renowned sugar chemist and a one-time head of the Bureau of Chemistry of the US Department of Agriculture (forerunner of the Food and Drug Administration). The idea of an ACS Division of the History of Chemistry stemmed from a conversation between Browne and Edgar Fahs Smith when they were taking a break from attending papers at a national ACS meeting held at Northwestern University in the fall of 1920. Browne also wrote a book entitled “75 Eventful Years: A History of the American Chemical Society.” This paper will describe the contents of that book, which is a valuable resource for anyone interested in the history of the Society.

PAPER 3803291

Historians of HIST

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

While many of the members of the Division of the History of Chemistry qualify as chemical historians, this talk will focus on only ten of them. They include: Charles A. Browne, Henry M. Leicester, Mary Elvira Weeks, Wyndham Miles, Aaron Ihde, Anthony Travis, Sidney Edelstein, Ralph Oesper, Mary Virginia Orna and George B. Kauffman. The emphasis will be on their impact on the field of the history of the chemical sciences and their publications. Their influence on HIST itself will also be discussed.

PAPER 3804494

HIST's sixty years of sponsored publications

Mary Virginia Orna*, maryvirginiaorna@gmail.com.* ChemSource, Inc., Mount Vernon, New York, United States

For sixty years, the Division of the History of Chemistry (HIST) has sponsored publications of history-related volumes drawn for the most part from symposia that were presented at American Chemical Society (ACS) meetings. The origin of each volume depended upon individuals who organized symposia, or in some cases, proposed book volumes. It has been the practice of the Division to provide some financial support for these ventures; many organizers were able to obtain additional support from various types of grants and contributions. Generally, the editor of the volume was also the organizer of the event. Except for the Archaeological Chemistry volumes, there were no set series or themes over the years, but the volumes fell almost naturally into six categories: archaeological chemistry (9 volumes), thematic biographical collections (6 volumes), anniversaries and landmarks (8 volumes), entertainment and diversion (4 volumes), subdisciplines (8 volumes) and places (2 volumes). It is hoped that this catalogue of HIST publications will whet your appetite for a more complete read of some of these volumes. Many of them are unique in their content and execution. This is a body of literature that deserves to be better known as a font of information for the curious and a source of reference for the scholar.

PAPER 3828844

HIST's journal: The bulletin for the history of chemistry

Carmen J. Giunta*, giunta@lemoyne.edu.* Department of Chemistry, Le Moyne College, Syracuse, New York, United States

The *Bulletin for the History of Chemistry* is the journal of the ACS Division of the History of Chemistry. It began publication in Spring 1988, intended as an outlet for chemists interested in the history of their discipline as the *Journal of Chemical Education* decreased the number of historical papers in its pages. William B. Jensen at the University of Cincinnati was the founding editor, serving in that post through numbers 13/14 in 1992-1993. Paul R. Jones, then at the University of Michigan, succeeded Jensen as editor from numbers 15/16 in 1994 through the two issues of volume 35 in 2010. The current editor, Carmen J. Giunta at Le Moyne College, followed Jones from volume 36 in 2011 to date. The presentation will discuss the origins of the journal and some highlights from its 35 years, concentrating on the Jensen and Jones years.

PAPER 3802926

William Barry Jensen: Founder of the *Bulletin for the History of Chemistry*

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

Bill Jensen has served HIST in many ways over the 40 years of his membership. He was the Secretary-Treasurer from 1986-1989 and Chair during 1990-1991. But, perhaps his greatest service to HIST was his founding of the *Bulletin for the History of Chemistry* in 1988. He served as Editor from 1988-1995. He has published extensively in this journal and won the Outstanding Paper Award in 2011. Jensen was the Edelstein Awardee in 2005 for his voluminous contributions to the history of chemistry, especially the history of chemical education. This talk will chronicle his development as a chemical historian, his major publications in the history of chemistry, and his permanent influence on the field.

PAPER 3807228

Treasures from the HIST archives

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

Over the last century many permanent records have been collected by the Division of the History of Chemistry. After many years of informal collecting, the Chemical Heritage Foundation agreed to house these archives. James J. Bohning (1934-2011) was the official Archivist of HIST and both organized and curated the collection. Upon his demise, John Sharkey became the Archivist and produced the current detailed Finding Guide. One of the treasures of this

collection is a set of philatelic Cachets honoring ACS Presidents. Many ephemera of this sort are only found in this archive. There is extensive documentation on winners of HIST Awards. Programs and printed versions of papers presented at HIST meetings are catalogued. Box 17 is an especially rich collection of documents associated with HIST and the Chemical Heritage Foundation. In addition to an official Affiliation with the Heritage Council at the CHF, HIST was a moving force in the Bolton Society, the worldwide community of chemical bibliophiles. A set of booklets associated with the National Historical Chemical Landmarks Program is held in box 20. HIST has been a major part of this program. Many documents are associated with HIST in box 37 that are important for the history of HIST and the ACS, but are not likely found archived anywhere else. Anyone desiring to explore the rich history of HIST would be advised to visit the now Science History Institute in Philadelphia. The finding guide is now posted on the HIST website.

PAPER 3820863

Finding and framing a historical question

Peter J. Ramberg*, ramberg@truman.edu.* Department of Chemistry, Truman State University, Kirksville, Missouri, United States

A critical component of the historian's toolbox is the ability to identify, refine and frame a proper historical question that can be answered with available sources. In this portion of the workshop, I will outline what constitutes good historical questions, and the thought processes historians use to create them. Most historical studies begin with a simple question that requires research-identifying and examining closely primary, secondary, and tertiary sources–that in turn extensively refines and changes the question. The resulting historical work then makes claims about the past by answering this question using the sources. To illustrate this process, I will use some specific examples drawn from the history of chemistry and apply the "five Cs" of historical thinking, published in 2007 in the American Historical Association's publication *Perspectives*: change, context, causality, contingency and complexity. By the end of the workshop, I hope that participants will understand more clearly the difference between a "literature review" of old journal articles and a "historical/philosophical analysis" of a specific episode in history of chemistry.

PAPER 3817091

Finding historical primary sources

Evan Hepler-Smith*, evan.heplersmith@duke.edu.* Department of History, Duke University, Durham, North Carolina, United States

Primary sources are the foundation of historical scholarship. In most cases, the novelty of a new historical argument rests on examination of primary sources not considered by previous scholars, re-readings of primary sources yielding new evidence or interpretations, or juxtaposition of primary sources not previously considered alongside one another. But how do you find appropriate primary sources for the history of chemistry in the first place? And how do

you pick and choose among the sources you find? The increasing ease of digital access to myriad published and unpublished historical materials raises anew a challenge that has always plagued historical scholarship: too many sources, too little time. This talk will focus on three general techniques for finding relevant sources in all manner of repositories, physical or digital: following citations, browsing collections, and searching for individuals and topics of interest. You may notice that these are not only key skills for historians but also, frequently, part of the day-to-day work of chemists navigating the voluminous literature of their own professional fields. As two editors-in-chief of *Chemical Abstracts* wrote in 1927, “the literature of chemistry is like a great, inspiring mountain with a core of rich ore,” for chemists and historians of chemistry alike. Drawing lessons from my own research on the history of chemical information professionals and chemical reference literature, I will discuss how chemist-historians can capitalize on their professional familiarity with chemical literature searching to find historical primary sources, both within the professional literature of chemistry and beyond it. This presentation will include a workshop component in which participants can practice approaches to finding historical primary sources that we discuss (internet-enabled device required).

