

# Newsletter for Senior Chemists

MAY 2017

## Welcome Note from SCC Chair

*Thomas Beattie gained his PhD in Physical Organic Chemistry at The University of Wisconsin. His career has been mainly spent working in early stage drug discovery, and he currently consults in the*



*biopharmacy area. He has served on the Senior Chemists Committee (SCC) for several years, and is now the SCC chair. His work on the SCC has included planning the very successful series of Senior Chemists Breakfasts held at National Meetings, and finding speakers for that event. He lives in San Diego and is a member of the San Diego Local Section.*

Welcome again to the *Newsletter for Senior Chemists*. I am happy to report that our change to a new mailing address [seniorchemists@acs.org](mailto:seniorchemists@acs.org) has led to a 25% increase in email openings of our last newsletter, and, hopefully, better recognition and actual readership. We are pleased with feedback received asking us to post back issues of the SCC Newsletter for reference on the Senior Chemists Group on the ACS Network, which you can access now, and on the new Senior Chemists web site that is planned for a launch this summer.

In the travel section of this issue, now called "A Chemists' Bucket List", we have four new discoveries for you to consider as you travel. If you do visit any of our suggestions, please let us know of your impressions.

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“Help a Teacher”, written by Dennis Chamot, focuses on our SCC effort to encourage senior chemists to connect locally with teachers. We are exploring with Adam Boyd, Assistant Director of the American Association of Chemistry Teachers (AACT), on how to develop connections within ACS local sections of senior chemists with teachers in their local school systems. Other articles include reports on SCC activities, judging at science fairs, flame retardants, a famous chemist, and Dwight Chasar’s part 6 of “Chemistry is for the Birds”. Two firsts to look for, George Heinze has contributed a book review and George Heard a crossword puzzle.

Not in this issue, but worthy of note, is the increasing interest in the **Senior Chemists Group on the ACS Network** described in the last issue by James Chao and Semora Smith. We recorded more than 200 viewers and have increased the SCC volunteers who will be responding to inquiries and comments. If interested, check it out at <https://communities.acs.org/groups/senior-chemists>.

My thanks go out to all the volunteers who contribute to the SCC Newsletter, either by contributing articles or by working on the editing and construction of the newsletter. Overall, it is a big effort, but one that we all enjoy doing to encourage ACS seniors to keep professionally interested and active. As always, we invite feedback – we view our *SCC Newsletter for Senior Chemists* as a two-way street. Please share your thoughts and comments with us by sending notes to [seniorchemists@acs.org](mailto:seniorchemists@acs.org).



**ACS LEADERSHIP INSTITUTE in Dallas, TX**  
On January 28, SCC Chair Tom Beattie and SCC Staff Liaison Semora Smith participated at the Resource Fair to meet Local Section leaders attending the Institute. The Institute brings

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**ConC Liaison:**

together a variety of ACS members for training, making contacts, taking courses and development activities. SCC recognizes the need to connect with ACS Local Section leaders to increase their knowledge of how to empower senior chemists in their local sections to utilize their individual expertise and experience for the benefit of other seniors, younger section members, and the local public. Meeting and discussing ideas with representatives from many local sections opened windows of opportunity for engagement upon return to their communities. We distributed handouts of the SCC vision, mission and goals, SCC Newsletters, and upcoming SCC events to tweak their interest. We learned much about what some local sections were doing and gave help and encouragement to others to attempt some new activities for seniors. Surprisingly, traffic at our booth was almost continuous, and we quickly decided to annualize our SCC presence at this annual event.

### **SENIOR CHEMISTS BREAKFAST SAN FRANCISCO NATIONAL MEETING**

On April 4, Professor Paul Alivisatos, UC Berkeley's Vice Chancellor for Research, Samsung Distinguished Professor of Nanoscience and Nanotechnology, former Director of the DOE Lawrence Berkeley National Laboratory, Director of the Kavli Energy Nanoscience Institute and a founder of two prominent nanotechnology companies, Nanosys and Quantum Dot Corp., was the featured speaker at the sold-out SCC breakfast.



Paul Jagodzinski, Paul Alivisatos, and Tom Beattie

Image provided by Linda Wang

His presentation took the audience on a journey through the ups and downs of his research career, and illustrated how nanotechnology is impactful in the real world. Following the talk was a Q&A session, which became wide

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## **Help a Teacher, Help a Child**

by Dennis Chamot

*Chamot gained his BS in chemistry at Brooklyn Poly (now part of New York University) and his PhD in organic chemistry at the University of Illinois, as well as an MBA from the Wharton School of Finance at the University of Pennsylvania. Most of his work life was spent at the National Academies. He is a member of the SCC and is very involved in volunteer work for the ACS at both the local and national levels. He is a member of the Chemical Society of Washington local section and served as its president in 2016.*

As a member of the Senior Chemists Committee, I have been exploring ways in which senior chemists can be more involved with students and teachers at the K-12 level. Two excellent opportunities lie with the AACT and the American Chemical Society Science Coaches program.

ACS established AACT in late 2013. In the works for several years now, AACT is a national organization dedicated to supporting K-12 teachers of chemistry. Clearly, this is an important endeavor, as future chemists as well as the general citizenry pass through the pre-college education system. In addition, a good grounding in chemistry and other sciences is essential in our highly technological society. There are many excellent and dedicated

ranging and included topics such as nanodots delivering high resolution images in the current market's high-end televisions, current students' interests and their view of the world, and the increasingly broad range of employment possibilities for chemists and other scientists.

