THE VORTEX

AMERICAN CHEMICAL SOCIETY CALIFORNIA SECTION

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During National Chemistry Week, a Girl Scout builds a ball and stick model of acetic acid.

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LAFAYETTE LIBRARY & LEARNING CENTER FOUNDATION

Science café

ACS Chemistry for Life®

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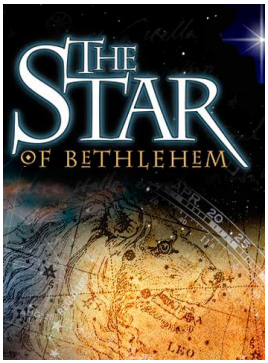
What was the Star of Bethlehem?



A miraculous sign …

….. a prophecy

…. an unusual astronomical event?

The Biblical Gospel of Matthew, describes a star appearing in the East at the time of the birth of Jesus of Nazareth. For millennia, both believers and unbelievers, skeptics and the curious have wondered about the Biblical account of the Star of Bethlehem.

Join Saint Mary's College's astrophysicist, Ron Olowin, to reinvestigate this popular symbol of the Christmas season.

Our "Science Cafe" conversation will combine current **historical** scholarship and **astronomica**l facts in an effort to provide explanations, religious interpretations, review methods of determining the year the historical Christ was born and depictions of the event in art and popular culture.

The richly illustrated presentation will be for a general audience.

Wednesday, December 10, 2014
7:00pm to 9:00pm
Lafayette Library, Community Hall
Reserve at: tinyurl.com/Sciencecafebethlehem
Cost $5.00 at the door

Pre-order your boxed meal at bookmarkcafe.com/events or call (925)283-9999

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Happy Holidays

The Excutive Committee and the staff of the *Vortex* wishes a joyful holiday season and a Happy New Year to you and your family.

As in previous years there is no Section meeting in December. Please check the website, www.calacs.org, for information on future meetings and activities.

We also want to take this opportunity to remind you that gifts to the Section are tax deductible and help support our outreach activies to schools and students in our community.

Lou Rigali, Editor

THE VORTEX

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Chair's Message

Mark Frishberg

As I sat down to write the final Chair's message of my term, I expected to feel relieved that my year as Chair was coming to a close and I would not have to write any more "messages" for the *Vortex*. But that is not how I feel. A strong case can be made that CAL-ACS has had another great year, and that will be reflected in our annual report, but I see so much more that I would have liked to accomplish that I actually feel that my term is ending too soon. I knew coming in that the timing was not quite right for me to have the time and energy available that I would like to devote to be Chair, but we were in need of continued experienced leadership and it was time for me to step forward. I really would have liked to see us make sufficient strides in long range planning to solve ongoing budget issues and find mechanisms to get more young members involved in the local section, and I still hope to take a step or two in that direction before the end of the year.

On the other hand, I can look back upon my year as Chair as one that continued to insure the support for the many members and activities that make the California local section special and effective, including the co-hosting of the ACS National Meeting in San Francisco in August. Getting to work with and to know many of our long time local section contributors better has been a special privilege. There is Alex Madonik who, along with support from Greti Sequin and numerous other volunteers, unselfishly kept on adding to our list of public outreach activities whenever new ones were identified, such that events at the San Leandro Public Library in the spring, the ACS National Meeting in the summer, and for the Fairfield Girl Scouts in the fall were added to our usual NCW Family Science Night, Solano Stroll, and Bay Area Science Festival participation. Elaine Yamaguchi has continued her very worthwhile operation of Project Seed, and with Sheila Yeh, our Women Chemists Committee. Eileen Nottoli has led our high school interactions, responding to the elevation of this activity by National ACS by working to set up a workshop for teachers next January, and stepped forward to assume coordination of our Chemistry Olympiad effort when current committee chair, Donald Maclean, received a job transfer. Sheila Kanodia continued ownership of our Earth Day activities at the John Muir National Historical Park. My long time friend, Lee Latimer, who continues to be interested in everything ACS, coordinated our ACS National Meeting activities, along with assistance from Charlie Gluchowski and Attila Pavlath.

