

## American Institute of Chemical Engineers Knoxville-Oak Ridge Section

For additional information see our Web site at: <http://www.ornl.gov/sci/aiche/>  
Or contact: Paula George, [georgepm@ornl.gov](mailto:georgepm@ornl.gov), (865)576-0603 or  
Rita Gray, [rgray22@utk.edu](mailto:rgray22@utk.edu), (865)974-5356

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### May 2014 Meeting

Date: Thursday, May 15, 2014 – ***Final meeting before summer hiatus***  
Cost: \$10  
Location: Frank H. McClung Museum, The University of Tennessee, 1327 Circle Park Drive, Knoxville, TN - Park along the circle drive in front of the museum (just across from the torchbearer statue). No parking passes are needed. Come in the front door, and a guard will be available to direct you to the correct location.  
5:30 pm AIChE Executive Committee Meeting (All members welcome),  
6:00 pm Pizza and soft drinks at the Museum  
7:00 pm Program – Dr. C. Stuart Daw, Oak Ridge National Laboratory – *How Caves Played a Key Role in One of the First Biochemical Industries in the U.S.*

**Abstract** - Ever since its development in the early 20th century, the Haber-Bosch process has been the primary source of chemically stabilized nitrogen compounds. This is especially true for propellants and explosives, almost all of which are based on oxides of nitrogen, which supply the oxidizing component of their chemical energy. In earlier centuries however, nitrogen oxides, in the form of nitrates, were derived primarily from natural biological sources, including bird guano and cave soils. The latter source in fact played a strategic role in U.S. history during both the War of 1812 and the Civil War. In this presentation, Stuart Daw will give an overview of the biochemical processes that produce nitrates in cave soils and how these resources were heavily exploited for commercial and military purposes in the U.S. during the 18th and 19th centuries. Stuart will also describe the physical and chemical processes used to extract the raw nitrates from caves and convert them to refined saltpeter for gunpowder. The production of gunpowder from cave soils reached its zenith the U.S. Civil War, when the Confederacy launched its own version of the Manhattan Project to construct a massive powder works near Augusta, Georgia. Although cave nitrates are no longer commercially exploited for producing explosives and propellants, the story of the strategic role they played in American history provides an interesting perspective on the emergence of the U.S. chemical industry.

Bio – See page 2.

**Please make your reservations by noon on May 14, by contacting**

Paula George, [georgepm@ornl.gov](mailto:georgepm@ornl.gov), (865)576-0603 or  
Rita Gray, [rgray22@utk.edu](mailto:rgray22@utk.edu), (865)974-5356

**The Section will subsidize up to 15 students,  
including graduate students**

## May 2014 Meeting (Continued)

**Bio** - Dr. C. Stuart Daw is a Fellow of the American Institute of Chemical Engineers and has been employed at Oak Ridge National Laboratory (ORNL) for 35 years, where he currently serves as a UT-Battelle Corporate Fellow. He is also an Adjunct Professor in both Mechanical and Chemical Engineering at the University of Tennessee. His major current interests include chemical reaction engineering, combustion, emissions controls, and thermochemical biomass conversion. For the past 10 years Dr. Daw has coordinated the Crosscut Lean Exhaust Emissions Reduction Simulation (CLEERS) activity for DOE's Office of Vehicle Technologies, which involves a broad-ranging collaboration among national labs, universities, and industry to accelerate the development of fuel efficient emissions controls for transportation. He also recently initiated a similar collaborative project in computational biomass conversion among national labs for DOE's Bioenergy Technologies Office. Besides his professional interests, Dr. Daw is a long-time member of the National Speleological Society, the main technical society in the U.S. devoted to scientific exploration and research of caves. He is currently a co-coordinator of the Cave Research Foundation Cumberland Gap Cave Research Project.



(Center for Nanophase Materials Science at ORNL –  
Source: DOE Photo Archive  
<https://www.flickr.com/photos/oakridgelab/9068816020/>)

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“Never memorize something that  
you can look up.”