PAPER 3817519

For historians, the "secondary literature" is primary: A user guide for chemists

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

To academically educated professional historians, a full accommodation and acknowledgment of the existing secondary literature is an integral part of every historical investigation; in the sciences, this mandate is analogous to conducting a meticulous literature review as a required element of every research plan. However, chemists who pursue the history of their discipline may not always know the best methods and sources to master this body of literature in the field of history of science. The speaker will argue for the wider historiographical place of the secondary literature in historical methodology, and make specific recommendations for some of most useful and trustworthy methods and databases for historians of science.

PAPER 3823208

Surveying the current state of historical research on chemical sciences

***Mary Ellen Bowden**, mebowden1@verizon.net.* Science History Institute, Philadelphia, Pennsylvania, United States

As in chemical research so in historical research a potential author is expected to contribute to knowledge by discovering new material and making interpretations of new and old content. Surveying what has alresdy been written about a topic and evaluating claims made by earlier scholars reduces the possibility of presenting as novel that which has already been discovered--an overlap deaerving at least an endnote acknowledging the earlier work. Reading secondary sources also provides an opportunity to mine endnotes and bibliographies for references that have escaped the notice of a researcher new to a topic. How to find recent literature in history of

science? There are several important bibliographies online such as the *Isis Cumulative Bibliography* with its tool *Isis CB Explore* and the *History of Science, Technology, and Medicine Database.* Using *Google* or *Google Scholar* at some point in research can be beneficial, but one needs a good ear to separate wheat from chaff. *Wikipedia* tends to be more reliable in this regard since many of its articles are written and critiqued by professional historians. One should also consult printed compilations or *surveys*--the more recent, the better, e.g., *A Cultural History of Chemistry* (6 vols.; Bloomsbury, 2022). What about the great reference works of the past like Partington's *History of Chemistry* (6 vols.,; Macmillan, 1961-70) and the *Dictionary of Scientific Biography* (18 vols.; Scribner's, 1970-80), the *New Dictionary of Scientific Biography* (8 vols.; Scribner's, 2007), and the *Complete Dictionary of Scientific Biography* (26 vols.; Gale eBook, 2008). These weighty tomes may in fact carry outdated views, e.g., on Pasteur. Here and elsewhere in the research process consulting with appropriate members of HIST and the History of Science Society's Forum for the History of Chemistry may prove invaluable.

PAPER 3818394

Creating primary sources for historical study: Oral history and capturing the unwritten record

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Science, at its core, is a human endeavor. Many historians rely on scientific publications to understand specific components of scientific knowledge production and how that information is communicated to the broader scientific community, but there is much more to science than what is contained in journal articles. Science is about decisions made, funding opportunities available, collaboration with colleagues, insight, innovation, and the confluence of years of work, study, reflection, and expertise. These latter facets of science are ones not often captured in traditional publications, so the human component of scientific discovery is often lost to the annals of history. Using the oral history methodology—in-depth interviewing captured through audio and/or video recordings and then transcribed and archived—elucidates these un-written aspects of the pursuit of new knowledge about the natural world. Participants in this symposium will be introduced both to oral history as a methodology and to the products of that research, learning what oral history offers for preserving the modern history of science and how those materials can be used to understand the life of a scientist and the scientific life. While this part of the symposium will not be offering training in oral history per se, it will provide attendees a broad understanding of the methodology and its practices and offer resources for further inquiry. Additionally, they will have a better sense of the role of oral history in complementing the traditional written historical record of science and its practices, and oral history’s importance in allowing historians to write deeper studies scientific practitioners and the work that they do.

PAPER 3821844

Putting the chemical text into political and social context

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History of chemistry is not simply a chronicle of a series of discoveries of truthful knowledge, or even a list of knowledge claims whether they ended up being validated as correct or discarded as erroneous by later researchers. Rather, the task of the historian of chemistry is to set those various chemical researches and writings into "context," explaining how the events of the past made sense on their own terms. This is not simply a matter of biographical material — although that is essential — but it extends to the social and political worlds in which chemists of the past operated. Even though that is easily said, and constitutes the basic practice of historians of chemistry working today, it is less obvious precisely *how* one goes about researching "context." Chemists are trained to plumb the scientific literature, trace back footnotes, and interpret ambiguous or tangled chemical reasoning, but they are not trained to find secondary literature about Prussian patent law, or changing agricultural practices for indigo, or the history of the Cold War visa regime and how it might have impacted transnational collaborations. This presentation will discuss the importance of political and social context, how it can illuminate questions and research programs in the history of chemistry, and which techniques are effective in orienting practicing chemists toward the available literatures.

PAPER 3824503

Hidden figures in the history of chemical sciences: Why write their history and how?

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The acclaimed movie *Hidden Figures* celebrates African-American women who were "human computers." It is the story of their struggle to be acknowledged for their role in sending men into Space during a time of intense competition with the Soviet Union. Before it hit the box office though the story was published as a book based on extensive research. Hidden Figures can and should be retrieved from all corners of the history of science and technology. This presentation will focus on the why and the how of the work of recapturing overlooked contributions and contributors in the history of the chemical sciences. We will investigate little-known figures and what we can learn from them about how the development of science is usually conveyed. This presentation will also consider how historical accounts may end up defining what science is and how scientific research works, especially in the teaching environment. We will examine the ways these stories can be found and recovered, paying particular attention to how those stories are narrated, and how historical material is located and used when there is little available documentation. The talk will alternate between short presentations of cases, and active engagement from the audience.

PAPER 3822165

Helen Free: A doer

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While I was a member of the ACS Women Chemists Committee (WCC), Helen Free was appointed to the Committee. This was at a time, the late 1970's, when very few women were chosen to receive an ACS national award other than the Garvan Medal. In response to this dire situation, the WCC had decided to focus its efforts on writing motions for the ACS Council demanding a change in the selection process for awards. The sole activity of the Committee was in drafting these motions and then endlessly editing them. There were numerous discussions on grammar and correct word usuage. I can tell you from the facial discussions on Helen and the mumbling of Mary Goode, who had joined the Committee at the same time as Helen, they were not pleased with those discussions. Looking back, I do not remember the Committee ever identifying ways that the WCC could impact the award selction process other than writing these motions. The frustration on the WCC continued to grow and in a few years, the WCC was actively proposing that the identification of the Garvan Medal awardee be stopped. After attending two meetings on generating motions, it was not surprising that both ladies simultaneously left the WCC. Several years latter Mary was elected ACS President and was followed a few years later by Helen. Both Helen and Mary were doers and just talking and complaining was not their thing. Helen went on to strengthed the ACS's outreach to children and significantly increased its interactions with the general public. Over the years I had many interactions with Helen and in this presentation I will discuss some of them.