### **50, 60, ... and now 70 Year Certificates of ACS Membership!**

Each spring, ACS Local Sections receive packets of certificates for recognizing 50 and 60 years of ACS membership. That prompts Local Sections to initiate plans for lunches or dinners or some other event to honor these members. Often, remarkable stories of a lifetime of chemistry are revealed. As a regular attendee in the San Diego Section, I look forward each year to our event, where I have met some truly remarkable chemists and heard some amazing accounts of chemists and their success in "improving people's lives through the transforming power of chemistry."



ACS Executive Director Tom Connelly with 70 Year Member, Dr. Don Iffland of the Kalamazoo Local Section  
Image provided by Lydia Hines

A chance remark among SCC members led to wondering how many 70-year ACS members might there be. John Gardiner in ACS Membership checked for us and found more than 500 ACS members with 70 years and more of ACS membership. This year, thanks to John and SCC, for the first time, 118 certificates for 70 years of ACS service were sent out in the packets. We are hoping Local Sections will join us in ensuring that this newly recognized cohort of senior ACS members receives their individual appropriate recognition.

teachers in the system, but even the best can use more resources in these tight budget times as well as the assistance of experts in the teaching of science.



The ACS volunteer Science Coaches program is "an educational outreach initiative dedicated to enhancing science skills in students across the United States" by pairing chemists with AACT teacher members in elementary, middle, and high schools. So, AACT provides resources for teachers, and the Science Coaches program can provide chemists to assist.

Senior chemists who apply to the Science Coaches program can offer their experience, knowledge, and enthusiasm, and in return enjoy the relationships they develop with teachers and students. They can create and perform demonstrations, work with students on hands-on activities, help students prepare for science fairs, tutor students, and interact with teachers in a variety of useful ways. The possibilities are endless. And all activities are local, through local schools; no major travel is required.

For more information on the American Association of Chemistry Teachers, explore their website: [www.teachchemistry.org](http://www.teachchemistry.org).

To get more information about the Science Coaches program, or to apply, contact staff at [sciencecoaches@acs.org](mailto:sciencecoaches@acs.org).

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## THE SENIOR CHEMISTS' BUCKET LIST – INTERESTING PLACES TO VISIT

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### Woolaroc, a Northeast Oklahoma Gem by Ray Anderson

*Ray Anderson obtained his undergraduate degree in chemistry from the University of Kansas and his PhD from the University of Wisconsin in organic chemistry. Most of his working life was spent at Gulf Oil, the National Institute for Petroleum and Energy Research, and the Idaho National Laboratory doing energy related research. Now retired, his retirement activities include travel, skiing, hiking, volunteering, and grandkids. He and his wife, Virginia, live part-time in Idaho and part-time in Oklahoma. Ray is the copy editor for the Senior Chemists Newsletter and also writes articles for it.*

If you find yourself in or near northeast Oklahoma with some time to spare, you couldn't spend your time better than with a visit to Woolaroc Museum and Wildlife Preserve, located 12 miles southwest of Bartlesville, OK. Woolaroc (derived from three words: woods, lakes, and rocks) was established in 1925 as the ranch retreat of Frank Phillips, the founder of Phillips Petroleum. The visit begins with a drive through the 3,700-acre wildlife preserve where prominent species are American Bison (buffalo), elk, and longhorn cattle, which are native to the area. Many additional species have been added to the preserve.



The Woolaroc museum contains “one of the most outstanding western art collections in the world that also represents the culture and lifestyles of the people and peoples of America and the American West”. The Woolaroc collection includes works by the “Old Masters” of western art including Frederic Remington, Charles Russell, and Thomas Moran. The sculpture collection includes pieces by

Remington, Russell, Harry Jackson, John Free, and Joe Beeler. The 12 bronzes that were entered in the 1927 Pioneer Woman contest, including works by the best sculptors of the day, are also displayed. Firearms displays include one of the world's finest collections of Colt firearms, pistols used by both sides in the Civil War, and historic arms from Browning, Singer, Remington, and Winchester (the company that built the guns that “Won the West”). There are exhibits on the WOOLAROC aircraft that won the 1927 race from Oakland, CA to Honolulu, saddles and gear of cowboys, ranch memorabilia, and the American Bison and its impact on the New World.

The Woolaroc Lodge ranch house “stands today as a classic symbol of the colorful oil boom era.” It was “a place for Frank Phillips to entertain his friends and close the business deal... share his friendship with the local Native American tribal leaders...and rub elbows with local outlaws, bank bandits and train robbers”.

Depending on the date of your visit, you may be able to attend a spring or fall trail ride, an Oklahoma Mozart Festival concert, and the cow thieves & outlaws reunion; you may visit a mountain man camp or a fall traders encampment, or see the Woolaroc Wonderland of Lights. For more information, visit <http://www.woolaroc.org/>; quotations above are from this site.

Other points of interest near Bartlesville include the Frank Phillips Mansion, the Price Tower Art Center (in the only skyscraper designed by Frank Lloyd Wright), the Phillips Petroleum Company Museum, and the Tom Mix Museum.

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## The InfoAge Science History Learning Center & Museum at Historic Camp Evans by Thomas C. Sedergran

*Tom obtained his BS in chemistry from Drexel University and his PhD in organic chemistry from Syracuse University. He developed and transferred processes for both large and small pharmaceutical companies all over the world. He has been a member of the ACS for 39 years. He continues consulting in both the chemical and pharmaceutical industries.*

The InfoAge Science History Learning Center and Museum ([www.infoage.org](http://www.infoage.org)) is located at historic Camp Evans in Wall Township, NJ. It is an interactive museum created to inspire students and families to learn science and history in the very same buildings where it happened. InfoAge is a group of cooperating organizations dedicated to the preservation and education of information age technologies developed at Camp Evans.

