THE VORTEX

AMERICAN CHEMICAL SOCIETY **CALIFORNIA SECTION**
VOLUME LXXVII NUMBER 3 **MARCH 2016**

Dr. Jyllian Kemsley, C&E News Editor, giving two talks in Chico on March 4. See Page 4 for details

CALIFORNIA SECTION, ACS
MARCH SECTION MEETING
March 24, 2016
Medical Technology Inspired From the Arctic Ocean
Biomimetic Anti-Ice Nanomaterial

Speaker: Dr. Xiaoxi Wei, CEO X-Therma, Inc.
Date: Thursday, March 24, 2016
Time: 5:30 – 6:45 PM Social Hour, 7:00-8:15 PM Section Meeting, Presentation, Q&A
Place: Chevron Research Technology Center-Auditorium, 100 Chevron Way, Richmond,
Cost: $10 Members, $15 Non-members, Includes Appetizers and Non-alcoholic beverages during Social Hour. Please make reservations(510-351-9922 prior to March 18.

Abstract:

In the modern world, over $200 Billion dollars is spent fighting unwanted ice crystals every year. Antifreeze is a critical additive to control unwanted ice growth in the biomedical arena to extend bio-life span and a wide array of other industries (e.g. frozen food, airplane/gas pipeline deicing and engine coolants). A major breakthrough is demanded because of the limitations of the classic chemical antifreezes, dimethyl sulfoxide (DMSO) and glycols, and their toxicity to living organisms and the environment. Nature has evolved a great solution for arctic species to survive in a frozen world by producing natural antifreeze proteins (AFPs), which are about 10,000X more effective compared to industry standards. However, the extremely limited resources of AFPs and difficult purification hinders the commercialization of these most needed proteins, leading to unreliable worldwide production. AFPs also exhibit a short shelf-life and may cause immune reactions in humans.

By embracing the beauty of Nature's design and the power of nanotechnology, X-Therma is developing the first bioinspired, non-toxic and hyper-effective anti-ice nanomaterial via biomimetic nanoscience to properly preserve functional cellular and complex tissues, to enable long term organ banking that may one day save millions of lives. The single anti-ice material holds great potential for wide range of industrial applications.

X-Therma is a selected Industrial User Affiliate with the Molecular Foundry, Lawrence Berkeley National Laboratory. Our cryoprotectant innovations were awarded the Patrick Soon-Shiong Innovation Award and X-Therma is 1 of 6 teams, and the only chemical company, funded by the DoD initiative for a new Apollo-like Federal project "Organs on Demand" to enable complex organ/tissue long-term biobanking.

We welcome you to join our presentation to experience how bioinspired chemistry can bring safe and effective anti-ice solutions for a better life and a better world!

Biography:

Xiaoxi Wei, Ph.D. Founder & CEO of X-Therma Inc.; User Affiliate to Lawrence Berkeley National Laboratory. X-Therma Inc. is a young company with the mission to develop safe & effective biomimetic nanotech anti-icing solutions to enable long term bio-banking of tissues for applications in Regenerative Medicine technologies.

Dr. Wei is a chemist and cryobiologist whose research has focused on supramolecular assembly including the development of synthetic transmembrane nanopores with distinguished selectivity via biomimetic nanoscience. Her publicatons include 8 peer reviewed research papers including the prestigious journal Nature Communications. She has been an invited speaker at the Global Organ Banking Summit 2015, Silicon Valley. and at the DARPA "Organs on Demand" workshop at the United States Military Academy, West Point. Her company, X-Therma, Inc has been awarded "Selected Industrial User" collaborator status at The Molecular Foundry, Lawrence Berkeley National Laboratory for the period 2015-2017. She is the PI of a Department of Defense Innovation Research Award

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THE VORTEX

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Chair's Message

Science is fun for some, a satisfying career for others and a way to explain the meaning of life for still others. Given those different perspectives, there are bound to be differences of opinion even on different scientific issues such as the benefits of nuclear reactors for generating power, government policy on issuing work visas, the cause of climate change, to name a few. So it is even with Members of the Section. This is a long way of saying that the discussions on activities or programs at our ExCom meetings reflect various points of view and if you do not attend, your opinion may not be represented.

The Section operates with money generated through Members' dues, external charitable grants and donations, and some from income generated by the Section's Trust Fund.

The Trust Fund was generated a number of years ago, primarily by a method no longer available. For practical purposes the value of the trust and its ability to generate additional income is subject to factors largely outside our direct control. One of the functions of ExCom is to decide which programs to fund, and how much. While the formal budgeting process usually starts in the early fall; budget issues arise all through the year. This is the place to be if you want input on how and where money is spent.