PAPER 3821405

Dr. Helen Free: Role model and trailblazer

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Dr Helen Free served as the American Chemical Society (ACS) president when I was becoming aware of the difference between an ACS member and an ACS volunteer. I will speak of the role Dr. Free had in my leadership development in ACS governance. Only two other women (Anna J. Harrison and Mary L. Good) has served as ACS president prior to Dr. Free; thus, I was impressed that the Society had elected her, an industrial chemist, an inventor and a community leader and volunteer. In 1993 when she was president of ACS, I was holding my first office in a local section. I was surprised when I won the position as Chairman-Elect of the Northeastern Section (NESACS). The Chair of NESACS attends the award banquet at the Spring ACS national meeting to present the James Flack Norris Award in Physical Organic Chemistry; NESACS sponsors this endowed award. While attending this meeting in 1993 I was introduced to ACS governance; I visited several open committee meetings. I was aware of who was the Society president in previous years; but when I arrived in Denver that year a woman was at the helm. I mostly watched Dr. Free from afar; we had little direct contact. Yet her presence had a strong impact on my decision to get involved, to be an ACS volunteer, not just at the local level but on the Society level as well. I will share with you her traits that I observed, her actions that

spoke to me, for example, her gift for local section chairs and above all, her presence. Yes, I stand on the shoulders of sheroes such as Dr. Helen Free.

PAPER 3834804

Tough act to follow: Helen Murray Free (ACS President 1993) as viewed by her successor

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As a flag carrier for ACS, Helen Free had a widely recognized and a very visible public face. She was always enthusiastically on-target conveying 50-year membership pins, presenting ACS awards, and ribbon-cutting new landmarks. Helen loved the ACS, loved being its spokeswoman, and was an articulate advocate for enhanced public understanding of science. Few, however, recognize just how much behind-the-scenes, governance-centric, and colleague jaw-boning was necessary to launch those visible enterprises. This presenter will review Helen's role in the founding days of historical chemical landmarks, the international ACS-chapter sites, the restructuring of the NRCC, the VIP program, and several other ACS initiatives of Helen's time.

PAPER 3835376

Remembering Helen Free

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An ACS staffer looks back on pleasant times spent with Helen during ACS National and Regional Meetings – especially during her presidential succession years – 1992 – 1994.

PAPER 3826995

Helen Free: Scientist, leader, humanitarian, and friend

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In 1993, she became the third woman to be elected elected president of ACS. As president, Free’s top priority was to raise public awareness of the positive role chemistry has played in our lives. ACS instituted an award in her honor in 1995: the Helen M. Free Award in Public Outreach. Helen became a champion for science education and outreach, chairing the National Chemistry Week task force of the ACS for five years. She received the ACS’s Garvan Medal, honoring distinguished service to chemistry by a woman, in 1980.She is most known for revolutionizing many in vitro self-testing systems for diabetes and other diseases while working

at Miles Laboratories. The tests are still marketed today with blood tests as Ascensia Diabetes Care, and urine tests under Siemens Healthineers. The pioneering dip-and-read strips, allowed for testing to be more convenient and efficient, enabling doctors and patients to be less reliable to laboratories for results. She was an inspiration to many women and to men as well. This presentation will feature personal interactions with Helen and how she inspired me to run for President of the ACS.

PAPER 3805674

Helen M. Free Award for Public Outreach: Recognizing innovative volunteers

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When she assumed the presidency of the American Chemical Society in 1993, Helen M. Free pledged to initiate and support activities that would “improve the public’s awareness of chemistry’s contributions to the quality of daily life.” The Helen M. Free Award for Public Outreach was established in 1995 by the American Chemical Society's Committee on Public Relations and Communications and honors an ACS member for their creative, long-term volunteer efforts in our communities.

PAPER 3817548

Guardian angels, mentors and passion

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Numerous events, people, and situations influence our career trajectories. Sometimes a person is aware of the intervention, sometimes, the intervention is not recognized until much later, and sometimes it appears as a friend or a snippet of advice. It takes special people in our lives to help us realize our worth, skills, and passions. These individuals provide a helping hand or a nudge whether we know it or not; such was the case with Helen Murray Free. An interaction with her had a way of blossoming into something bigger. They provided the needed push. They provided insight and illuminated the path forward for many.

PAPER 3828471

Science cafes, STEM journeys, and science in your swimsuit, oh my!

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Maclachlan is the 2021 recipient of the Helen M. Free Award for her numerous annual public outreach efforts on Cape Cod. Anecdotes about the inspiration, organization, facilitation, and continuation of the Cape Cod Science Cafe, the Wicked Cool Science Cafe, STEM Journey, and Science in Your Swimsuit will be shared.

PAPER 3820766

Recipient of the 2022 Helen M. Free Award for Public Outreach: Sharing my evolution of over 20 years of community outreach at the Helen Free Symposium

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I am a science education influencer with over a million followers on social media platforms. My science content motivates viewers to investigate their world through hands-on experimentation. With over 20 years of community science education outreach, I have brought science activities to schools, libraries, foster care programs, Big Brothers and Big Sisters organization, Girl Scouts and Boy Scouts, and children's hospitals. I will be sharing my experiences in community and social media outreach at the Helen Free Symposium.

PAPER 3816871

Microspectroscopy in art conservation and archaeology: Early applications from the MML

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The Molecular Microspectroscopy Laboratory (MML) was established in 1984 at Miami University. The purpose of the MML is to make state-of-the-art molecular microspectroscopy available to scientists from industrial, government and academic laboratories. Microspectroscopy was a relatively new technique at the time of the MML's inception, and research conducted at the MML quickly identified several fields that could benefit from a microspectroscopic approach. Specifically, the analysis of art and historic objects was an ideal application due to only needing samples a few microns in size for analysis. Pigments, dyes, binders, fibers, and other organic components were identified in various paintings, fabrics, and manuscripts. Collaborating with other experts enabled much to be learned about the objects, including the identification of a forgery. The identification of some dyes in certain regions also

helped to establish dates for early trade routes in the Americas. Techniques for infrared, Raman, and visible microspectroscopy developed in the late 80's and early 90's at the MML are still used today in conservation laboratories. Clearly, microspectroscopy continues to be a valuable tool for the analysis of historic objects.

PAPER 3804985

Exploring cultural heritage with portable MRI

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Cultural heritage defines our identity. Tangible cultural heritage is treasured in museums, excavation sites and nature parks. Their preservation and restoration strategies often rely on nondestructive methods of analysis. One such method is magnetic resonance imaging (MRI) known from medical diagnostics. We have made MRI portable. How portable MRI works will be explained, and its use in analyzing objects of cultural heritage will be illustrated with measurements of antique Roman frescoes at excavation sites, paintings and master violins in museums, mummies and bones, and biofilms in Yellowstone National Park.

PAPER 3817109

Hearthstone project: Combining formal art analysis & analytical chemistry

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Our long-term collaboration has focused on the technical art history of hundreds of large-scale polychrome open-air murals located in the Lower Pecos Canyonlands archaeological region of Texas. To build a chronological model for Pecos River style pictographs, we have selected ten murals for study that are geographically distributed throughout the region. Our research design involves: (1) conducting a formal analysis of the art to document and describe diagnostic Pecos River style pictographs selected for dating; (2) examining mural stratigraphy using digital microscopy on the panel and the construction of Harris matrices for superimposed figures; and (3) obtaining 60 radiocarbon dates for Pecos River style pictographs using plasma oxidation and accelerator mass spectrometry. Preliminary results demonstrate that Pecos River style painting persisted for thousands of years during the Middle and Late Archaic Periods (5500 to 1300 cal BP). These results are significant as Pecos River style art has strong parallels with the religion and cosmology of later Mesoamerican agriculturalists, suggesting archaic origins of a pan-American core belief system.