**Albert Einstein**  
1879-1955  
*Theoretical physicist*

## April 2014 Meeting Recap

During the April 2014 meeting of the Knoxville-Oak Ridge Section of AIChE, Keith Jackson of Chicago Bridge & Iron Company provided an overview of *Control Strategies to Reduce Mercury Emissions from Coal-Fired Power Plants*. Keith provided the regulatory basis for mercury control requirements, a summary of various mercury detection, measurement, and control technologies, mercury content of various fossil fuels, mercury forms, and the advantages and disadvantages of the various control technologies. Keith also discussed mercury re-emission control and the use of proprietary slurry, REDOC Hg<sup>RPC</sup>, in re-emission control. A copy of the slides from the April meeting is available on the Media page of the Knoxville-Oak Ridge Section web site at: (<http://web.ornl.gov/sci/aiche/mediagate.html>)

## 2014-2015 Section Meetings – Request for Program Ideas

Is there a topic you would like to learn more about, or do you have a suggestion of a dynamic speaker for an upcoming section meeting? Please submit your ideas to the local section officers prior to the program planning meeting, which will be held in July or early August. Send your ideas to Chair-Elect Kyle Mack at [kylematthewmack@gmail.com](mailto:kylematthewmack@gmail.com).

(Article courtesy of David DePaoli)

## CBE Department Student Poster Presentation at May Meeting

Student Poster planned for May meeting – Tyler Cosby,  
***Characterizing Proton Conductivity in a Deep Eutectic Solvent***

***Bio:*** Tyler Cosby, originally from Pulaski, TN, graduated from Tennessee Technological University with a B.S. in Chemical Engineering in May 2013. He was active in the undergraduate AIChE and Omega Chi Epsilon (OXE) chapters. In the summer of 2012 and 2013 he was a part of the Technology Internship Program (TIP) at SABIC Innovative Plastics in Mount Vernon, IN where he worked in the bisphenol A technology lab. He joined Dr. Joshua Sangoro's Soft Materials Research Group as a PhD student in the fall of 2013.

Tyler is a first year graduate student studying eutectic mixtures and ionic liquids as a research assistant under Dr. Joshua Sangoro.

***Research Summary:*** In the past decade eutectic mixtures have received increased attention as potential materials to fill roles in numerous applications such as chemical separation processes, drug solubility, solar cell electrolytes, supercapacitors, chemical sensors, and solvents for chemical synthesis. In order for this potential to be realized, a better understanding of the relationship between chemical structure and mixture properties is needed. In this work, charge transport and structural dynamics in the 1:2 mole ratio mixture of lidocaine and decanoic acid (LID-DA) have been characterized over a wide temperature range using broadband dielectric spectroscopy and depolarized dynamic light scattering. Additionally, Fourier transform infrared spectroscopy (FTIR) measurements were performed to assess the degree of proton transfer between the neutral parent molecules. From analysis

of the FTIR spectrum, as well as our detailed analysis of the dielectric data, we have determined that this carboxylic acid based deep eutectic mixture is approximately 25% ionic at ambient conditions. Furthermore, we have found that the rate of proton transport is nearly identical to the rate of structural relaxation at all measured temperatures, indicating that fast proton transport via a Grotthuss-type mechanism does not occur in LID-DA. Our results indicate that while LID-DA exhibits the thermal characteristics of a deep eutectic solvent, its charge transport properties resemble those of a protic ionic liquid.

## Information about the Frank H. McClung Museum

The McClung Museum at the University of Tennessee, Knoxville, aims to advance the understanding of natural history and culture through our collections, exhibitions, research, and outreach programming. The McClung Museum, which was opened in 1963, has strong collections in anthropology, archaeology, decorative arts, local history, and natural history.

Exhibits at the museum showcase the geologic, historical, and artistic past of Tennessee, as well as cultures from around the globe. In doing so, the museum seeks to promote a better understanding and respect for the world's cultural heritage.

As a part of the university, the McClung supports and participates in the mission to serve the state, region, and nation through scholarship, teaching, artistic creation, professional practice, and public service. The McClung is one of only thirteen museums in Tennessee to be accredited by the [American Alliance of Museums](#), reflecting the institution's commitment to excellence.