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Girl Scouts Celebrate NCW

Janet Schunk

On Sunday afternoon, 19 October 2014, over 100 Girl Scouts from Solano County, ranging from second graders to middle-schoolers, along with their troupe leaders and mothers, converged on Golden West Middle School in Fairfield to kick off the start of National Chemistry Week, The Sweet Side of Chemistry: Candy! The afternoon got started with a bang, literally, as Bryan Balazs created an explosion as part of his chemistry demonstration show.

The girls then broke into groups to rotate through the seven hands-on activity stations where candy was used to demonstrate various chemistry principles. The girls, using paper chromatography as a separation technique, were led by Sheila Yeh and the Chevron team to discover what colors make up brown and orange M&M's.

To learn about density, they discovered that Life Savers don't float, but mini Three Musketeers and Kit Kat candies do. Then the girls tried to sink mini marshmallows by squishing them to change the marshmallow's volume. Next stop, exploring a way to detect acids using sour candies. Latisha Paw U led the girls in Sour Candy Surprise by placing several different candies in water that had baking soda added. The girls learned that the citric acid or malic acid in the candies react with the baking soda (sodium bicarbonate) to form bubbles of carbon dioxide. At other stations, the girls learned about the amount of sugar in a serving size. At one station, they calculated the percent sugar in sticks of sugar gum and sugarless gum. At another station, they matched servings of various candies to the amount of sugar in a single serving.

Along the way, the girls traveled with their "Molecule Passport", a sheet that showed key molecules (name, formula, and structure) from the activities, collecting stamps of participation. When they arrived at the Build Your Own Molecule station, the girls used ball and stick models to build molecules like water, carbon dioxide, citric acid, and sucrose.

For the Girl Scouts, this science-focused event was a new direction, where they explored science principles as well as discovering new and different career paths. The event's success was confirmed by the noise level and excitement throughout the day. The girls now know that chemistry is all around us, even in our candy, and you can have fun learning about it.

Solano County Girl Scouts discover the secrets of the Sour Surprise as they celebrate NCW with the California Section at Golden West Middle School in Fairfield on 19 October 2014.

The California Section Celebrates National Chemistry Week at Helms Middle School

On Wednesday, 22 October 2014, the California Section celebrated National Chemistry Week at Helms Middle School in San Pablo, as approximately 300 students and their families gathered for Family Science Night. The Scientific Jam band opened the show - these middle school science teachers know how to rock! Bryan Balazs was back with his chemistry demonstrations, by turns intriguing and dazzling. Jeanne Pimentel and Lee Latimer welcomed visitors on behalf of the ACS, and Helms Principal Jessica Petrilli added her thanks. The entire Helms science faculty, led by Chair Rich Volberg, was there to cheer us on and to display their latest robotic inventions. The faculty and students of neighboring Contra Costa College were there to help us set up a dozen hands-on activities, along with teams from Chevron and UC Berkeley's Alpha Chi Sigma chemistry fraternity.

With this year's NCW theme, "The Sweeter Side of Chemistry: Candy" in mind, Chevron presented "Colorful Candy Chromatography" while NCW veteran Janet Schunk organized a series of activities around candy density and composition. The evening featured many favorite activities from past FSN events as well. Margareta Séquin (assisted by Yuan Chen) tested visitors with Scents from Plants; they then learned to build molecular models of the aroma compounds. Joe Drumm supervised the pH Workshop, while Mike Pinkerton presented Colorful Electrolysis. James Gardner trained modern day scribes to make their own iron tannate ink. Lena Trotochaud showed kids how to identify plastic bottles for recycling, both by the numbers and by their physical properties. UV-sensitive plastic beads are another favorite topic, with middle school science teacher Margaret Elliott there to reveal their secrets. Birgit Drews introduced visitors to the base-pairing code of DNA and RNA; they then extracted real DNA from strawberries (under the watchful eye of Eileen Nottoli), and could take the colorless, mysterious sticky fluid home with them in their own 1.5 mL microcentrifuge tubes.