PAPER 3821963

Chemical connoisseurship: How scientific techniques help us better understand the age-old questions of attribution

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Questions of attribution have captured the minds of art connoisseurs for centuries. Many works of art have been attributed and reattributed repeatedly over the course of their existence. One of the most vexing issues is whether a work is by a master, student, or even a copy by a later follower. Several paintings in the Clowes Collection at the Indianapolis Museum of Art pose just this question, but technical art history and scientific investigation have helped us further our understanding of how, and by whom, these paintings were made. Two examples that will be discussed is the reattribution of a portrait, most recently thought to be a 19th century copy of a Rembrandt, to the workshop of Rembrandt himself and the ongoing research into a series of small portraits, attributed to the circle of the enigmatic artist Corneille de Lyon, which have perplexed scholars for generations.

PAPER 3815764

Spectroscopic investigation and dating of a painted wooden Cristo crucificado sculpture

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This presentation will discuss the investigation of a painted wooden Cristo Crucificado (crucifix) sculpture using analytical and spectroscopic techniques. The goal of this research was to identify the age of the sculpture and characterize the materials used in its creation, as well as to identify strategies for conservation and repair of the piece. The sculpture was investigated using a variety of analytical techniques including X-ray fluorescence (XRF) liquid chromatography-mass spectroscopy (LC-MS), gas chromatography-mass spectroscopy with pyrolysis (py-GC-MS), scanning electron microscopy with electron dispersive X-ray spectroscopy (SEM-EDX), Raman and infrared (IR) spectroscopy, and carbon dating. These analyses elucidated the materials that were likely originally used in the sculpture, as well as later modifications and repairs. These analyses also gave insight into the age of the sculpture, which was previously disputed. The sculpture is polychrome painted wood with carved details, and includes inlays of previously unidentified material in areas representing wounds. The cross support is simple wood, apparently unstained and unpainted. Some damage is evident on the sculpture, including a broken arm and toes. The Cristo sculpture originated in Mexico, but little is known about the artist and creation of the piece. The style of the sculpture, in particular its physical proportions, simple color palette, and realistic wounds, are consistent with older (pre-1800s) Spanish colonial art as opposed to more recent stylized (post-1800s) pieces that incorporate indigenous artistic traditions. However, the simple wooden cross support is inconsistent with the style of the

rest of the piece, and may represent a later addition. Our investigations, in collaboration with an art history research group, aimed to elucidate the origin and age of this sculpture.

PAPER 3827007

Hand-painted magic lantern glass slides: Influence of the light source and materials on the projected images

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Magic lanterns were the earliest form of image projector that greatly impacted global socio-cultural and academic practices and has regained great interest today with the re-enactment and new production of magic lantern shows. With the simultaneous use of sounds, the magic lantern was an audio-visual communication medium commonly used between the 17th and 20th centuries. The light sources of the magic lanterns evolved with technological advances, which changed the projection conditions over time. On the other hand, the manufacture of the glass slides for projection by magic lanterns went through three stages of development. In the beginning, the images were entirely hand-painted. In the first half of the 19th century, printing techniques emerged, and in the second half, photographic techniques were introduced. Nevertheless, hand-coloring continued to exist and often complemented the latter two.
With extensive collections of magic lanterns and glass slides in heritage institutions worldwide, research has been predominately centred on their role as a precursor of film and cinema. However, there is a lack of systematic research on their production, history of use, and the best conservation strategies for their preservation. This challenge is currently being addressed by linking the analysis of documented methods and materials used to produce hand-painted glass slides, the material characterization of historical slides and the reconstruction of historical paint recipes in the laboratory. A correlation between what is mentioned in written historical sources on hand-painted slides' production and what is analytically found in historical slides has been established. In particular, the identification of light-sensitive red organic pigments poses additional concerns regarding the conservation of historical slides and their use in contemporary magic lantern shows. Reconstructions of red organic paints produced following historical recipes will be irradiated by different light sources to simulate the conditions used during projection by magic lanterns. The light and temperature levels will be measured and correlated to the color and molecular changes characterized by colorimetry, UV-Vis, Raman and Infrared spectroscopies. Furthermore, the influence of the light sources on the projected red colours will also be investigated. This work will allow assessing their conservation state and original visual appearance in historical hand-painted magic lantern glass slides.

PAPER 3807953

Role of archival recipes in interpreting the chemistry of early Meissen porcelain technology

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Unpublished XRF data on the composition of body, glaze and five enamel pigments on several Meissen porcelain objects associated with the so-called Hoym-Lemaire Affair will be presented. The objects relate to a scandalous event around 1730 that shook Europe's first manufactory of hard paste porcelain. In 1728 the French merchant Rodolphe Lemaire managed to persuade Meissen to make copies of Japanese porcelain for sale as East Asian originals in Paris. The success of this dubious enterprise depended on the development of additional pigments that closely emulated the Japanese Kakiemon palette of colors. The painter and pigment technologist Johann Gregorius Höroldt supervised their decoration while he was also recording his other recipes for porcelain painting in a handwritten document preserved in the Meissen archives. In all cases the colorant chemistry can be related to special procedures introduced by Höroldt specifically for this purpose. We shall illustrate how the color formulations for these objects, designed to imitate Japanese Kakiemon porcelain, differ from those on earlier porcelain from 1723-24, as well as later (mid-18th century) objects. A surprising observation was the absence of antimony or tin in the yellow colorant. As an ancillary finding we have confirmed analytically for the first time that undecorated and unmarked Meissen porcelain in storage since prior to 1725 was decorated around 1730 and became part of the Hoym-Lemaire shipment. Our combination of XRF data with the complete texts of historical recipes from the Meissen archives underscores the role of the chemical sciences in elucidating art-historical details.

PAPER 3816549

Hidden secrets in 18th-to-20th century glassmaking: The contribution of science for the past and the present of the Portuguese historical glasses

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This research intends to study four Portuguese batch books dated from the 18th to the 20th century, assigned to different glassmakers and Portuguese factories that laboured during this period. To this end, the selected glass recipes will be examined, reproduced, and characterised. Since these arcana are a set of notebooks from different periods, some are written in 18th-

century Portuguese, others already have chemical formulae written in 19th-century notation. Chemistry is the base of everything, and glass production was not an exception. An example of that is the springiness of particles, from Descartes, which arouse the attention of the polymath, Robert Hooke, years later when he starts to contribute to the study of the phenomenon underlying glass drops quenched into the water – Prince Rupert's drops – that can be considered the early form of tempered glass. The end of the 18th century was marked by several chemical evolutions, which created opportunity for innovation and progress in the 19th-century glass industry. Thanks to the laws of modern chemistry, such as the principle of conservation of matter put forward by Lavoisier – all ingredients began to be systematically weighted prior to be put in the crucible, the same applying to the products obtained at the end – glassmakers increased their awareness and control over raw materials and, which greatly improved glass production. This craft which up to now had been based on a purely empirical approach, produced sodium carbonate or sodium ashes, for example, by calcinating different raw materials and controlling the purity and the content of sodium carbonate, normally through the smell and the taste of the final substance. The main goals of this research are to continue the study of Portuguese glass production from the 18th to the 20th century, by considering the development of chemical and physical knowledge, which was incorporated in glassmaking with the aim of clarifying the methodology for historical glass reproductions, and assist in the attribution of authorship of some historical objects kept in Portuguese museums.

