THE VORTEX

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THE SAN ANDREAS FAULT

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REMINDER

March Meeting of the California Section

What has chemistry contributed to our everyday

Date: March 8, Sunday, 2:00 p.m.

Place: Lawrence Hall of Science, 1 Centennial Drive, Berkeley

Description: Four 15-20 minutes lectures will describe the role of chemistry in the areas of Transportation & Energy, Medicine, Food & Agriculture and Communications. The emphasis will be on WHAT, not HOW! The presentations will be done in layman language, no chemistry background is needed

PROGRAM.

1. Transportation and Energy, Dr. Paul Jagodzinsky, Northern Arizona University, ACS District Director

2. Medicine, Dr. Hannah Powers, Maze Therapeutics, Pharmaceutical Research Chemist

3. Food and Agriculture, Dr. Wally Yokoyama, WRCC- USDA, ACS Division of Food and Agriculture

4. Communications, Dr. Attila Pavlath, ACS President, 2001

It will be followed by leisurely viewing of the exhibit of 32 colorful posters with the chronology of developments and illustration of 75 special examples. The posters can be found on www.chemistryinyourlife.org in 32 languages. A contest will be held to find anything in your life which has nothing to do with chemistry.

Please call the Section Office 510-351-9922 to register your and your guest's attendance. Entrance to the Lawrence Hall of Science requires a fee of $16, but for those registered it will be free (though, you have to buy a parking ticket ($1/hour) at a kiosk). A special check-in desk will be set up at the entrance for those registered.

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Chair's Message

Jim Postma

Academics can study a subject to the point that the life is sucked out of the subject, and such may be true of studies on "volunteering." But the success of the ACS, nationally and locally, is mostly due to its volunteers. That perspective makes volunteering seem more like an obligation than a pleasure but I hope I can convince you that volunteering has benefits for you, not just the organization.

My experience with the ACS suggests that volunteering, even for simple tasks, can be of significant personal value. Specifically, it's a great way to develop a network of chemist colleagues that can be valuable when you need employment, a solution to a chemical problem, or a sympathetic friend. Volunteering can also be a great way to renew your perspective and rekindle your passion; the drudgery of a job can be replaced with enthusiasm, especially when you see the chemical world through the eyes of a child.

With that being said, our local ACS Section has many opportunities to volunteer. If you check our website (www.calacs.org) you can find Expanding Your Horizons, a career conference for young women in grades 6 – 9 along with science fairs and STEM fairs. These require volunteers but are easy entry points if you are new to the activity; you'll be well trained and mentored if you sign up. Also notice the Chemists Celebrate Earth Day event (and John Muir's Birthday) at the John Muir Historic Site in Martinez. This fall there will be many volunteer settings as our section co-hosts the ACS National Meeting in San Francisco.

You can find most of the information that you'll need on our website. If not, give Julie a call in our office, 510.351.9922.

Jim jpostma@csuchico.edu

California Section, ACS
April Section Meeting

"Ethical Issues of Working Scientists"

Speaker: Sandra C. Greer, Professor Emerita of Chemical and Biomolecular Engineering and of Chemistry and Biochemistry, The University of Maryland College Park; Professor Emerita of Chemistry, Mills College. Author of Elements of Ethics for Physical Scientists (MIT Press, 2017)

Date: Saturday, April 4, 2020.
Time: 10:30 am
Place: Mills College,5000 MacArthur Blvd, Oakland- Moore Natural Science Building, Room 215
Campus Map link https://www.mills.edu/docs/mills_college_campus_map.pdf
Cost: No Charge
Reservation: Please contact the CalACS office by email office@calacs.org or 510-351-9922 by Wednesday, April 1st, 2020.

Abstract:

Scientists encounter ethical issues while doing science, while working among other scientists, and while working within society. Today we will think about how to approach ethical issues in general. Then we will look at the ethical issues we encounter in dealing with other scientists. Scientists work daily with other scientists - as collaborators and coauthors, as supervisors and supervisees, as mentors and mentees, as referees and reviewers, as role models and advisors. All these activities have ethical components.