The programs (bilingual in English and Spanish) were printed on thermochromic paper that changed color as kids collected activity stamps before returning to the Multipurpose room for liquid nitrogen ice cream and some NCW souvenirs. It seemed that no visitor was disappointed, and many

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Audience at the Helms Middle School Family Science Night on 22 October 2014

Methylating Mercury (Revisited) (Part 2)

Bill Motzer

In Part 1 (February 2014 Vortex), I described the California Coast Range mercury (Hg) ore deposits and mines and how they have contributed to the source and production of methylmercury (H_3C-Hg^+ abbreviated as $MeHg^+$) in lakes, reservoirs, and San Francisco Bay. Two of the most seriously impacted reservoirs occur adjacent to the now closed New Almaden mines, which have been incorporated into Santa Clara County's park system. These are the Guadalupe and Almaden Reservoirs, owned and operated by the Santa Clara Valley Water District (SCVWD). The Guadalupe Reservoir (Figure 1) is approximately 8 km east of San Jose, California, at 187 m above mean sea level. It has a surface area of 300,000 m^2 (74 acres) with a capacity of 3,415 acre feet (4,212,000 m^3) or 11,127,879 gallons. (Note: One acre-foot ≈ 325,853 U.S. gallons.) As a rule of thumb in water management, one acre-foot is the planned water usage of a suburban family household; where water conservation is followed and often enforced, a typical family uses only about 0.25 acre-feet of water per year. (One acre-foot/year is approximately 893 gallons per day.) The Almaden Reservoir is about 0.6 km from the New Almaden mines. Both reservoirs are still being impacted from old mercury mine wastes, particularly during large storm water runoff events when mercury-laden sediments are transported downstream into the reservoirs.

Once deposited in the reservoirs, elemental mercury (Hg^o) and ionic mercury [Hg(II)] are readily converted by anaerobic bacteria to MeHg, generally measured in ng/L or parts per trillion ranges in reservoir water. However, biomagnification, believed to be predominantly produced by anaerobic bacteria and algae, increases MeHg concentrations in the food chain so that fatty fish tissues accumulate MeHg in the mg/kg or parts per million ranges. Therefore, both reservoirs are now classified as impaired and the California Office of Environmental Health Hazard Assessment (OHHEA) strongly recommends and alerts those fishing in reservoir waters to catch and release only and not to consume the fish.

Transport and Fate of Hg-laden Sediments

HgS in the form of the minerals cinnabar and metacinnabar is virtually insoluble; therefore unmined mineralized areas would not be expected to be MeHg sources. However, in mine environments, Hg(II) may be readily transported from mercury ore tailings contained in mine wastes. Such tailings are commonly called calcines, because of the practice of adding lime (CaO) to the ore as a desulfurizer to increase mercury recovery during the roasting process. Calcines, however, may retain as much as 5 to 10 percent of the mercury once contained in the ore; concentrations may range from 10 to 1,500 mg/kg. Weathering and subsequent transport of calcines downgradient into anoxic or reducing environments now becomes an important process.

MeHg Production

The exact process of MeHg production is still not well understood, but it most likely takes place once the mercury-laden sediments have been transported into streams and lakes (Figure 2). Ecosystem characteristics have important roles in bioaccumulation of MeHg by aquatic organisms. Generally, low pH promotes both Hg bioavailability and methylation and therefore, biota in acidic systems tend to have relatively high MeHg concentrations (Figure 3). Wetlands are exporters of organic matter (which facilitates particulate and dissolved Hg and MeHg transport into downstream waters) and act as sources of MeHg production. As such, lakes with more surrounding wetlands may produce more MeHg from methylating bacteria.