Historically the Section has sponsored a number of activities and programs, many with schools and children. That education of our children needs more resources is not very controversial. Our award winning programs such as Project Seed, Family Science Night, Chemistry Olympiad, High School and Community College Educational Grants program, as well as others, reach many in the community

Some of the major programs that the Section supports which benefits members directly are the Western Regional Meetings, the monthly Section meetings, the periodic Women's Chemist Committee programs, and our career counseling services. Lately our YCC have been active in arranging fun and informal networking functions important to one's career.

The Section is open to suggestions for new programs and activities that are relevant to you, its Members. I would like to hear from you by phone, e-mail and by your attendance at the ExCom meeting Tues. March 1 at Denny's Restaurant in person or by telecom.

I also look forward to seeing you at the March 24 program where Dr. Xiaoxi Wei, the Founder & CEO of X-Therma Inc., a new Bay area startup company, will speak on some practical applications of biomimetic nanoscience.

Lou Rigali, 510 268 9933,
lr101898@aol.com

Beyond the Bench: A Career in Science Writing

On March 4 Dr. Jyllian Kemsley, C&E News Editor is giving 2two talks in Chico. At 1:00 p.m. at CSU Chico in Ayres Hall 201 she will talk on "Beyond the Bench: A Career in Science Writing" (and other unconventional careers.) Then at 4:30 p.m. (with hors d'oeuvres at 4:00) in the Bell Memorial Union room 203 on Laboratory Safety, entitled "From the Safety Beat: The UCLA Fatality and Beyond." C&EN Senior Editor Jyllian Kemsley will review her path from chemistry major to pharmaceutical analyst, graduate student, and now science writer. She will talk about her current job at Chemical & Engineering News and what it's like to help generate a weekly magazine for a scientifically savvy audience. She will also discuss other nontraditional careers for scientists.

From the Safety Beat: The UCLA Fatality and Beyond

The death of researcher Sheharbano (Sheri) Sangji in 2009 from injuries sustained in a chemistry lab fire at the University of California, Los Angeles, shocked the chemistry and academic safety communities. C&EN Senior Editor Jyllian Kemsley will review details of the incident and discuss its cultural and legal aftermath. She'll also examine other recent notable demo and lab incidents, their common themes, and institutional responses.

Biography

Jyllian Kemsley went to Amherst College thinking that she'd become a lawyer but was lured into chemistry by some excellent teachers. After getting her bachelor's degree, she spent two years as an analytical chemist at Merck before escaping the "Garden State" for the "Golden State" and graduate studies at Stanford University. Toward the end of her time at Stanford, she was contemplating her career options when a friend introduced her to the concept of "science writer." She retooled her skills in the science communication program at the University of California, Santa Cruz, and then freelanced for several years. She now reports and writes from the San Francisco Bay area for Chemical & Engineering News. She covers topics ranging from atmospheric chemistry, NMR spectroscopy, and laboratory safety to breast milk composition, marijuana quality

Meeting continued from page 2)

to develop breakthrough cryoprotectants enabling complex tissue/organ cryopreservation. She was also the winner of the Patrick Soon-Shiong Innovation Award 2015. X-Therma has been successful startup raising $400,000 initial funding and managed a $7,500,000 equipment procurement project within the petrochemical industry. Dr. Wei is a member of the Society for Cryobiology and the American Chemical Society (ACS), Vice Chair of ACS Younger Chemist Committee (YCC) California section,, and CEO Space International, Scientific Advisor to Life Extension Foundation.

Future CalACS 2016 Programs

April 13th Science Cafe

April 16 YCC panel on Motherhood and Women Chemists, USDA Albany

April 21—Justin Siegel, U Washington —Startups

May—Awards Luncheon

Other potential Meetings
Torey Arvik, Sonomaceuticals, LLC. Obesity, inflammation and grape seed prebiotics
Ruihong Zhang, UC Davis, Recycling waste for energy self sufficiency

Science café

Co-sponsored by
Lafayette Library and Learning Center Foundation
Mervyn L. Brenner Foundation, and the California Section, American Chemical Society

Adam Schnitzer: Art & Science of 3D Layout

From Storyboards to Final Film

The Technical & Creative Process behind CG Layout in Film

Tuesday, March 15th 7pm Community Hall

Discover the world of 3D animation and live action CG with Industrial Light and Magic layout artist, Adam Schnitzer.

Adam will discuss his background & work on titles such as *Toy Story 2, Monsters Inc., Star Wars: Clone Wars, Pacific Rim, TMNT*, *Rango*, and *Strange Magic*.