Biography:

Sandra Greer received her B. S. in chemistry in 1966 from Furman University in her home town of Greenville, SC. She received her Ph. D. in chemical physics from the University of Chicago in 1969, then spent nine years as a research chemist at the National Institute for Standards and Technology in Gaithersburg, MD.

In 1978, she accepted a professorship in the Department of Chemistry and Biochemistry at the University of Maryland in College Park, MD. She chaired that department in 1990-1993. In 1995, she accepted a joint appointment in the Department of Chemical and Biochemical Engineering. In her research career, Dr. Greer was an experimental physical chemist focusing on the thermodynamic properties of solutions, including phase transitions and polymer solutions.

After 30 years at the University of Maryland, Sandra moved to Oakland, CA, to serve as Provost and Dean of the Faculty at Mills College -- and to live near her twin sons and (later) her two grandsons. She retired in 2015 and is now writing and speaking. Her book "Elements of Ethics for Physical Scientists" was published by the MIT Press in 2017. She is at work on an undergraduate textbook on the chemistry of cooking

In 2004, she was awarded the American Chemical Society Francis P. Garvan-John M. Olin Medal, and in 2014 she was awarded the ACS Award for Encouraging Women into Careers in the Chemical Sciences.

Digital Dentistry (Part 2)

Bill Motzer

In Part 1 of Digital Chemistry (February 2020 Vortex), I described the fascinating new method for producing dental X-rays, allowing a dentist to rapidly and precisely produce X-ray images without film. The digital images that my dentist took determined that I had a carie (cavity) under an old porcelain crown. This required subsequent removal and replacement and having endured the old method of crown installation. I was not looking forward to its replacement; however, I was in for a surprise.

A dental crown (aka dental cap), is a restoration completely covering or encircling a tooth or dental implant. Crowns are used to improve tooth strength, appearance, and halt additional deterioration. They may be required when a large cavity threatens a tooth's health, a filling that can no longer be supported, or the tooth fractures or breaks leaving an intact nerve and root. Commonly, the dentist prepares the tooth by removing the carie, if present, filling the evacuated space with an appropriate material, and then remove portions of the tooth to be inserted into the crown. Prior to and after these procedures, with the older conventional method, the dentist makes tooth impressions with final crown fabrication outside of the mouth. These dental impressions create a negative mold by using a soft plastic material such as silicone that subsequently hardens in the mouth and when removed provides construction of a cast made from plaster or similar materials. The positive cast includes the tooth to be crowned and may also include surrounding upper and/or lower teeth.

Crowns are constructed from many materials (e.g., gold electrum, porcelain-covered stainless steel, resins, ceramics, etc.), generally fabricated by indirect methods because the cast is sent to an outside facility that manufactures finished crowns. This may take several weeks and if there are fitting problems or defects, considerable adjustments may be required, or a new crown may have to be manufactured. Also, while waiting for the finished crown, the patient has to wear a temporary cement crown subject to fracturing or breakage. If the fit is acceptable, the crown is bonded to the tooth by dental cement.

In the past two or so years, a new method has evolved employing CAD/CAM and 3D printing technology. After the old crown is removed (under local anesthetic), the dentist first makes a mold/cast using a wand that scans the patient's mouth. This only takes a few minutes and the scan is uploaded to a computer program producing a three-dimensional model; the dentist then adjusts the digitized mold/cast until the desired shape is achieved. The procedure is shown on a computer screen in the patient's full view and this captivating process takes less than an hour. Once completed, the crown is manufactured in the office in a milling machine (about the size of a microwave oven) from a block of yttria-stabilized zirconia (aka zirconia or YSZ), a very hard ceramic used as a strong base material for full dental ceramic restorations. YSZ is a unique substance and marvel of materials science, but because YSZ is relatively new to dentistry, published clinical data is somewhat limited. The YSZ dental core is milled in a soft presintered state and once furnace sintering is completed, it shrinks by 20% reaching a full strength of 850 to 1,000 MPa. All of this process is accomplished in the office in about two to three hours.