PAPER 3804496

Pigments: Poster children of technical art history

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Edward Waldo Forbes (1873-1969), Director of the Fogg Art Museum at Harvard University from 1909 to 1944, adamantly maintained that art and science are so firmly linked that a work of art cannot be understood without also understanding the materials from which it is made. With that statement, Forbes brought into being a new discipline: technical art history. Its practice is now firmly established in the world's major museums of art where chemists, physicists, art conservators and other scientists work side by side at the never-ending task of preserving and enhancing their collections. This paper will describe how selected pigments and pigment classes exemplify and indeed, in some cases, owe their very existence to the practice of technical art history.

PAPER 3822146

Bluer than blue: Defining Pliny's Egyptian blues

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An ancient Roman wall painting with a blue sky tells little of the range of colorant choices from which a Roman artist potentially could have chosen. Gradients of Egyptian blue were available in a good commercial market. This range is made clear by two sources, Pliny the Elder's *Natural History* (late 1st c. A.D.) and Diocletian's *Maximum Edict of Prices* (301 A.D.), both of which indicated that there more than one kind of Egyptian blue existed, each at a different price point. This study seeks to define the four Egyptian blues discussed by Pliny, exploring in particular what feature(s) might have differentiated the most expensive variety, known as Vestorian blue, from the other Egyptian blues. A tripartite study will be undertaken to explore the differences in Roman Egyptian blues. First, there will be a careful exploration of Pliny the Elder's text. Then, the scientific analysis of archaeological examples of raw Egyptian blue will be surveyed in order to explore what variables in manufacturing techniques or ingredients could set these blues apart. Finally, the information gleaned from the literary and archaeochemical study will then be tested by manufacturing modern examples of Egyptian blue. These manufactured samples will be evaluated for their suitability for painting and measured archaeometrically in order to understand their properties. Such a study will make it possible to better understand the knowledge of materials that Egyptian blue artisans had in mind when making materials.

PAPER 3827106

Analysis of organic dyes on historical textiles in a museum setting by liquid chromatography with detection by diode array and mass spectrometry (LC-DAD-MS).

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Understanding the chemical composition of artwork can provide objective information on its authorship, date and location of creation. Textile dyes are organic compounds most amenable to analysis by LC-DAD-MS. This paper reviews published data and the significance of the findings from three woven objects studied at our museum in the past several years to highlight the interface of art and science. Firstly, a man's coat from Uzbekistan thought to be from early 19th century was studied. LC-DAD-MS analysis showed that dyes extracted from fourteen samples were all synthetic, with the most recent being Direct Red 23 first reported in 1900. Thus, this Uzbek coat was a product of the early 20th century. Furthermore, the distribution of colored analogs revealed the crude methods used to prepare some of the dyes. Secondly, the blue color on a Japanese *yukata* from 1950s was found to be 5,5'-dibromoindigo (5,5'-DBI). Since antiquity blue textiles were dyed by indigo that was prepared from a plant source until it was replaced commercially by the synthetic version in 1897. In the 1920s Dow Chemical Company was known to have prepared and marketed 5,5'-DBI. However, to date, our report was the first identification of 5,5'-DBI on a textile. The exact circumstance of its use on the

yukata is still being investigated. Finally, three yarns from an Iranian carpet fragment first thought to be from the 15th century, was found to contain Metanil yellow, indigo, and Congo red, the latter of which appeared after 1884. Additional two unknown Congo red analogs have been identified by MS, NMR and independent synthesis as products of its reaction with formaldehyde, a common environmental volatile organic chemical. Thus, aside from rectifying its date of creation, the data suggest that following its creation, the textile could have been exposed to pollution.

PAPER 3811125

Investigating carbon-based black pigments with a nonlinear microscopy technique

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Carbon-based black pigments are among the oldest and most widely used pigments in all forms of art and can be produced from a variety of materials. Studies of these pigments with linear spectroscopic techniques reveal little about their photophysics and cannot differentiate the pigments. Pump-probe microscopy uses nonlinear interactions of two, tunable wavelengths with the sample to provide molecular specificity. Interrogating the time delay of the two wavelengths can reveal lifetime information of excited-state populations providing an additional level of contrast. Focusing on Bone Black, while also looking at Lamp Black, Charcoal, and Graphite, we generate false color images of our regions of interest with pump-probe microscopy. Through these images, we spatially separate different carbon-based black pigments from one another when they are mixed, as well as carbon-based black pigments from colored pigments, such as vermillion and ultramarine blue. Through pump-probe microscopy, we aim to understand the photophysics of carbon-based black pigments and to apply our knowledge to understand how these materials were manufactured to give context to artworks where they are present.

PAPER 3821425

Winsor & Newton's 19th-century manufacturing processes: How science unveils the artists' colorman choices

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Winsor & Newton (W&N) was a leading 19th-century artists' materials manufacturer that supplied influential artists worldwide. The company was founded in 1832 by William Winsor (1804-1865), a color chemist and artist, and Henry Charles Newton (1805-1882), a professional

artist. Both were truly committed to developing and improving the quality of their products. During the 19th century, W&N made several artists' materials available, including those considered more prone to degradation, such as the yellow chromate-based pigments and the red anthraquinone lake pigments. Unfortunately, the artworks by Vincent Van Gogh (1853-1890) show the damaging impact of these pigments' color alteration. However, they can be found in pristine condition in the artworks by Amadeo de Souza-Cardoso (1887-1918), one of the most important Portuguese Modern painters and a prominent figure of the Armory Show in 1913. Amadeo was a known user of W&N art materials. The W&N 19th century archive is a unique primary documentary source covering handwritten formulation instructions and workshop notes for their artists' materials. It is available as a database comprising digitalized page-images of 85 manuscript books (corresponding to 16.648 page-images) and 47 W&N 19th-century trade and retail catalogues. Research in the W&N 19th century archive database allows reproducing their manufacturing processes with as much historical accuracy as possible, giving insight into their manufacturing steps and conditions, such as the starting reagents, pH of precipitation, additives, etc. In a time when the concept of pH did not exist, it is very interesting to verify how it was controlled throughout the manufacturing processes. Furthermore, it enables the preparation of pigment references, which is crucial to optimize the multi-analytical apparatus used to characterize them in historical objects. W&N's formulations for yellow chromate and red anthraquinone lake pigments have been analytically detected in samples from Amadeo's materials and oil paintings. This presentation will discuss the 19th-century artists' colourmen choices and how they affect the stability of historical paints. This new knowledge advances our understanding of historical materials and their chemical analysis, contributing to contemporary conservation and authentication strategies.

PAPER 3805280

Technical art history and the chromatic history of Portuguese *azulejos*: The case of yellow

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The chromatic palette of Portuguese *azulejos* expanded dramatically during the 17th century, with colours ranging from blue and white to different shades of green and yellow, through to orange, purple and brown. Despite the enormous importance of *azulejos* in the history of Portuguese art, we have no primary sources on how to prepare the colours and glaze the tiles. This paper presents data from an ongoing research project that investigates the chromatic history of Portuguese *azulejos* through their colour chemistry. We started with yellow, a very versatile but technically challenging colour to achieve. We know that Naples yellow (lead antimonate) was employed as the pigment of choice, but questions still remain as to how exactly it was manufactured and what recipes were followed to achieve the many shades of yellow that we can see on artwork. To answer these questions, we first replicated a number of Naples yellows according to recipes from well-known Italian Renaissance treatises. The

resulting colours span from pale yellow to dark orange and confirm that small adjustments to the recipe provided artists with an extensive palette, accommodating their chromatic needs. Then, we painted our experimental pigments on test tiles, over a white background, to assess the influence that the glazing process had on the colour. All our experiments were analysed for their chemical, molecular and chromatic profile. Finally, by comparing and contrasting our data with data obtained from historical *azulejos*, we selected three Naples yellow recipes as the most representative of the Portuguese tradition. We argue how the combination of scientific analyses and experimental replications offers key insights on artistic practices and technological choices, filling the gap left by the absence of textual evidence. Our results reaffirm the importance of technical art history as a cross-disciplinary approach to the study and preservation of cultural heritage.