MeHg is believed to be produced predominantly by sulfate-reducing bacteria in reducing or anoxic sediments. Recent investigations at other Coast Range mercury mines, such as those draining into Clear Lake, California, where the lake sediments have near neutral pH, show that different types and strains of reducing bacteria can

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readily produce MeHg. For example, the iron-reducing bacterium *Geobacter* sp. strain CLFeRB, can methylate mercury at environmentally significant rates comparable to *Desulfobulbus propionicus* strain 1pr3, a known active methylating sulfate-reducing bacterium.

Remediation

Since 2003, the SCVWD has evaluated various methods to control elemental mercury transformation to MeHg. This has been done by installing solar-powered circulators that should increase reservoir water dissolved oxygen concentrations that would either slow or stop MeHg production. However, to date, these circulators have not improved the reservoirs' water quality. The SCVWD has also investigated elevated mercury sources in sediments entering the reservoirs and may install pilot oxygenation systems to determine if these will slow or reduce MeHg production. The Jacques Gulch project, in which mine wastes were removed, reduced the major source to the Almaden Reservoir.

In a future article, I'll discuss how mercury sources can be determined or fingerprinted.

Figure 1: Guadalupe Reservoir and dam in April 2014. Note the lowered water surface due to California's prolonged drought. View to northwest. Photo by W.E. Motzer.

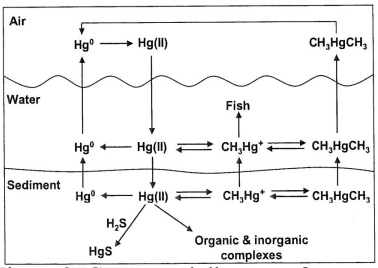

Figure 2: Conceptual diagram of mercury and MeHg+ cycling in lake environments.

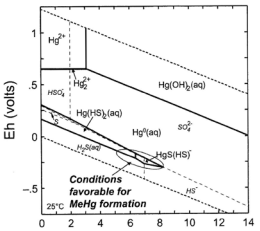

Figure 3: Eh (redox)-pH diagram showing possible conditions for MeHg formation.

Chair, continued from page 3)

Not to be left out are the people who tend to work behind the scenes, such as Paul Vartanian, who has been especially helpful to me in sharing aspects of CAL-ACS history that I needed to know, as well as continuing to be the go-to person for section by-laws questions, insuring the smooth operation of our local section election, and helping buy and deliver food for several of our meetings. Helping Paul be nominated and honored as an ACS Fellow was one of the most satisfying moments of my year. Counsel from past-Chairs, Brian Balazs, Wally Yokoyama, Marinda Wu. Linda Wraxall is greatly appreciated for her involvement in WCC, in the start of Science Cafe and with the Section's Career Counseling group. Other key people have been our other officers, our Secretary, Michael Cheng, and Treasurer, Will Kuo, our Directors and the Trustees of our Trust fund, particularly Igor Sobolev and Alex Mihailovski. Lou Rigali has maintained his long time stewardship of the website and Vortex, with Nicki Davis and Patrick Lee stepping forward to help, something that hopefully will continue since Lou has now been elected to the demanding role of Chair-Elect for 2015. Of course, one person that cannot be left out of recognition is our office manager, Julie Mason, who holds so much of our activities together with her timely attention to preparing and sending out notices and reminding people of upcoming deadlines. In any list of acknowledgments, it is always a challenge not to leave out deserving people, and I expect that I have probably done so, and apologize.

As the year draws to a close, I am very encouraged about our immediate future and I am looking forward to Charlie Gluchowski's year as Chair. Charlie has been a very active Chair-Elect, getting involved with most of our public outreach activities, and putting in the effort to set up some great meetings, such as the evening with Carl Djerassi in October, and the joint event he has started planning with the Santa Clara Valley and Sacramento local sections for this spring.