From storyboards to a finished film, Science Café looks at the layout process, including blocking, composition , cinematography and the tools of the trade.

A rare look inside the world of **Lucas Arts™** and **ILM** answering some of the question "How did they do that?"

NEW:

Purchase Tickets in advance at: *tinyurl.com/3Dlayout*

$10 General Admission—Adults*

$5 LLLCF Donor

*** FREE:** Children 10-15, High School Students w/ID

Tickets Available by Calling: 925-283-6513 X102

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Science Cafe

Wednesday, April 13th 7pm Community Hall

Exploring Northern California's Underwater Wilderness
Speaker: Dirk Rosen, MARE Engineer and Founder
Wednesday, April 13,2016 7:00pm Community Hall
Purchase $15 tickets at: tinyurl.com/ScienceCafeMARE
Current LLLCF donor tickets: $5
Donors, please call to purchase: (925) 283-6513 ext. 102
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After the Anthropocene (Part 1)

Bill Motzer

Introduction

"Life after People," a recent, very popular Discovery Channel TV series described the fragility of our engineered structures (e.g., buildings, bridges, dams, and highways) and how soon these structures would decay and disappear if humans were no longer around to continuously build and maintain them. Except for the pyramids of Egypt and perhaps the Great Wall of China, most engineered structures will last for only a few centuries and most traces will likely be gone within 10,000 years. However, current anthropogenic environmental impacts have now focused some scientists in conducting research on how much of an impact we humans have had on the Earth, proposing a new "Epoch" called the Anthropocene. The current debate among such scientists is when the Anthropocene actually began. Was it when humans first began practicing agriculture (beginning in the Neolithic ~10,000 BCE), or when we began mining and smelting metals (e.g. Copper/Bronze Age ~ 4,000 years BCE), or the first nuclear explosion that spewed radioactive isotopes into the atmosphere and onto the Earth's surface (i.e., beginning of the Atomic Age on July 16, 1945 with the first atomic bomb test)?

Figure 1: Harvard Pit Lake at the former Jamestown Mine near Sonora, CA, which operated from July 1986 to July 1994. Approximately 16.9 Mtons of gold ore was mined averaging 0.057 oz/ton. The final pit measures 1,500 x 3,200 x 660 feet (~440 x 975 x 200 m), which is considered to be a rather small open pit when compared to the largest U.S. open pit at the Bingham Canyon Copper Mine near Salt Lake City, UT, measuring 2.75 miles (4.5 km) across and 0.75 mile (1.2 km) deep. Water in the pit lake is local groundwater upon evaporating results in additional groundwater being drawn into the lake. Photo by W.E. Motzer, May 2007.

This series therefore will focus on what substances/materials (e.g., chemicals) humans have produced and released into the environment that would remain if human

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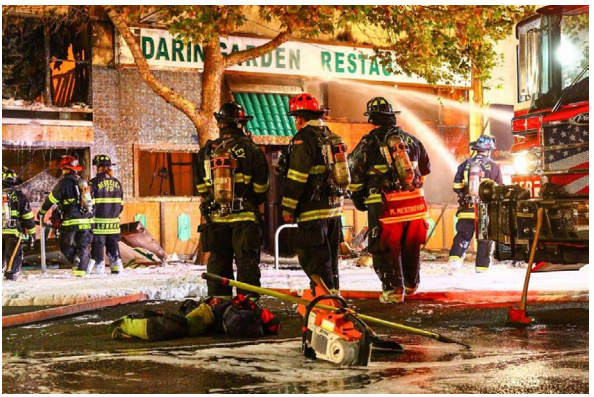
activity were to cease or disappear, and how long they might remain detectable by current analytical methods. According to many scientists, disappearance of humans may be inevitable. Although there are currently more than seven billion of us, no species is considered exempt from extinction and we, like many other species, may succumb to natural (e.g., asteroid/comet impacts: see *The Vortex*: March – April 2010, Impacts of Impacts) or human-caused catastrophes (nuclear/chemical/biological war, climate change), or sometime in the future, we may just migrate to other planets, leaving behind a polluted planet.

Physical Impacts

Human activity is now changing the Earth's topographic surface rivaling natural tectonic uplift and erosion. Examples include mining (open pit and strip), agricultural practices (terracing and soil erosion), road and megacity construction, dam and reservoir impoundments, regional groundwater withdrawal (e.g., causing land subsidence). All such practices result in removal and diversion of huge amounts of soil, rock, and water on a global scale and they are leaving clear topographic signatures embedded on the Earth's morphology. For example, mining and construction soil erosion rates have been estimated in the 1980s to range from ~0.2 to 0.3 mm/year (yr) in the U.S. and in other industrialized countries, upto ~0.6 mm/yr. A natural European erosion rate was calculated at 0.05mm/yr and a global estimated erosion rate at~0.4 mm/yr.