Zirconia is zirconium (Zr; Z=40) dioxide (ZrO_2), occurring naturally as the mineral baddeleyite, found in low silica-bearing igneous rocks such as alkaline syenites. However, pure ZrO_2 is manufactured from raw material largely provided by the mined mineral zircon (zirconium silicate or $ZrSiO_2$). On a large scale, ZrO_2 is obtained by melting $ZrSiO_2$ with coke and lime. At

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room temperature, ZrO_2 has a monoclinic crystal structure; however, at higher temperatures, it transitions to tetragonal and cubic crystal structures resulting in volume change stresses, causing cracking upon cooling. Therefore, zirconia is stabilized by blending or doping it with small amounts of other oxides, such as yttrium (Y; Z= 39) oxide (Y_2O_3); this additive stabilizes the final tetragonal and/or cubic phases.

Yttrium is a silvery-metallic transition element chemically similar to the lanthanide elemental series (aka "the rare-earth elements" or REE that range from Z=58 for cerium to Z=71 for lutetium). Yttrium is almost always found in combination with other lanthanide elements in REE minerals; it's never found as a free or native element but occurs in the mineral xenotime (yttrium phosphate or YPO_4) that may contain 50% yttrium. Commercially obtained xenotime occurs as small tonnages of xenotime-containing sand recovered from Malaysian tin mining. It also occurs in other REE mined minerals such as monazite [$(Ce,La)PO_4$] and bastnaesite [$(Y,Ce)CO_3F$]. Yttrium metal is produced by reducing yttrium fluoride (YF_3) with calcium. The silvery white, moderately soft, ductile metal is quite stable in air; however, rapid oxidation begins above approximately 450 C resulting in Y_2O_3. One should note that these crowns are expensive, generally ranging above $1,500 (dental insurance helps). However, my new crown was a perfect fit, and I'm quite happy with it

Senior Chemist Committee

Attention:

Retired Chemists, Engineeers, Scientists of all persuasions, join us on Sat. March 14 at 400pm There is no age requirement. The agenda for this meeting is to explore the ways that we can utilize our skills and talents to the benefit of our community.

The meeting will be in the Jack London District, 255 4th street #101. This is a red brick building on the corner of 4th and Alice.

All we need is a confirming email to lr101898@aol.com

Gifts & Donations

It is easy to select the programs you want to support. Call 510 679 4894 or email LR101898@AOL.com and find out how your contribution can be used.

WCC Meeting Report Imminent Shaking: What Kinds of Earthquake Warnings Are Possible?

On Saturday, February 15, 2020, Dr. Sarah Minson of the U.S. Geological Survey discussed how an earthquake early warning system works, how warnings are issued, how much warning is possible, and how to best make use of such alerts.

Dr. Minson began her talk by pointing out that "earthquake early warning" (EEW) is something of a misnomer; it should really be called a "shaking early warning." People don't need to know about every earthquake, they only need to know about ones that are close enough and big enough to produce strong shaking. "It's not the earthquake that matters, it's the shaking."

Giving timely warnings of strong shaking is a challenge, however, because of the way that earthquakes develop. Every large earthquake begins as a small earthquake that grows larger and spreads farther. There's no way to tell whether a given earthquake will grow; you need to wait and see how big it gets. "Earthquakes are not psychic; they don't know in advance how big they're going to be, and earthquake early warning (EEW) isn't psychic either."

Because EEW is not psychic, it doesn't know whether a newly-detected earthquake will grow. Consider that the probability of a magnitude 5 (M5) earthquake is 100 times that of an M7 earthquake like the 1989 Loma Prieta earthquake. If EEW sends an alert for every M5 event, the system might send dozens of false alarms. On the other hand, if EEW waits long enough to determine the amount of shaking, it might send the alert too late. Moreover, warning times for shaking are short, typically tens of seconds at most.

EEW works best for users who can take an attitude of "better safe than sorry." For example, if you respond to every alert with the recommended "Drop, cover, and hold on!", a false alarm does no harm. Similarly, responding to an alert by slowing down a train is well worth the nuisance of a false alarm, if it avoids a costly train derailment. On the other hand, some users have a very low tolerance for false alarms. For example, while a nuclear power plant can be damaged by strong shaking, the cost of shutting down the plant in response to a false alarm can run into the millions. Those who remember the disruption caused by the October 2019 PG&E shutdown in response to a false-alarm weather event can appreciate this.