### CURRENT EXHIBITS AT McCLUNG MUSEUM

- [Edmontosaurus annectens](#)  
Meet the McClung Museum's newest addition, and University of Tennessee's newest and oldest Vol—an *Edmontosaurus annectens* recently named "Monty" by popular vote. This dinosaur is now on permanent display in front of the museum on Circle Park Drive. Learn more below, tag your best photos of the dino with #mcclungdino, and see real duck-billed dinosaur bones in the McClung Museum's permanent exhibit, [The Geology and Fossil History of Tennessee](#)
- [Ancient Egypt: The Eternal Voice](#)  
Through the art, artifacts, and writings in this exhibition, the ancient Egyptians still speak to us. A fine collection of original objects, most manufactured more than 2,000 years ago, shed light on the daily life, religion, and writing of these captivating people. A small number of replicas complement the ancient objects, allowing the visitor insight into an ancient way of life.
- [Archaeology & Native Peoples of Tennessee](#)  
The incredibly rich Native American heritage of the state of Tennessee and the archaeological work that has assisted in understanding that past are revealed in this comprehensive and engaging exhibition. Based on more than sixty-five years of research by University of Tennessee archaeologists, the exhibit features many of the finest artifacts of the museum's world-class archaeological research collection, including its widely known examples of prehistoric Native American art.
- [The Decorative Experience](#)  
For the permanent exhibition *The Decorative Experience* we have selected 175 items from the museum's collection that embody an aesthetic component. These items come from cultures and societies throughout the world and range in age from 2400 BC to the twenty-first century. Every type of medium is represented in the objects—ceramics, textiles, stone, metal, glass, wood, paint, bone, shell, and combinations of these. Almost all of the exhibition's items were acquired as gifts, many coming to the university before the museum opened in 1963.
- [Geology & Fossil History of Tennessee](#)  
A life-size replica of the skeleton of a Cretaceous mosasaur, a large extinct marine reptile, looms overhead, greeting visitors to the *Geology & Fossil History of Tennessee* gallery. Exhibits include hundreds-of-millions-of-years-old fossils, more recent Ice Age fossils, and ongoing accounts of present day geological and climatic events.
- [Human Origins: Searching for our Fossil Ancestors](#)  
The question "where did we come from?" has interested theologians for millennia and scientists for centuries. In the permanent exhibition, *Human Origins*, the McClung Museum presents a comprehensive overview of the scientific understanding of the last six million years of the evolution of hominids—humans and our ancestors.

- [The Civil War in Knoxville: The Battle of Fort Sanders](#)

*The Civil War in Knoxville* begins with an overview of the national political situation in the fall of 1863 and then focuses on the pivotal role of Knoxville's Battle of Fort Sanders and East Tennessee during the American Civil War. Original artifacts, both family heirlooms and archaeologically excavated items, as well as primary source documents, photographs, and video illustrate key elements of this historically significant time and place.

- [Tennessee Freshwater Mussels](#)

*Tennessee Freshwater Mussels* is divided into three broad subject areas: the biology and diversity of freshwater mussels; the Native American use of freshwater mussels; and the commercial use of freshwater mussels—the button and pearl industries, both cultured and natural. In addition, the exhibit offers two video segments, one on the life cycle of freshwater mussels and the other on freshwater pearl cultivation in Tennessee. The exhibit is sponsored by Knox County, the Lucille S. Thompson Family Foundation, and the American Pearl Company, Inc. in Nashville.

## SPECIAL EXHIBITS

### Glass of the Ancient Mediterranean:

**January 18, 2014 – June 1, 2014**

Over thousands of years, glassmakers in the ancient Mediterranean produced stunning vessels incorporating a variety of manufacturing techniques and decorative schemes. From its origins in third millennium B.C. Mesopotamia to its widespread popularity in the Roman and Byzantine Empires, glassmaking underwent tremendous developments through periods of innovation and experimentation. Some trends quickly came in and out of style, while others revolutionized the industry.

This exhibit from the Yale University Art Gallery, which is home to one of the best collections of ancient glass in the United States, explores these vibrant displays of ancient technology and aesthetics. The pieces of glass on display range from second millennium B.C. New Kingdom Egypt to the seventh century A.D. Byzantine Empire and exemplify major manufacturing and decorative techniques.



Ancient Mediterranean glass

### Brightly Beaded: North American Indian Glass Beadwork:

**January 18, 2014 – June 1, 2014**

Of the many things American Indians acquired through trade with whites, few items held greater value than glass beads, and female artists throughout much of native North America quickly mastered the craft of bead working. This exhibition presents exemplary selections of beadwork, primarily from four culture areas—Plains, Great Lakes, Subarctic, and Northeast—and explores the techniques, as well as the functional and cultural significance of these pieces. This brightly beaded art served as a highly visible expression of ethnic identity and pride that continues to this day.