The learning center and museum is comprised of the:

- Home of the Marconi Wireless Telegraph Co. of America – The receiving and control station for trans-oceanic wireless communication from 1914 to 1926.
- Home of the Army Signal Corps Radar Laboratory – Top secret radar development center for the U.S. Army from 1941 to 2000.
- Radio Technology Museum - Collection of wireless communication technology (radio/TV) from Marconi to the present.
- Electronics Warfare Museum – Display of electronic measures and counter measures from 1941 to the present.
- Vintage Computer Museum – Collection of vintage computers from the 1940s to the 1980s.
- Military Technology Museum – Exhibit of vintage, historic military artifacts such as jeeps, tanks and amphibious vehicles that were essential to the success of U.S. military operations.
- Space Exploration Center – Home of the Tiros dish antenna used to track Sputnik and America's first weather satellites.
- Shipwreck Museum – Exhibits from New Jersey shipwrecks.
- WWII Miniature Museum – Models and key battle dioramas of equipment used in WWII.



A tour through the various museums reveals the history and importance of the Camp Evans site and its impact on the outcome of WWI through the Cold War. The technology developed at the site changed the course of history and ensured the safety of America.

InfoAge is open to the public on Wednesday, Saturday, and Sunday from 1:00 to 5:00 p.m.

### **A Visit to Cotton, Inc. Headquarters by James L. Chao**

*Dr. James Chao obtained his BS and MS Chemistry degrees from University of Illinois in Urbana-Champaign and his PhD from University of California - Berkeley in 1980. Most of his working life was spent at IBM Corporation working in the laboratory as a Materials Chemist and later as an Emerging Technology Strategist working on IP licensing and promoting intellectual property business development, before retiring in 2009. In retirement, he is involved heavily in the ACS as Councilor of the North Carolina Section and serves on the National Committee on Patents and Related Matters, as well as on the Senior Chemists Committee.*



The North Carolina Section's Senior Chemistry Committee was given an insider tour of the Global Headquarters of Cotton Incorporated in Cary, NC in 2015. Cotton Inc. is an industry not-for-profit institution, which is largely funded by cotton producers in the United States and world-wide. Its operations are overseen by the Cotton Board and approved by the U.S. Department of Agriculture (USDA). Cotton Inc. not only

conducts its own research into advancing technology for advanced cotton textiles, but also provides funding for collaborative research grants to U.S. institutions. Its day-to-day operations include providing standards for colors and help with the grading of cotton bales for various uses. These activities include specifications for the annual color palette and new patterns for the industry to stay in fashion. State-of-the art equipment is often acquired in order to share manufacturing and technical specifications for manufacturers in the cotton textile industry. For many years, Cotton Inc. was responsible for promoting cotton through its **100% Cotton** labels on apparel sold in the United States.

We were very much impressed by the advanced technology methods including lasers to mark clothing, the use of very high speed weaving machines, and the development of new materials including blends for high-end clothing applications. As many of you are aware, the clothing industry is a very competitive and lucrative business compelling U.S. manufacturers to create new and desirable properties for today's sportswear and other specialty applications using advanced textile technologies. Besides advanced textile manufacturing research, Cotton Inc. is also engaged in agricultural and environmental research for improved cotton strains and agricultural production. They have been recognized for their efforts in green production and sustainability and improvements to the use of cottonseed oil and other by-products for cattle feed.

The headquarters is located just outside of Research Triangle Park in North Carolina in Cary's Weston Park. Contact: World Headquarters, 6399 Weston Parkway-Cary, North Carolina 27513; Telephone (919) 678-2220; <http://www.cottoninc.com/corporate/About-Cotton-Incorporated/World-Offices/>. Tours of the R&D and the Global HQ facility can be pre-arranged for small groups. For a map to Cotton Incorporated World Headquarters, [Click here](#).



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## The Oregon Museum of Science and Industry by Warren Ford

*Warren Ford obtained a BS in chemistry from Wabash College and a PhD in chemistry from UCLA. Most of his working life was spent at Oklahoma State University where he taught and directed research in organic and polymer chemistry. He is a member of the Portland local section and a member of the Senior Chemists Committee.*



The Oregon Museum of Science and Industry (OMSI) is located in a repurposed electrical generating plant on the bank of the Willamette River. OMSI offers a wealth of hands-on features to educate and entertain visitors of all ages. The Chemistry Lab has six lab bench stations with experiments rotating weekly. Each experiment takes 1-5 minutes. Someone in the group must be able to read the directions at a grade 4-6 level. There are also labs for physics, lasers, IT, life sciences, earth sciences, a planetarium, and

a science playground for preschoolers. Featured exhibits rotate quarterly. A theater with a huge screen shows science and nature films hourly. OMSI is not fancy, but lots of fun. Bring your children and grandchildren and plan to spend half a day. You may visit the site at [www.oms.org/](http://www.oms.org/).

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## ELEMENT NAMES – A Puzzle by George Heard

*George Heard did his BSc in Chemistry at the University of Melbourne and a PhD in quantum chemistry at the University of Tasmania. Most of his career has been spent working at the University of North Carolina Asheville as a faculty member. He*

lives in Asheville and is a member of the Western Carolinas ACS local section. He enjoys compiling crossword puzzles, and has written the one below for the SCC Newsletter.