PAPER 3826891

Teaching at the crossroads of chemistry and art: Using interdisciplinary activities to increase student engagement in a non-majors course on the chemistry of art

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Scientific Connections: Chemistry of Art was introduced in the Spring of 2015 at Ouachita Baptist University (OBU), a private liberal arts undergraduate institution with approximately 1700 students. The new course was developed as part of the university-wide renovation of the CORE curriculum. Chemistry of Art has been offered for several semesters at OBU, allowing for the evaluation and improvement of the course's ability to meet student-learning outcomes. Increased discussions of history, case studies, hands-on laboratories, and student projects all work together to make this interdisciplinary class a memorable experience for the students and the instructor. Colleagues from several disciplines across campus have joined us in the class and lab, sharing their expertise and excitement for that day's topic. A favorite project allows students to research and present on several methods utilized in technical art history, discussing strengths and weaknesses of each technique. This project and others will be included in the presentation. Much of the material in this course was developed as a result of attending workshops offered by the NSF-sponsored Chemistry Collaborations, Workshops & Communities of Scholars (cCWCS) and by continued conversations with members of the community. The author thanks cCWCS for helping to make this course possible.

PAPER 3824769

Unraveling the creative process of an artist through a non-invasive multianalytical study

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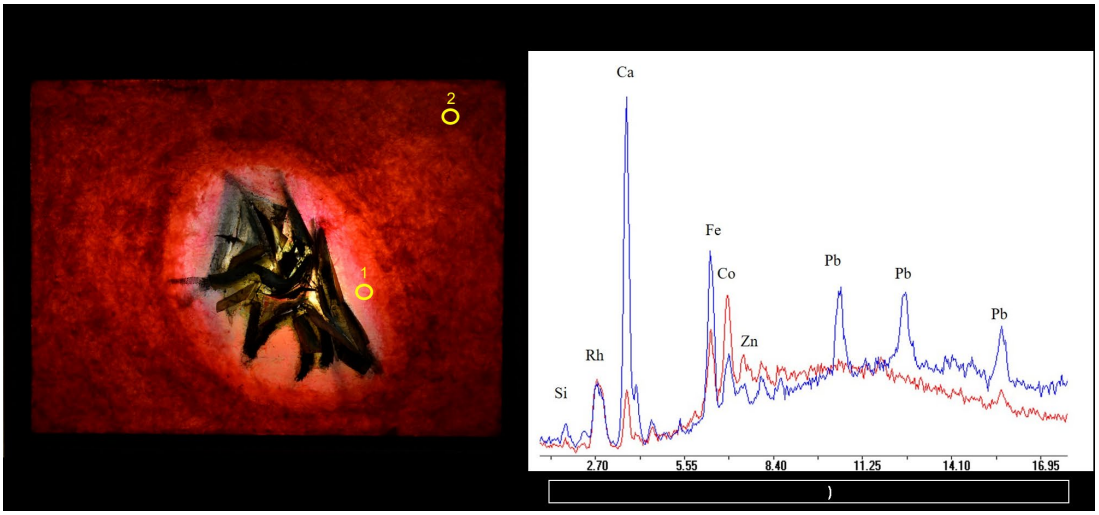
This work involves a non-invasive multianalytical study of ten paintings and two fiberglass polyester resin sculptures by artist Licio Isolani (1931-2015) with the objective of investigating the usage and evolution of the artist's materials over time, thus gaining insight into his creative process. X-Ray Fluorescence (XRF), Macro X-ray Fluorescence (MA-XRF), External Reflectance Fourier Transformed Infrared Spectroscopy (FTIR), Raman Spectroscopy and Nuclear Magnetic Resonance (NMR) were performed in-situ. The results reveal that the artist's early palette (1957-1962) involved the use of ground metals (Cu, Al, Zn, Pb and Au) on mixtures of acrylic and alkyd coatings applied either to canvas or on Aluminum-gilded linoleum surfaces. The presence of traditional pigments (eg. red lead, lead white, Prussian blue and ultramarine) along with modern organic ones was also identified by portable XRF, FTIR and Raman spectroscopies. In addition, the unusual find of high amounts of Chlorine by XRF in most of his Aluminum-gilded paintings suggests the possible use of chlorinated rubber resin often found in outdoor concrete paint or used as an anticorrosive agent. Two of Isolani's fiberglass polyester resin sculptures were also studied. The results show that the artist intentionally obtained translucency vs opacity effects on the sculptures by "color-matching" red lead and red organic dyes. Areas of high opacity also show the presence high-density fiberglass suggested by the high intensity of Silicon and Calcium in the XRF analysis, whereas transparent areas are mainly composed of red-dyed polyester resin. This preliminary non-invasive study shows the complexity and uniqueness of Isolani's techniques and his experimentation with "new materials" juxtaposed with "traditional" ones in both his paintings and sculptures.



Left: Untitled fiberglass polyester resin sculpture by Isolani illuminated from behind, displaying two areas (1) and (2) analyzed by portable XRF. Right :Overlayed XRF spectra of areas (1) in red and (2) in blue showing the presence of Pb on the highly opaque area (2).

PAPER 3826441

Paper and papermaking: Expansion of the chemical technology from China to worldwide use in the modern era

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Paper is the last and most recent of the writing materials in which words and knowledge have been recorded on prior to the digital age. Preceded by writing materials such as clay tablets, papyrus, and parchment, paper was first developed in China in the ~3rd century CE. It thereafter proliferated across the globe as knowledge of this material and the process by which it was manufactured expanded. Paper eventually achieved worldwide domination and usage, which partially coincided with the development of the printing press in the 15th century CE. The chemistry behind the process of paper and papermaking will be explored, in particular the differences between the early artisanal crafting and the later industrial-scale manufacturing. Additionally, the techniques, uses, and impacts of paper will be examined, both in terms of time period and geographical location. Finally, the implications of how the expansion of paper has positively affected the development of chemistry will be discussed.

PAPER 3827712

Science communication: Wit and humor have a dramatic impact

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Informing and inspiring the public about scientific knowledge.is an Art and Science that is more easily exemplified and epitomized than it is articulated and summarized. Wit and humor outlining the salient features of a science is pivotal in preventing misinformation and truly informing the public. Fun examples will be presented wherein outstanding scientists made lasting contributions to the public discourse through endearing wit, humorous commentary and precision in communications.