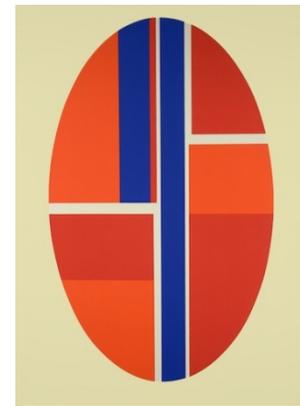


Pair of Moccasins

## UPCOMING EXHIBITS

### **The Collector's Eye: American and European Art from the McClung: June 14, 2014–August 24, 2014**

The McClung Museum is the University of Tennessee's museum, and in that sense, has been the recipient of the varied objects that alumni have gifted to the University. Among those gifts is a significant grouping of American and European art, representative of major artistic movements from impressionism, to modernism, to neo-plasticism. Indeed, the studied taste of a handful of collectors has not only helped form the backbone of the McClung Museum's art collection, but has also shaped the history of the museum itself. This exhibit—which features around fifty paintings, sculptures, and works on paper—explores the work of American and European artists, and the influence that art patrons and collectors have had on the McClung Museum.



Ilya Bolotowsky (1907–1981), Russian–American, Oval Tondo, c. 1971, 6 Color Serigraph on Heavy Paper, Gift of James E. and Doris G. August, 1979.13.2.

### **Birds, Bugs, and Blooms: Natural History Illustration from the 1600s–1800s:**

**September 6, 2014–January 4, 2015**

Drawing on the collections of the McClung Museum, the University of Tennessee Library's Special Collections, as well as private collections, this exhibit explores the fascinating intersection of art and science in the tradition of natural history illustration. From 17th century imaginings of fantastical beasts, to the extremely accurate 19th illustrations of plants and animals, the works on view highlight how increasing access to travel, technology, and books, as well as the evolution of the field of science, changed how these artful illustrations were created and interpreted



Wampum Snake, Mark Catesby, from "The Natural History of the Carolina, Florida and the Bahamas", Vol. 2. Pub. 1743, McClung Museum, 2007.5.18.

(Source: The University of Tennessee, McClung Museum of Natural History & Culture web site: <http://mcclungmuseum.utk.edu/> )

## Activities Calendar

Date	Time	Topic	Speaker	Location
May 15	6:00 PM	How Caves Played a Key Role in One of the First Biochemical Industries in the U.S.	Stuart Daw	McClung Museum
August		Planning Meeting	Executive Committee	TBD

## Sponsoring Opportunities

We continue to accept advertising in the newsletter in order to provide funds to support student participation in the meetings.

Rates per newsletter are:

**\$80** full-page advertisement

**\$45** half-page advertisement

**\$25** quarter-page advertisement

The section will also continue to accept individual or corporate sponsors to provide student meals at section meetings. The sponsor will be recognized at the meeting and in the Newsletter.

The cost to sponsor one meeting is **\$200**. It's a great way to encourage students to attend the local meetings and become future members in the Institute!



(ITER Tokamak Pit – Source: DOE Photo Archive  
<https://www.flickr.com/photos/oakridgelab/13695661245/>)

*“Genius is one percent inspiration and ninety-nine percent perspiration.”*

**Thomas Edison**

1847-1931

American inventor and businessman

## Officers

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See us at:  
[www.ornl.gov/sci/aiche/](http://www.ornl.gov/sci/aiche/)

*Editor: B. Lewis*

### *About Our Organization – Education*

AIChE offers a variety of continuing education options for chemical engineers and their colleagues, including a variety of online courses offered through the eLearning Center and developed by renowned engineers and other experts. In addition, AIChE offers in-person, classroom-style courses on chemical engineering essentials and specialty fields. Browse by topic and course type.

Find the classes you need in the format you want. Adding skills is one of the best ways to make sure your career remains on track. And one of the best ways to add new skills is by taking a course from this catalog. From core operations to process safety to biotechnology to sustainability and project management, there's something for you.

AIChE offers courses developed and taught by recognized experts with operational and instructing expertise. Learn process safety from the professionals at CCPS, the Center for Chemical Process Safety. Learn about bio

manufacturing from the Society for Biological Engineering. Sustainability courses are offered by the Institute for Sustainability. Or choose from the wide range of courses developed by AIChE.

Look through the 2014 catalog and see the spectrum of available classes. From Instructor-Led Training to eLearning courses to classes run just for your company, you'll find the formats and topics that set the stage for success – for you and your organization. You'll earn CEUs and PDHs. And your satisfaction is 100% guaranteed, always.

(Excerpts from national AIChE web site:  
<http://www.aiche.org/resources/education>)

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