**Hint: To figure out the clues in capitals, think about the title of the crossword puzzle.**

### Element Names – a puzzle by George Heard

**Across**

- 1. "2001" computer
- 4. a covering
- 9. Hindu mystic
- 14. traveling
- 16. ozone depleter
- 17. *COP BAR*
- 19. "The A-Team" actor
- 20. front of a boat
- 21. the first number
- 22. hurry
- 23. lowly serviceman
- 27. azidothymadine (abbr)
- 28. sphere
- 29. combine
- 30. sleek plane
- 31. operatic song
- 33. rotating cylinder
- 35. *FELINE*
- 41. donkey
- 42. not for
- 43. Roman greeting
- 44. play a role
- 46. what I hope this puzzle is
- 47. musical notes
- 48. optical instrument
- 53. married female
- 54. digested
- 55. politician, at times
- 56. not in
- 57. *SNAGS*
- 63. regions
- 64. British botanist, author of "British Mosses"
- 65. barks
- 66. factotum
- 67. envision

**Down**

- 1. drunk sound

- 2. sprayer
- 3. musical script
- 4. \_\_\_ Aviv
- 5. gallery feature
- 6. buddy
- 7. clumsy
- 8. asterisks
- 9. loose cover
- 10. conflict
- 11. like seaweed
- 12. bared one's buttocks to
- 13. central
- 15. Washington baseball player
- 18. \_\_\_ wop
- 22. pilgrimage
- 23. young horses
- 24. florentine root
- 25. remembrance
- 26. condemn
- 32. I see it now!
- 33. jokester
- 34. functional group
- 36. international alliance
- 37. low down
- 38. head warmers
- 39. beginning of the show
- 40. loch \_\_\_
- 44. dress
- 45. indentation in a parapet
- 48. thai sauce
- 49. rapture
- 50. lubricant
- 51. rescued
- 52. I believe (Lat.)
- 56. hackneyed
- 58. tree juice
- 59. Rwanda (IVR code)
- 60. \_\_\_ ammoniac
- 61. internet address
- 62. whiskey

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## **The Big Picture: On the Origins of Life, Meaning and the Universe Itself**

By Sean Carroll 470 pp. Dutton \$28. Also available from amazon.com at prices starting at about \$12.

### **Reviewed by George Heinze, former Chair of the Senior Chemists' Committee**

*George Heinze worked for 40 years at Johnson & Johnson, including 17 years in research and twenty-three years in management. His positions included vice-president of operations in the pharmaceutical sector, and vice-president for new technology and business development for Europe and the Pacific Rim. He has been an ACS member for 59 years. His volunteer work for ACS included a term on the ACS board of directors, serving as the chair of the Committee on Committees(CONC), the chair of the Committee on Nominations and Elections(N&E), and chair of the Senior Chemists Committee (SCC). He is a member of the North Jersey section. In retirement, he likes to travel and to show dogs (Weimaraners).*



Professor Carroll, a theoretical physicist at Cal Tech, has furnished us with a dense book attempting to correlate what he calls “poetic naturalism” with the basic laws of the universe. To some degree, this is a blend of the basics of quantum theory with natural philosophy and, to a large degree, he succeeds if you stay with him.

Science is expanding, as is the known universe, and this presents the public with the problem of how to put it all together, particularly if you are writing for an extended audience (e.g., popularizing science in the wake of Stephen Hawking and Carl Sagan). Believing this, Carroll admits that how humans act and fit into the world goes beyond the

brief of basic physics. In order to explain this, Carroll approaches his subjects as much as a philosopher as a theoretical physicist.

The headings of some of his chapters give some context to how broadly he approaches his subject, such as “Our Universe,” “Time’s Arrow,” “The Quantum Realm,” “Why Does the Universe Exist?,” “The Origin and Purpose of Life,” “Are Photons Conscious,” and “Existential Therapy.” In the process, philosophy comes to the fore, as in the chapter “Listening to the World” where he proposes “Ten Considerations” as a substitute for “The Ten Commandments,” having previously shown through logic that God is an impossible construct.

Carroll has attempted an “all-in-one volume” that achieves a large measure of success, such as an explanation of quantum entanglement and the arrow of time, but perhaps is not as persuasive when it comes to questions as to why we are here and how we fit in.

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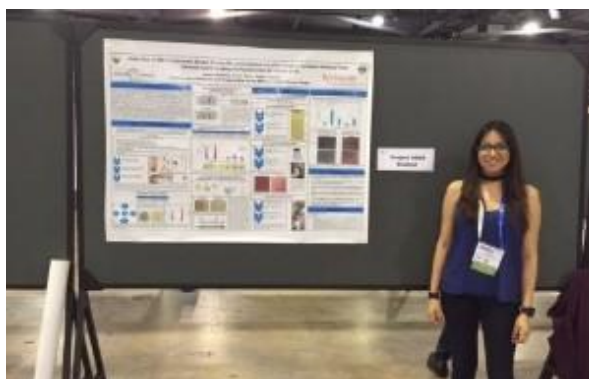
### **Senior Chemists Can Serve as Judges at Science Fairs by Nadia Makar**

Nadia Makar studied chemistry, physics, and mathematics at Saint Peter’s University in Jersey City, NJ. She worked as a High School teacher at Union Hill High School, NJ, for 20 years teaching all three subjects. For 10 years, she was the science department chair, then became the Science Supervisor of Union City High School Academy for Enrichment and Advancement, and now is the Science, Technology, Engineering, and Mathematics (STEM) Supervisor for Union City Schools District. In 1989, she was honored by President George Bush at the White House as a Presidential Awardee for Excellence in Mathematics and Science Teaching. She lives in Cliffside Park, NJ and is the Project Seed Coordinator for the New York section. She is an ACS Fellow.