Dr. Minson ended her talk by repeating her two main takeaways:

Earthquakes are not psychic, and neither is earthquake early warning.

Earthquake warning is a calculated risk. You need to gamble on taking action on small earthquakes just in case they happen to produce strong shaking, and hope that in the long run the odds pay off in your favor.

Over 30 people attended the event, which was hosted by the Women Chemists' Committee of the California Section of the American Chemical Society (CalACS). USDA is thanked for donating the use of its facilities.

Nicki Davis, PhD

The New Year is less than two months old, and the California Section calendar is already filling up with exciting community outreach events. It's time to let your enthusiasm for chemistry shine as we show the public that Science is FUN!

On Wednesday, March 4th, Cal ACS volunteers will return to Glorietta Elementary School in Orinda for their annual science fair. The Chevron Slime Team will be there, and we'll have new activities for the Earth Week 2020 theme, "Sustainability: Protecting Our Planet through Chemistry." Even if you've never tried doing hands-on chemistry with young kids, you'll enjoy this event and the warm reception we can count on at Glorietta. The time is 5:30 pm to 8:00 pm, and the address is 15 Martha Road, Orinda CA 94563.

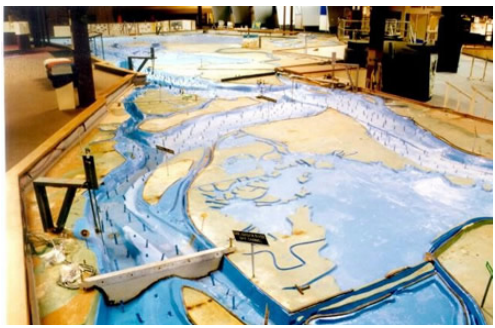
Do you remember you first science fair? The excitement is still real for thousands of Bay Area students, and hundreds of the very best will bring their projects to the Golden Gate STEM Fair at the Bay Model in Sausalito on Saturday, March 14th, 10 am to 4 pm. The organizers have invited Cal ACS to present hands-on activities at this event; we'll meet young scientists while also exploring the working model of the Bay Area watershed maintained by the US Army Corps of Engineers. this event could be a great outing for the whole family.

Earth Day is coming, and we wouldn't think of missing the annual celebration of John Muir's birthday at the National Historical Site in Martinez. You can join us there on Saturday, April 18th, 10am to 4pm at the ACS Booth, which will feature new activities based on this year's Chemists Celebrate Earth Week (CCEW) theme, "Sustainability: Protecting Our Planet through Chemistry." There's a lot of work to be done, so the ACS has partnered with EarthDay.org to promote environmental cleanups across the country. You can sign up on line or contact Earth Week Coordinator Sheila Kanodia to let her know you can help out in Martinez on April 18th: sushila.kanodia@gmail.com

We hope to see you at some or all of these events. Please contact me at 510-872-0528 or alexmadonik@sonic.net if you can help out.

Stay tuned and watch our web site at calacs.org for updates.

Alex Madonik



Girls' comparative advantage in reading can largely explain the gender gap in math-related fields

Thomas Breda and Clotilde Napp

Women are underrepresented in science, technology, engineering, and mathematics (STEM) university majors and jobs. STEM is however a broad group that includes fields in which women are not underrepresented, such as life science or psychology. Scholars have underlined the necessity to focus more narrowly on the STEM fields which are math intensive, such as computer science or engineering, as the underrepresentation of women in these fields remains large and has not decreased at all in most developed countries during the two past decades.

For example, over the period 2004 through 2014, the share of bachelor's degrees awarded to women in engineering and computer science in the US has stagnated around 20%, while it has decreased from 46 to 43% in mathematics and statistics and from 42 to 40% in physical science.

This underrepresentation of women in math-intensive fields is a source of concern for two main reasons. First, it contributes to gender wage inequality in the labor market as math-intensive jobs pay more and are also subject to a smaller gender wage gap. Second, it represents a loss of talent that can reduce aggregate productivity—as many talented girls shy away from math-intensive careers—leading to the shortage of workers with math-related skills at a time when the demand for such skills is increasing. Women remain strongly underrepresented in math-related fields.