Open-pit mine development is additionally important in that such mining is significantly affected by subsequent increases in raw material and worldwide production demands for concrete, iron and steel, aluminum, copper, gold (see Figure 1), coal, and glass. Such demand and uses are predicted to increase significantly by 2050 with associated increases in global environmental impacts. Refined products from such mining are subsequently "redeposited" globally in roads, city infrastructure (e.g., steel frame and concrete building, landfills, etc.), pipelines, electrical transmission lines, etc., and in associated surface water runoff to rivers and the oceans. Such materials are also now being incorporated into the geological record; how long they can persist will be discussed in future articles.

Berkeley restaurant burns down



The Mandarin Garden, a Berkeley Restaurant, for more than 30 years and a regular site for the monthly Executive Committee Meetings burned down Friday, Nov. 27, 2015.

CalACS will be trying various places to hold its regular monthly Executive Meetings. Until then, check the Vortex or website. www.calacs.org. The next Meeting is on March 1 and will be at Denny's Restaurant in El Cerito, on 1344 San Pablo Ave, 510-235-5900, a 7 minute walk from the Del Norte El Cerrito Bart Station.

Report on November 2015 Section Meeting-- Thorium Nuclear Fuel: Benefits and Challenges

Thorium offers a potentially attractive route to nuclear power as an alternative to the uranium fuel now used in commercial power plants. Thorium is more abundant than uranium, but can be used only after conversion to uranium U-233.

With a thorium-fueled, properly designed molten salt reactor, there is potentially a zero risk of a catastrophic meltdown. Thorium, however, is not immune to proliferation risks. Although the spent thorium fuel contains no plutonium, its radiotoxicity over time is expected to be comparable to that of the spent uranium fuel now stored at plant sites in the U.S. Research is underway to provide the information needed to make thorium-fueled power plants a commercial reality.

Over the years, our Section has periodically had meeting programs on nuclear power. The last one was a presentation in 2008 by Dr. Jasmina Vujic of the Nuclear Engineering Department at U.C. Berkeley, in which she spoke of a "nuclear renaissance". Unfortunately that ended with the Fukushima disaster in 2011, when loss of water cooling resulted in the meltdown of the cores of three U-235-powered reactors and ultimately in the release of radioactive materials. This event was a major setback for conventional uranium-based nuclear power throughout the world. It led to a renewed interest in thorium, which has been known for decades as an alternate fuel but has never been used for commercial power production. Some of the most important research was done at Oak Ridge National Laboratory in the 1960s using a molten salt reactor system. Thorium has been receiving increasing attention from governmental research organizations as well as private enterprises, which see thorium as a much safer alternative to uranium. Proponents of thorium point to its abundant availability, potentially meltdown-proof operation, and reduced proliferation risk. Attesting to the wide range of interest in the subject, a meeting of the International Thorium Energy Organization was held in Mumbai, India last October, at which 46 speakers representing 35 countries presented papers.

To obtain a better picture of what thorium has to offer, we sought an unbiased expert. We found him in Prof. Massimiliano Fratoni of the U.C. Berkeley Nuclear Engineering Department, who graciously accepted our invitation to bring us up to date, and who provided the above heading for his presentation.

Our meeting at the Chevron Technical Center was opened by Charlie Gluchowski, Section chair. Dr. Fratoni began his talk by noting the current strong interest in thorium, quoting a headline stating "Uranium is so last century - enter thorium, the new green nuke". He said that he is neutral on the subject, neither for nor against thorium. Discussing reactor principles, he explained that to be useful as a nuclear fuel, an isotope must be capable of controllable fission. Fission is induced when a neutron collides with and is absorbed by a "fissile" nucleus such as that of U-235. Fission results in the production of smaller nuclei, 2 to 3 neutrons, and gamma radiation. The energy released in the process appears as heat and is converted to electric power, while the neutrons induce more fission events, resulting in a chain reaction. Natural uranium consists of over 99% U-238, and only about 0.7% U-235, which happens to be the only naturally occurring isotope prone to fission. Since the natural U-235 concentration is too low to initiate a chain reaction, the uranium is enriched to about 5% for power plant use and is installed in reactors in the form of solid rods. Although U-238 is not fissile, it is "fertile", meaning it can absorb neutrons to produce unstable U-239, which after two beta-emission (electron loss) steps becomes fissile Pu-239. Although some of the plutonium fissions, most ends up in the spent fuel, which is now stored at commercial plant sites in the U.S. without recycling.