To inspire students at the pre-college level to pursue careers in Science, Technology, Engineering, and Mathematics, the scientific community sponsors thousands of science fairs throughout the country and around the world each year. Thousands of schools hold science fairs that take place during December and February. The best projects move on to the district level and from there to the state and regional levels. The regional fairs feed into the Intel International Science and Engineering Fair, which takes place annually during the second week in May.

Known as Intel/ISEF, the 2016 fair took place in Pennsylvania. It was attended by more than 1,700 students from more than 75 different nations, all 50 states, and the United States

Territories. There are 17 different categories in which the students can compete: Animal Sciences; Behavioral and Social Sciences; Biochemistry; Cellular & Molecular Biology; Chemistry; Computer Science; Earth Science; Electrical & Mechanical Engineering; Bioengineering & Materials Engineering; Energy & Transportation; Environmental Management; Environmental Sciences; Mathematical Sciences; Medicine & Health; Microbiology; Plant Sciences; and Physics & Astronomy.



The Intel/ISEF lasts a week and is the culmination of thousands of local, regional, and statewide competitions that take place in different parts of the world. In the academic world, this event is like the Academy Awards for high school students. It is a program of the Society for Science and the Public and it is sponsored by the Intel Foundation. It is the world's largest international pre-college science competition and the premier global science competition for high school students to showcase their independent research projects. Hundreds of organizations, businesses, and universities (including the American Chemical Society) donate prizes, awards, and scholarships that total approximately \$4 million. Awards range from \$1,000 to \$75,000.

The program is constantly looking for qualified scientists to serve as judges at the local, state, national and international levels. The ACS Senior Chemists Committee can be a great source of judges. To volunteer at the local level, scientists can reach out to their local school districts and let them know that they are available to serve as judges. As for the international level, one can reach the organization by going online and signing up. The 2017 Intel ISEF will be held in Los Angeles, the 2018 in Pittsburgh, and the 2019 in Phoenix. For more information, you can reach Nadia Makar by email at [nmakar@union-city.k12.nj.us](mailto:nmakar@union-city.k12.nj.us).

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## The Nylon Guy by Al Denio

*Al Denio is a former member of the Senior Chemists Committee who has made several contributions to the Newsletter, often related to the history of chemistry and of chemists. He is a member of the Delaware section.*

Wallace H. Carothers grew up in the Midwest and became dedicated to chemistry at a young age. He attended the University of Illinois where he completed his doctorate in Organic Chemistry. Carothers joined the faculty at Harvard University in 1926. He truly loved research but was not comfortable in the classroom. He even considered a return to Illinois.

DuPont, meanwhile, had decided to set up a basic research lab to pursue fundamental studies in chemistry. A new lab was constructed at the Experimental Station outside of Wilmington. It soon had the nickname "Purity Hall." The company set out to hire the best and brightest chemists for this new venture. Professor Roger Adams was approached. He declined but suggested Wallace Carothers. Dupont invited him to visit Wilmington and made him an offer. Carothers had a mental health problem and felt safe in academia. He worried that his problem might not be accepted at DuPont and did not accept their first offer. In a letter to Arthur P Tandberg at DuPont, Carothers explained: "I suffer from neurotic spells of

diminished capacity which might constitute a much more serious handicap there than here.” DuPont assured him of their support and Carothers accepted their offer, moving to Delaware in February 1928.

He decided to focus on making polymers, a new area of chemistry. In 1930, Arnold Collins of the Carothers group made the compound chloroprene, which polymerized to make the first synthetic rubber. This was named Duprene, but later renamed Neoprene. This was a great invention but its high cost, compared with natural rubber, limited sales.

DuPont hired a new lab technician for Carothers in 1930. Joe Labovsky was 18 and a new high school graduate. He had arrived in Wilmington from the Ukraine six years earlier, unable to speak English. He was a bright diligent student and graduated near the top of his high school class. Carothers took a liking to Joe, partly because they both loved Russian music and literature. He helped him to get a DuPont scholarship to attend the Pratt Institute in New York for three years. Joe then returned to the Carothers research group in 1934. Research in the group had focused on condensation polymerization, especially on polyamides and polyesters. Nylon-66 was invented on February 25, 1935 in the Carothers group at the Experimental Station by coupling adipic acid and hexamethylenediamine. Both compounds have six carbon atoms in a chain, which explains the suffix 66.



This new fiber had excellent properties and was viewed as a replacement for silk fibers. DuPont quickly realized that this new invention had great potential. The company soon started construction of a large nylon plant at Seaford, Delaware. Nylon-66 would go on to be a very profitable success and DuPont's Textile Fibers Department added other fibers that made it a cash cow for many years. Carothers's groundbreaking work proved experimentally that long chain polyamides and polyesters could be made, and had physical properties much different from those of low molecular weight materials.

Sadly, Wallace Carothers' mental health problems were becoming worse. His severe depression problems were not helped by the medications then available. He sought relief from alcohol over the years. Then one night in 1937, he drove to Philadelphia, checked into a hotel and used potassium cyanide to end his suffering. It was a tragic end to a great organic chemist.