This phenomenon is problematic because it contributes to gender inequalities in the labor market and can reflect a loss of talent. The current state of the art is that students' abilities are not able to explain gender differences in educational and career choices. Relying on the Programme for International Student Assessment (PISA) data, we show that female students who are good at math are much more likely than male students to be even better in reading. As a consequence, the difference between 15-y-old students' math and reading abilities, which is likely to be determined by earlier socialization processes, can explain up to 80% of the gender gap in intentions to pursue.

PNAS July 30, 2019 116 (31) 15435-15440; first published July 15, 2019 https://doi.org/10.1073/pnas.1905779116

Edited by Susan T. Fiske, Princeton University, Princeton, NJ, and approved June 10, 2019 (received for review April 4, 2019)

Summary by Lou Rigali

Associate Editor(s) Wanted for the Vortex (Volunteer)

The Vortex is looking for someone who likes to read and writet to provide orignal and summaries of technical articles for publishing in the Vortex. No office hours, no deadlines.

Latest Developments in the California Section SEED Program

E. S. Yamaguchi

Before the 2020 SEED program starts in earnest, I want to review three aspects of the 2019 SEED program. They are:

Outstanding student completion rate

ACS Scholarships won by our students

Partnership with the Society for Technical Communication

We had 49 SEED students start and finish the 9-week, full-time research assignments in industry, academic, and government laboratories all over northern CA. This is not easy, since all students are required to give a technical talk and answer questions from their peers, other mentors, teachers, and me. I attended all the students' talks, taking place as far north as UC Davis and as far south as Parlier, CA at a USDA laboratory. Failure to do so means they would not receive the larger fraction of the SEED fellowship of $2500.

Recently, I was informed that Chui Yi (Cindy) Ho won a $5000 ACS scholarship for her freshman year at UC Davis, where she plans to major in Biochemistry. How did she do this? First, she had an excellent chemistry teacher (Ailin Lian) at Lowell High School in San Francisco. Second, she did two summers of SEED, and she listened to me announcing the scholarship at least twice and heeded my reminder emails. Her mentors at the USDA lab (Niu Dong and Colleen McMahan) taught her so effectively, that by the end of the first summer of research (SEED I), Cindy was determined to be a scientist. Sarah Throne, her SEED II mentor, was thrilled to learn that Cindy won one of the 27 ACS scholarships available to former SEED students. For SEED II, she worked at the USDA, studying "Engineering Enzymes for Biomass Degradation toward Biofuels."

But there is more good news! I also learned that one of the former 2018 CA Section SEED students, Sokobe Chuong, won one of only three college scholarships, and they are renewable for every year in college. Sokobe is majoring in chemical engineering at Long Beach State University, and this $5000 scholarship is very helpful for him to attain his educational goals. He worked in the lab of University of the Pacific professor, Jerry Tsai on the "Effects of Protein Sequence on Protein Structure through Modern Molecular Biology Techniques." Again, his high school chemistry teacher introduced me to Sokobe. Since I live in the Bay area, how am I to know the identity of any student in Han Nguyen's chemistry class at Bear Creek High School in Stockton?

The final point is that our Section's SEED program has partnered with the Society for Technical Communication (STC) to provide scholarship applicants volunteer help for polishing their application statements. STC is the oldest professional association working in all industry segments on projects involving technical communication. Totally by chance, I had the good fortune to collaborate with then Chevron employee, Liz Miller, who was also President of the local East Bay STC chapter. We worked together through two summers of SEED, and she thought of this STC/ACS partnership idea prior to her retirement. She enthusiastically developed a set of talking points for me, so I could attend a few STC meetings and introduce SEED to its members. It worked, and furthermore, Cindy was Liz's first volunteer student.

Not everyone is a native-born English speaker, and SEED is filled with those students, especially those from the Central Valley, where 66% of the CA Section SEED students reside. I can't think of everything to expose deserving students to the possibility of future careers in STEM related fields; however, the CA Section SEED program can partner with an organization that has the skills to benefit students beyond the initial SEED research experience.

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