The situation with thorium differs from that of uranium in many respects. Thorium is three to four times more abundant than

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uranium, with India, Brazil, Australia and the U.S. each accounting for over 9% of known world reserves. The element is found mainly as the phosphate in the mineral monazite, along with several rare earths. Unlike U-235, Th-232 is not fissile, but is considered "fertile", i.e. absorption of a neutron will not cause fission but will result in conversion to Th-233, which after two beta-decay steps involving protactinium Pa 233 yields U-233, which is fissile (it was discovered by Glenn Seaborg and co-workers in 1940). In that respect thorium resembles the fertile U-238 in the conventional uranium cycle that leads to the formation of plutonium-239. The two processes are compared in one of Dr. Fratoni's slides. In both cases the final products, Pu-239 and U-233, are capable of fission after absorption of a neutron. In both cases a nuclear reaction cycle has to be initiated with a "seed" such as U-235 or Pu-239.

Thorium fuel has been tested in many reactor types in several countries. A molten salt reactor performed successfully in experiments at Oak Ridge National Laboratories in the 1960s, using separately prepared U-233. The molten salt concept is considered by many to be the most promising for a thorium fuel cycle. A typical solvent consists of a blend of lithium and beryllium fluorides. Thorium-232 fluoride is added as the fuel, along with a seed such as U-235 fluoride initially, until enough U-233 is produced to start a self-supporting chain reaction. After the seed has been exhausted, only Th-232 will need to be added as the fuel for continued reactor operation. Reactor operating temperatures are in the 550 to 700° C range. The advantages of a properly designed, homogeneous molten salt system are an essentially zero risk of a meltdown and release of radioactive materials, the possibility of adding fuel and removing end products continuously without the need for a shutdown, and the absence of plutonium in spent fuel products. Dr. Fratoni pointed out that, contrary to claims made by some proponents of thorium, spent reactor fuel products will be comparable to spent uranium fuel in their short- and long-term radiotoxicity. He also cautioned that the proliferation risks of the thorium fuel cycle cannot be easily ignored. With additional processing, it may be possible to produce purified U-233, which is potentially as effective in weapons applications as U-235 or Pu-239. Dr. Fratoni repeatedly emphasized that more research is essential before thorium-based power plants achieve commercial status. He ended his presentation with a listing of references, the most informative of which (in my opinion) was a 2015 OECD report; it can be accessed at http://goo.gl/wO8uJ6.

Dr. Fratoni's presentation was followed by a lengthy question-and-answer period, which indicated the audience's interest in the subject. I thank Dr. Frantoni for his presentation and Chevron for making the Technical Center's auditorium available.

Igor Sobolev

CalACS has a limited number of livermorium pins available at $7.50 each for the first 50 purchased. E-mail lr101898.aol.com for details.

Element 116 is in honor of Lawrence Livermore National Laboratory. The Livermore scientists collaborated with Flerov scientists in the lab in Russia to synthesize superheavy elements.

Partners for Progress and Prosperity

The California Section is now soliciting nominations for the 2016 P3 Salute to Excellence to recognize outstanding partnerships from our local section. The 2016 P3 Salute to Excellence will be presented at our traditional Awards Luncheon this May along with our 50, 60 and any 70 year ACS members and other California Section awards.

The P3 Award winner will then be automatically submitted for the P3 Award at the next Western Regional Meeting. Self nomination packages or other nominations for the P3 Award for the California Section should be received by the end of March. Please email nominations or any questions to marindawu@gmail.com

Please visit www. acs.org/regional awards for details regarding the P3 Award established to recognize outstanding partnerships. All the regional meetings across the country last year awarded P3 Medals plus up to $1K to honor great partnerships for the first time.

Some of you might recall that my presidential theme was "Partners for Progress and Prosperity" (C&EN, 2013). My priorities as President included 1) concentrating on members' needs and interests; 2) collaborating to enhance the global chemistry enterprise; 3) communicating the value and benefits of chemistry to society; and 4) celebrating diversity and inclusivity (core values of ACS).

Thanks again to many who worked together to support my presidential theme of how we can all be "Partners for Progress and Prosperity! (P3)" It was fabulous to see all 2015 Regional Meetings and also International Activities participate in recognizing excellent collaborations and partnerships with P3 Awards this past year.

The California Section awarded the first P3 Salute to Excellence last year to Dr. Elaine Yamaguchi for her outstanding partnerships with mentors, donors, and teachers for Project SEED.

Thanks again for all your support over the years!

Marinda Li Wu, 2013 ACS President

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