Joe Labovsky was shocked by the death of his mentor. He remained at DuPont for a long career and resolved to keep the memory of Carothers alive. He established a nylon museum in the basement of his home and gave frequent talks about the history of nylon. When he finally had to move into a retirement home, he donated his collection to the Delaware Academy of Chemical Sciences. Much of his collection is now in an exhibition in the Department of Chemistry and Biochemistry at the University of Delaware. Labovsky died in 2013 at the age of 101. His will left money to several area museums plus the Delaware Section of ACS to help preserve the memory of Dr. Carothers.

The Delaware Section established the Carothers Award, given every year since 1978, to recognize chemists” who have made outstanding contributions and advances in industrial applications of chemistry.”

#### Reference

Hermes, Matthew E., Enough for One Lifetime, American Chemical Society and the Chemical Heritage Foundation, 1996.



## **Chemistry is for the Birds – Part 6 in a series of articles about birds by Dwight Chasar**

I have been birding for 35 years. A serious birder, I go out nearly every day and have birded in more than 15 countries. I am most involved with my North American life list of birds, nearly but not yet 700 species, but I also keep lists of birds I see each year in all the Ohio counties and am particularly interested in the extra-limital nesting

birds in my area (birds normally seen outside this area). As a volunteer for the Cuyahoga Valley National Park, I lead bird walks for the public 1-2 times a month and organize spring and fall bird censuses for the park each year. I give various talks on birds to a number of bird clubs and civic groups. My studies and findings are published in our local birding publications.

All of us know that many of the elements consist of isotopes, e.g., the element isotopes have the same number of protons but a different number of neutrons in the nucleus. Some of the isotopes are radioactive and some are stable. Carbon-12 has two other isotopes: stable carbon-13 and radioactive carbon-14. The latter is used for carbon-14 dating of carbon-containing artifacts, the discovery of which won the Nobel Prize in chemistry for Willard Libby in 1960. Carbon-13 NMR makes use of the natural abundance of C-13 in organic compounds to help elucidate structures of the compounds. For my purposes here, however, I want to concentrate on the stable isotopes of hydrogen, i.e., deuterium or H-2, and oxygen, i.e., O-18, in particular but the discussion can apply to C-13, N-15, S-34 and others as well.

The natural abundance of the various stable isotopes that make up an element is fairly constant and any compound made up of elements that have stable isotopes will show that natural abundance or ratio. For hydrogen, the % ratio natural abundance is 99.985 H-1 and 0.015 H-2, while that for oxygen is 99.759 O-16, 0.037 O-17 and 0.204 O-18. So water, H<sub>2</sub>O, will have some deuterium and some O-18 naturally occurring in it that reflect the natural abundances of hydrogen and oxygen stable isotopes.

There is a tiny glitch, however, in the last sentence that needs to be addressed. The various combinations of hydrogen and oxygen isotopes that form water create molecules of different molecular weights and each of these variations of the water molecule creates a version of water that may have different physical properties, albeit very minor. For example, H<sub>2</sub>O is slightly lighter than HOD or H<sub>2</sub>O-18 and therefore, the heavier version will vaporize ever so slightly more slowly than the lighter version. So, if one uses the Atlantic Ocean along the eastern U.S. seaboard or the Pacific Ocean along the western seaboard as examples, it would be easier for the heavier version of water to evaporate in the southern climes than in the northern because of the higher average temperature of the water. This suggests that rain in the southern climes of the United States will consist of a higher percentage of heavier water than the rain in the north. In other words, deuterium isotope ratios in precipitation show a strong latitudinal gradient in North America.

If you accept the premise in the previous sentence, then organisms (plants, insects, humans) that take up water and incorporate it will reflect that difference in the stable isotope abundance of hydrogen and oxygen in water from north to south. Through a large number of analyses of tap water north/south/east/west in the United States, scientists have established crude contour intervals across the United States that reflect these changes in isotope abundances in water. It has been shown that the isotope ratios of oxygen and hydrogen in human hair correlate with the isotope ratios of local tap water and differ depending on where the individual lives (Proc. Nat. Acad. Sci. USA 2008, 105, 2788).

Thus, we finally get to the birds. Feathers are made essentially of the same keratin as in human hair. Keratinous tissues like hair and feathers are metabolically inert following synthesis. Birds that grow their feathers, either as a recently hatched bird, or from feather molt

as an adult, will incorporate water either directly from the liquid or indirectly from plants and insects that they eat. Since those plants and insects would reflect a different isotope ratio depending on the water of incorporation, the bird feathers will differ in isotope ratios depending on where the bird foraged when its feathers developed. Avian biologists have established where geographically and when feather development occurs in most species of birds. So let's use an example to show how this information is used. A bird develops its feathers somewhere in North America after birth and incorporates a specific isotope ratio of hydrogen. The bird migrates somewhere into Panama and is captured in a net, a standard technique for banding. A bit of feather is taken and the isotope ratio is determined. Based on the established contours for isotope distribution, an analysis indicates that the bird is from the New York area. Another bird of the same species is captured in Brazil and the isotope ratio reflects that the bird is from Nova Scotia. One can then begin to establish which geographic areas birds are born in and to where they migrate. Conversely, if a bird molts to breeding plumage on the wintering ground before migration and that bird is netted later at its breeding location that same year, then one has determined the bird's range as long as one has the isotope contours already established. This obviates the need for banding birds and then their subsequent recapture (a very low probability) to determine migration patterns, and breeding/wintering ranges. Chemistry comes to the rescue!