Finally, I want to thank all of our members who have helped return me to the ACS Council with their votes in the recent election. I look forward to regaining a position on a National committee where I can again work to improve services for our members, and to write and coordinate useful and complete reports to our members after each National meeting.

The Chevron team helps kids use chromatography to discover the secrets of candy colors at Helms Middle School Family Science Night on 22 October 2014.

Report of the WCC October meeting....The Genetics of Flower Formation

On Saturday, October 11, 2014, about 30 people gathered at the USDA in Albany, California, to hear Dr. Jennifer Fletcher make a fascinating presentation of the underlying genetics and chemistry behind flower formation.

With a BA from the University of Chicago, a PhD from the University of Utah, and four years as an NIH postdoctoral research fellow at Caltech, Dr. Fletcher joined the USDA-ARS Plant Gene Expression Center in 1999 to lead a laboratory studying the genetic pathways that maintain the stem cell reservoirs in shoots and flowers. She is also busy as an Adjunct Associate Professor in the Department of Plant and Microbial Biology at UC Berkeley, teaching, giving seminars in many venues around the world and contributing to public educational video series and textbooks.

In 2005 she was awarded the USDA Pacific West Area Early Career Research Scientist of the Year award for her lab's work investigating plant stem cell biology.

She began her talk with an overview of genes and inheritance, describing how access to genes is regulated: DNA is packaged into chromatin, and therefore, cells must open chromatin to transcribe gene DNA into RNA. She then referred to how mutations in the DNA can occur, and how this can lead to new traits in the organism, including the transformation of one organ type to another both in animals and plants. Homeotic transformation is a type of change in gene function, where a loss of function in the gene leads to the transformation of one organ type to another, as in when a fruit fly antenna becomes a leg. A floral example is double roses. There are three classes of homeotic gene activity, classes A, B, C and E (the latter must be present for the other three to work).

Flower organs are arranged in 4 whorls, each of which contains a specific organ type. From the outside to the center, these are the sepals, petals, stamens, carpels. All flowering plant species (except one) have this same arrangement of organs. Stem cell reservoirs are found at the growing flower tip, and these produce daughter cells for each whorl of organs.

Dr. Fletcher then began to explain the various mutations, some of which can cause flower organs to become other organs with different functions. Some studies looked at ectopic over-expression of floral organ genes, others at double or triple combinations of floral organ gene mutations. Some of these studies demonstrate that floral organs are modified leaves, though ectopic expression of the three classes of gene activities does not convert leaves to floral organs.

Although there are many more details to the pathways of formation of organs from stem cell activity than I can explain, she showed that there is a stem cell temporal feedback loop that is finally ended when certain proteins are made that bind to DNA and act to open the chromatin to allow access to DNA control of gene expression states. Photographs were shown of the plants that resulted from the various possible mutation expression combinations.

The unveiling of all these details involved untold prodigious hours of patience and pipetting! Her talk was fascinating, and it showed how research in biological chemistry is a very complex endeavor.

Submitted by Tanya Phillips, retired chemistry teacher, Piedmont High School.

Section Election Results 2015

Chair-elect	Lou Rigali
Secretary	Michael Cheng
Director	Bryan Balazs
Member-at-Large	Nikki Davis, Linda Wraxall, and, by write-in, Neal Byington
Councilor	Sheila Kanodia, Alex Madonik, and Mark Frishberg
Alternate Councilor	Neal Byington and Michael Cheng

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were reluctant to leave as our volunteers packed up their stations.

Since Marinda Li Wu launched our Family Science Night program in 1997, we have visited almost two dozen middle schools in five different counties. We are already planning for 2015, and new volunteers are always welcome. You can help us show the public that "Science is Fun!" And, as the Scientific Jam says, "It will make you very smart!"

Alex Madonik
Councilor and National Chemistry Week Coordinator, California Section, ACS

Extracting strawberry DNA at Helms Middle School Family Science Night on 22 October 2014

Colorful Candy Chromatography at Helms Middle School Family Science Night on 22 October 2014

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