PAPER 3828003

Milestones in the history of colorimetry

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The dependence of color intensity upon colorant concentration in solutions had likely been observed before the exact law was expressed mathematically. In his book *"Essai d'Optique, sur la Gradation de la Lumiere"* (published in 1729), Pierre Bouguer (1698-1758), wrote that the transmission of light was related to the thickness of the absorbing medium. Several decades later, Johann Heinrich Lambert (1728-1777) in his work titled *"Photometria, sive de Mensura et Gradibus Luminis, Colorum et Umbrae"* (published in 1760) made the more quantitative statement that the intensity of light that passes through m identical light-absorbing layers, each of which decreases the original intensity from I to I/n, equals I/n^m. Equally importantly, it was noted that "the amount of captured light increases with the number of particles within a given volume". Almost a century later, in 1852, August Beer (1825-1863) showed that concentration has a similar effect on the intensity of transmitted and absorbed light as layer thickness. One of the very first semi-quantitative colorimetric determinations of concentration was reported by George Biggin in 1799, who showed that the amount of "tanning principle" and gallic acid in tree bark can be found by estimating the "density" of color produced in a reaction with iron sulfate. The first apparatus allowing for the determination of color intensity, the "complementary colorimeter", was devised by Mueller in 1853. In 1870, Louis Jules Duboscq (1817-1886) constructed a colorimeter, which allowed for measurement of color density by comparison with a solution of known concentration. The most important early colorimetric studies as well as some of the color reactions employed for measurement of concentration will be described in detail.

PAPER 3828165

Legendary rivalry between Sir Christopher Ingold and Sir Robert Robinson

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Sir Christopher Ingold's contribution to organic chemistry appears in every organic chemistry textbook. Ingold described the two types of nucleophilic substitution (SN1 and SN2) for the first time. During and after World War II, Ingold's contribution to organic chemistry started to be recognized. He published "Structure and Mechanism in Organic Chemistry" book in 1953. Following the publication of this important organic chemistry book, he received a few medals, awards, and honorary degrees. He was knighted in 1958. The Cahn Ingold Prelog (CIP) method was published in 1956, and it is still used in organic chemistry to name the stereoisomers of a molecule. Sir Christopher Ingold became a fierce rival to the famous organic chemist Sir Robert Robinson. In this presentation, I will discuss the papers relevant to the rivalry between Sir Christopher Ingold and Sir Robert Robinson.

PAPER 3822951

Carl Schorlemmer: Co-founder of organic chemistry and contributor to the history of chemistry

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Carl Schorlemmer was a chemist of the 19th century, who was influenced by Robert Willhelm Bunsen in Heidelberg and Heinrich Will in Gießen. These two teachers combine the lineages of inorganic and organic chemistry (Leopold Gmelin and Justus von Liebig). While the field of inorganic chemistry was an established field, organic chemistry was in its infancies at beginning of the 19th century. Carl Schorlemmer's contributions to organic chemistry were significant comprising the studies of paraffines, the halogenation of hydrocarbons, the conversion into alcohols, and the discovery of new isomers of hydrocarbons. As professor of organic chemistry at Manchester he published 1874 "A manual of the Chemistry of the Carbon Compounds" as one of the first modern textbooks of organic chemistry. Together with Henry Enfield Roscoe he published more volumes of important textbooks of chemistry. Another area of Schorlemmer's interest was the history of chemistry as academic field influenced by Hermann Kopp at Gießen. His book "The Rise and Development of the Organic Chemistry" is his most important contribution. As a close friend of Karl Marx and Friedrich Engels Carl Schorlemmer was a very celebrated chemist in the former German Democratic Republic. The Technical University Leuna-Merseburg for Chemistry, which was located near the Leuna Werke, the largest chemical industrial complex in East Germany for manufacture of petroleum refinery products, was awarded in 1964 the name "Carl Schorlemmer" on occasion of the 10th anniversary of its establishment.

PAPER 3825141

Chemistry lectures (ca 1785-7) by the Reverend William Broadbent: A manuscript in shorthand

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Reverend William Broadbent taught natural philosophy, including chemistry, at Daventry Academy, during the period 1784-1791. Joseph Priestley had received his education at Daventry Academy some twenty years earlier. Shorthand was occasionally employed by students in note taking. It is not clear whether teachers employed this technique as well in their own lecture notes. At least one student notebook in shorthand, containing eleven lectures dated 1788, has been documented. The present notebook consists of twenty lectures in shorthand and includes a folding table of chemical affinities and a diagram of thermometers. Whole words include "phlogiston", "Priestley", "Watt", Black", "Watson", and "Bergman" among others. This presentation will include brief biographical background of Reverend Broadbent and some discussion of dissenting academies in eighteenth-century England.

PAPER 3818661

Justus von Liebig (1803-1873) and Russia's first organic chemists

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2023 is the sesquicentennial of the death of Justus von Liebig, a pioneer in the practical education of organic chemists. His Giessen laboratory became a model for western Europe and his seminal 1832 paper on the benzoyl radical with his friend and colleague, Friedrich Wöhler (1800-1882) reported the first really systematic study of organic compounds. Liebig's influence on the development of organic chemistry inthe west is well known, but over the course of 20 years he was also instrumental in the education of students who became leaders of chemistry in Russia. With the move towards Russification of chemistry in Russia, it became essential for the empire to develop a cadre of well-educated Russians who could be appointed to the professoriate, and this necessitated sending Russian students to western Europe to attend lectures by the most eminent chemists of the time. Liebig became one of these mentors, but it was not as simple as one might assume. The first Russian student to study at Giessen was Aleksandr Abramovich Voskresenskii (1809-1880), who became the "grandfather of Russian organic Chemistry," but it took Liebig's personal intervention for him to be permitted to remain in Giessen, considered a "dangerously free-thinking" university; for his entire time there, Voskresenskii was under the surveillance of the Tsar's secret police. Two years later, Nikolai Nikolaevich Zinin (1812-1880) from Kazan, entered Liebig's laboratory, where he became part of the group involved in the benzoyl study. In 1851, Nikolai Nikolaevich Sokolov (1826-1877), later Professor of Chemistrt at St. Petersburg, studied with Liebig, and in 1855, Friedrich Konrad Beilstein (Fyodor Fyodorovich Beil'shein, 1838-1906) spent time in the Giessen laboratory, the last of the important Russian organic chemists to do so. Liebig's effect on the early development of Russian organic chemistry will be discussed.

PAPER 3818771

Sergiy Mikolayovich Reformats'kii (Sergei Nikolaevich Reformatskii, 1860-1934): A founding father of Ukranian organic chemistry

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In 1834, the St. Vladimir Imperial University of Kiev was decreed by Tsar Nicholas I. The university has been the Taras Shevchenko University, since 1939, after Ukrainian national poet Taras Shevchenko, who had been employed by the university between 1845 and 1846, since 1939 and is now known officially as the Taras Shevchenko National University of Kyiv, and less formally as Kyiv University or Shevchenko University. The Russian invasion has had major effects on the university, which continues its activities despite the difficulties. Sergei Nikolaevich Reformatskii (Ukrainian: Sergiy Mikolayovich Reformats'kiy) was the second son of Nikolai Aleksandrovich Reformatskii, a Russian Orthodox Priest, and he received his early education at the Kostroma Theological Seminary. Following his graduation, he entered Kazan University in

1878, where he came under the influence of Aleksandr Mikhailovich Zaitsev (1841-1910). Here he began the work with organozinc nucleophiles that characterized his entire career. He graduated with the degree of *kandidat* in 1882, and the traveled to western Europe, where he worked with Viktor Meyer and Wilhelm Ostwald. On his return to Kazan, he began research for the degree of *Magistr Khimii*; he defended his dissertation, *Saturated polyhydric alcohols*, in 1889. The same year, he accepted the call to the Chair of Chemistry at St. Vladimir University. He remained here the rest of his life. Reformatskii is now remembered for his eponymous reaction (the one reaction of organozinc nucleophiles that was not superseded by the Grignard reaction). Reformatskii's life and career will be addressed.