Avian biologists have also shown using stable isotope studies that certain species of birds wintering on excellent wintering grounds e.g., better food supply, migrate earlier in the season than the same species from a poorer wintering ground and in doing so, can claim the better breeding territories. Survival of the fittest?

In one more example, scientists analyzing hydrogen isotope ratios in Bicknell's Thrush in the Dominican Republic realized that these individuals must nest further north in North America beyond their known range and confirmed this through extensive searching in the appropriate isotope contour for nesting thrushes. Thus, all of these data can be put to use in conservation initiatives with birds.

For isotope analysis, an isotope ratio mass spectrometer operating in a continuous flow mode is used. The feather samples are pyrolyzed in a reducing atmosphere to form H<sub>2</sub> and CO. The gases are transported to a gas chromatograph for separation and then to the mass spectrometer for determining the isotope ratio. A good all-around review of how isotope analyses are being used in understanding animal migration is by Hobson (*Oecologia*, 1999, 120: 314-326).

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## **Fire Retardance Chemistry for Polymeric Materials by Larry Ingram**

*Larry Ingram obtained his BS in Chemistry at Polytechnic Institute of Brooklyn and his MS in Chemistry at the University Pittsburgh in Synthetic Organic Chemistry. Most of his career was spent with Alcan Cable (Now General Cable Corporation). He is now retired and lives in Aliquippa, PA. He is a member of the Pittsburgh ACS local section. His retirement activities include chess, travel, golf, and time with his grandson.*

Fire in public places and homes is a serious killer. In 2010, for example, there were more than 3,100 deaths and about \$11.6 billion of property damages. Fire retardant (FR) additives are chemicals used in plastics and polymer materials that are added to products used in automotive, airplane, aerospace, building materials, carpeting, furniture, electronics, mass transit, electronic and defense. This is the first of a two-part series on the chemistry of fire retardants, and discusses halogen fire retardant additives.

The goal of fire retardants is to shut the fire down and prevent the fire from spreading. This is done by attacking one or more of the three legs of the fire triangle. These are the heat released, the oxygen that aids combustion, and/or the fuel needed for the fire. Additionally, smoke suppression is desirable to allow people to escape and fire fighters to gauge the severity of the fire. Minimizing corrosion is also important so that electronic equipment such

as cameras, audio systems, sprinklers and other vital communications continue to function during the fire.

Historically, Br and Cl halogenated chemical additives have been the primary choice for FR, primarily in conjunction with a synergist such as  $\text{Sb}_2\text{O}_3$ . These work well to form  $\text{SbO-X}$  (where  $\text{X}=\text{Br}$  or  $\text{Cl}$ ) gas components which reduce free radicals in the fire by combining the  $\text{SbO}$  with the free radicals. The  $\text{SbOX}$  gas is heavy, heat stable, non-flammable, and blocks oxygen from accessing the fuel, especially if any char forms during the decomposition. Bromine additives are preferred because the C-Br bond is less ionic than the C-Cl bond. The  $\text{SbOBr}$  gas suppresses the free radicals somewhat more effectively and makes the Br additives more cost effective (this is important). In some applications chlorine FR additives are preferred instead of bromine additives, where there may be a perceived concern that “all bromine FR additives are bad” (see the next paragraph). Fluorine C-F flame retardant bonds are too ionic and generally costlier by far. The preferred FR additive choice is up to the formulator.



The detrimental aspect of brominated halogen FR additives is that the polybrominated diphenyl ethers (PBDE's) tend to bio-accumulate by ingestion of small amounts, especially the octa and penta derivatives, posing environmental and health concerns. These two have high resistance to degradation, accumulating in blood, breast milk and fatty tissues, disrupting both estrogen and thyroid hormones. The EU Restriction of Hazardous Substances (RoHS) banned these two additives in 2006 and is basically adopted worldwide.

PVC materials produce the corrosive and toxic decomposition product HCl. Formerly, lead oxide but now mostly  $\text{Sb}_2\text{O}_3$  is used as the synergist, working as described above. The  $\text{PbCl}_2$  formed is a solid that blocks oxygen while reducing Cl radicals. The HCl by itself is somewhat flame retardant, but addition of metal oxide radical scavengers dramatically raises the oxygen index (percent oxygen needed to support combustion). Additionally,  $\text{CaCO}_3$  or  $\text{MgCO}_3$  may also be added to PVC as a flame retardant. This reduces the percent flammable material in the PVC, produces  $\text{CO}_2$  gas, and also forms  $\text{CaCl}_2$  that scavenges the chlorine free radicals. These are cost effective, but there must be a balance between usage level and loss of mechanical properties especially for flexible products such as wire and cable.

This halogen FR approach can increase smoke generated.  $\text{MoO}_3$  can be added in the 1-2% range to produce what is assumed to be  $\text{MoO}_2 \cdot \text{Cl}_2 \cdot \text{H}_2\text{O}$  that promotes formation of a surface char. The char blocks oxygen, insulating the polymer (fuel) from the heat, thus reducing smoke generated.

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The Chemical Education Foundation is the organizer of the “You Be The Chemist Challenge”<sup>®</sup> which is an interactive academic contest that encourages students in grades 5-8 to explore chemistry concepts and their real-world applications. The Challenge provides a unique opportunity for a variety of individuals and organizations—including schools, members of the chemical industry, educators, and other community partners—to come together and show their support for STEM education.