PAPER 3822923

Betty Wood: Scientist and educator at Bell Labs and beyond

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Elizabeth (Betty) Armstrong Wood (1912–2006) was an American geologist, mineralogist, physical chemist, crystallographer, author and association-organizer with a lifelong passion for education. Her knowledge of quartz crystals during WWII landed her a job at Bell Telephone Laboratories, Murray Hill, NJ in 1943. But not just any job: she was the first female scientist hired as a Member of the Technical Staff (MTS). During a 24-year career she collaborated on projects such as the characterization of quartz plates for use in communication devices and the X-ray crystallographic analysis of newly fabricated semiconductor and superconducting materials. An AT&T historical account notes that Betty’s scientific advice was constantly sought by Bell Labs experts and that her work “helped to develop an understanding of the relationship between physical properties and crystal structure and made possible the synthesis of many new substances with predictable properties." During the post-Sputnik era she was an outspoken advocate of science and engineering education for women, giving talks with titles like “Why Shouldn’t I Be a Scientist?” and “The Other Half of Scientific Manpower." Following her retirement in 1967, Betty participated in national efforts to revamp physical science textbooks, presented talks on rocks, minerals and iris hybridization, and founded an award for excellence in science writing. She also penned a travel book called "Science from Your Airplane Window."

PAPER 3827411

Alfred Bernhard Nobel: The man, prizes and the element

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Alfred Bernhard Nobel was a Swedish chemist who had a storied career beginning in study with Zinin and then Sobrero. This led Nobel to become interested in finding a way to control and use nitroglycerin as an explosive. After study with Ericsson, and time in Russia, he returned home to study explosives. This led to the eventual invention of dynamite in 1867 and later invention of gelignite and ballistite. In an effort to leave a better legacy, Nobel established five prizes utilizing

94% of his wealth in 1895. These prizes were: physical science, chemistry; medical science or physiology; literary work and the cause of international fraternity. Room was left open for interpretation on these prizes. The discovery, characteristics, preparation and purification of element 102 are quite interesting. The debate over naming of this element is also a fascinating matter to discuss.

PAPER 3816607

Why did Linus Pauling publish only one paper on the theory of strong electrolytes?

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With apologies to the professional historians of chemistry, I recount the following incident. In 1981, I received a curious letter from Linus Pauling, asking my opinion about his work on the Debye-Hückel theory of screened electrostatic forces in strong electrolytes. He worked on the theory when he was a graduate student at California Institute of Technology in 1922-1925. He asked about “corrections” to the Poisson-Boltzmann equation, and I replied that I did not know. He discussed the corrections with his professors and Peter Debye, but neither were enthusiastic and dissuaded him from publishing. Peter Debye suggested they work on a simpler problem, and they published a “little paper” in 1925, the reprint of which Pauling included with his letter. Naturally, his letter was highly motivating and has sustained my interest in screened electrostatic interactions for a long time. Still, it has always seemed odd that Pauling, when he was 80 years old, would write to a young Ph.D. about an “old matter” from the early 1920s, especially as he was rather vague about his “corrections.” Thanks to Google and the internet, I have now found Pauling’s interview with John L. Heilbron, which was recorded in 1964. By that time, Pauling did recognize that his professors were right in their judgement not to publish.

PAPER 3816328

Is there a place for the periodic table as chemistry embraces multi-disciplinary science and quantum field theory?

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The periodic table is inverted to accommodate physical spatial variation of electrons in elements within condensed matter. This Roberts-Janet Nuclear Periodic Table extends to plasma, nucleosynthesis, particle physics and cosmology where the electric field is repulsive. The relation $2n^2$ = n(n+1) Periodicity + n(n-1) Compactness observed by De Broglie and U(1) x SU(2) x SU(3) group symmetry has resulted in the Quantum Mechanical Table which has a one-to-one mapping with the Roberts-Janet Table. This convergence implies; repeated periods within the Periodic Table; a metallic state of helium; the production of more energy states as spatial variation decreases; identical independent magic numbers of neutrons and protons; Wilczek's asymptotic freedoms; the extinction of radioactivity as white dwarfs collapse to

neutron stars and black holes and its return via collisions between black holes and neutron stars with a re-cycling of heavy elements of an almost infinite atomic number as matter decays to elements familiar to the Periodic Table. Two cycles appear within the Roberts-Janet Table where the Second Law of Thermodynamics and Information Dynamics clash as entropy increases and decreases locally. Abiogenesis and Leptogenesis appear separately within different cycles. Mass number becomes an empirical property caused by the production of elements within every supernova with unique values for isotopic ratios - Mendeleev's original dilemma. This results in numerous Periodic Tables if mass number is included.

PAPER 3816189

Adeline De Sale Link (1892-1943): Chemist, communicator, and chemistry manual author

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Adeline-Mae De Sale was born on 4th January 1892 in Omaha, Nebraska. Her father was Oliver J De Sale, and her mother was Mae (Manton) De Sale. She attended St. Louis Central High School, Omaha graduating in 1909. Her tertiary education was at Vassar College, Poughkeepsie, New York, and there she obtained her BA with a record high grade point average in 1914. She then studied for her doctorate at the University of Chicago obtaining her PhD in 1917. In 1917, she obtained a position as an instructor in chemistry at Lawrence College, Wisconsin and she was promoted to Associate Professor. She married George K. K. Link who was a plant pathologist at the University of Chicago in 1918. She obtained a position as an Assistant Professor in the Department of Chemistry at the University of Chicago as well as working as an advisor. In the Chemistry Department, she was joint author with Professor H.I. Schlesinger of a laboratory manual of general chemistry which accompanied Professor Schlesinger's chemistry textbook. She did research with her husband (George K. K. Link) on botanical problems that included tobacco and potato mosaic diseases where her chemical expertise was most useful. She was well known for her leadership role in the American Association of University Women (AAUW). She communicated her love of chemistry by taking part in a radio show called 'Quiz Kids' on a regular basis. Adeline Mae De Sale Link died on 20th November 1943 when only 51 years old as a result of a cerebral haemorrhage. Professor Schlesinger said at her funeral that 'Professor Link was one of the outstanding women chemists of America and contributed much to the science of chemistry.'

PAPER 3802066

Barry Shapiro's NMR newletters from 1958 to 2001: The story of NMR in 516 volumes

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Barry Shapiro publshed the NMR newsletters from 1958 to 2001. They started as the MELLONMR Newsletter turned into the IIT NMR Newsletter and for the longes period were known as the TAMU NMR Newsletters before ending their run as simeply the NMR Newsletters

after Barry's retirement. These Newsletters lived from the contributions of the subscribers. Each subscriber was required to submit a contribution at regular intervals. They consisted of important methodoligical developments, interesting applications, whimsical NMR stories and more. Many of the major names in the field provided regular contributions. Overall this collection is a history of NMR in the form of personal communictions. I took it upon me to digitize the issues that were at my disposal and that were sent to me by others. The collection is currently complete from 1969 to 2001. I hope to be able add the remaining older issues soon. The collection can be found at: https://ismar-society.net/barry-shapiros-nmr-newsletters/. The newsletters only existed in paper form and many collection have been forever lost in numerous purges of personal libraries.