### **Aidan Blum, Past You Be The Chemist<sup>®</sup> Challenge Participant, Starts Chemistry Career at PVS Chemicals, Inc.**

*By Emily Belson, the Senior Manager of Communications & Marketing at the Chemical Educational Foundation<sup>®</sup>. She cares deeply about the environment and bringing the excitement of science to students everywhere.*



If you met Aidan Blum when he was a sixth-grader, you would recall a sweet, shy boy who preferred to stay out of the spotlight. Today, Aidan is an outgoing, energetic project engineer in the corporate engineering division at PVS Chemicals, Inc. (PVS). The transformation Aidan underwent was catalyzed by a role model to which so many trace the beginning of their journey, his favorite teacher.

It all started in sixth grade when Mrs. Frankowiak, Aidan's favorite teacher, stopped him to suggest he take part in their school's *You Be The Chemist*<sup>®</sup> Challenge. Aidan was hesitant, but his love of science drew him in and he decided to participate. With no chemistry background, Aidan began studying seriously. Looking back, Aidan quotes some of his favorite moments during the Challenge as the time spent studying with his father "who put in many hours making study materials" and quizzing him.

When competition day arrived, Aidan's long hours of preparation paid off. He won the local Challenge, continued to the state level, and made it all the way to the national event in his first year of participating. In the two succeeding years, he continued to shine and was a semi-finalist at the state level.

Aidan only has wonderful things to say about his Challenge experience. Being on stage well outside his comfort zone, putting his knowledge to the test, and being declared the winner gave him incredible pride in his command of the material and scientific process as a whole. His most treasured memories from the Challenge are each time he walked onto the stage to start the competition. "That feeling of fear, excitement, and pure adrenaline that comes with holding your own based on the work you put in studying...there is nothing as confidence building or life altering as that."

Aidan asserts his newfound confidence in chemistry and experiences with the Challenge greatly "impacted [his] future educational and career goals." In spring 2016, he graduated with a Bachelor of Science in chemical engineering and began his career at PVS, the corporate sponsor of the local challenge in which Aidan originally participated and later interned. Aidan identifies the Challenge as "one of the main factors that led [him] to study chemical engineering...and explore a career in the chemical industry."

Aidan urges current Challenge participants and aspiring scientists to "take every opportunity available to you, never be afraid to approach a teacher or professor, and find a mentor who will guide you to achieve your goals. The universe is huge, and there is so much left to discover. Follow your natural inquiry, always challenge yourself, and never for a moment stop learning something new!"

The full-circle nature of Aidan's Challenge experience, from competing at a PVS-sponsored competition to interning and beginning his career with the company, is the synergy the Chemical Educational Foundation<sup>®</sup> (CEF) strives to provide young scientists and the chemical industry. By supporting science in their own backyard, PVS inspired a student to pursue chemistry and is reaping the benefits of welcoming a passionate new employee. CEF offers many opportunities for passionate chemists, currently working or retired, to bring the joy of science education to their communities. To learn more and get involved with CEF and the *You Be The Chemist*<sup>®</sup> programs, visit [www.chemed.org](http://www.chemed.org).

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The ACS Senior Chemists Committee (SCC) will be offering a limited number of grants to local sections that wish to sponsor an event or activity that will increase the engagement of senior members and encourage innovative activities that will benefit the local community, schools, or legislative government.

- A limited number of grants (up to \$500) are available to local sections that wish to host an event/activity that meets the above criteria.
- Local sections must submit a [grant application](#) by Friday, July 14, 2017. Grant funds are limited and will be awarded on a first-come, first-served basis.
- A [summary report](#) must be submitted within 30 days of the conclusion of the event/activity.

For more information, please email [seniorchemists@acs.org](mailto:seniorchemists@acs.org).

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### EDITOR'S NOTE by Lynn Hartshorn

Many thanks are due to all the authors, listed above, and to the editing group. This includes Ray Anderson (copy editor), Don Clarke, Al Denio, Warren Ford, Herbert Golinkin, Don Harris, and Roland Hirsch. If you would like to help with occasional editing, I would love to hear from you. Please email me at [LGHARTSHORN@stthomas.edu](mailto:LGHARTSHORN@stthomas.edu).

I encourage all senior readers of this Newsletter to submit an article. Some ideas of the range of articles can be seen by looking at this Newsletter, as well as previous Newsletters. If you have an idea, but are not sure if it would be a suitable article, then please email me with your idea. Some additional topics that we have published include the various activities of senior chemists in their retirement, articles about science topics, the history of chemistry, volunteer work of seniors, etc. Articles should be a maximum of 500 words and be submitted to me as a Doc or DocX. The deadline is September 15 for articles that will be included in the fall Newsletter, which will be published in November 2017. You may send your articles to me or to [seniorchemists@acs.org](mailto:seniorchemists@acs.org).

### ACS SENIOR CHEMISTS COMMITTEE

The Senior Chemists Committee was established in January 2013 as a Joint Board-Council Committee and consists of 16 members and seven associate members. The Committee serves two constituencies within the ACS: (1) seniors who are still active either as full time or part time employees and consultants, or those who wish to stay closely connected to the ACS and its spectrum of activities; and (2) younger members and students who have questions about a



chemistry-based career or who have started careers and are looking for guidance in how to progress.

### **SCC VISION**

Improving lives using the knowledge and experience of senior chemists

### **SCC MISSION**

Address and support the needs and ambitions of senior chemists and to utilize their experience and knowledge

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