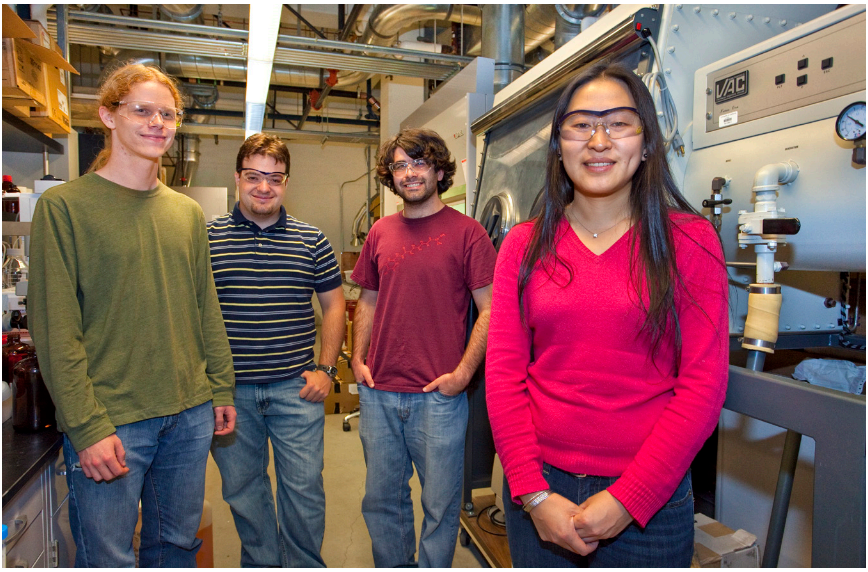
THE VORTEX

AMERICAN CHEMICAL SOCIETY
VOLUME LXXII NUMBER 7

CALIFORNIA SECTION
SEPTEMBER 2011



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THE VORTEX

Published monthly except July & August by the California Section, American Chemical Society. Opinions expressed by the editors or contributors to THE VORTEX do not necessarily reflect the official position of the Section. The publisher reserves the right to reject copy submitted. Subscription included in $13 annual dues payment. Nonmember subscription $15.

MAGAZINE OF THE CALIFORNIA SECTION, AMERICAN CHEMICAL SOCIETY

Volume LXXII September 2011 Number 7

Chair's Message

Bryan Balazs

As I am writing this column, I have just returned from two back-to-back trips in conjunction with the ACS, in locations about as far apart on Earth as you can get. The first was the final debriefing meeting of the 2010 Pacifichem Conference Organizing Committee, in Hawaii, where it was celebrated at the conclusion of a very successful five-year cycle for the conference last December. Suggestions for the next organizing committee were made to enable an even better conference in 2015. The second trip was to the International Chemistry Olympiad (IChO) in Ankara, Turkey, where the US delegation spent an exhilarating week, leading up to the awarding of two gold medals and two silver medals to the four high school students of the US team. Forthcoming were also ideas for July of 2012, when the IChO will be hosted at the University of Maryland outside of Washington DC.

A number of folks on the Executive Committee are going to be at the ACS National Meeting in Denver at the end of August, and discussions will be held on some of the issues considered at this meeting. Councilor Mark Frishberg has done an excellent job over the years in summarizing the issues that will come up before Council at each meeting, and in providing a report of each meeting after it occurs. Mark's latest report from the National Meeting last Spring in Anaheim is in the May Vortex, starting on page 11. Most Members are looking forward to Mark continuing to provide these excellent and informative summaries!

One final note before we going too far into the 2011-2012 academic year: the ACS annual membership dues notices will be arriving in your mailboxes soon, and please do not forget to consider checking the local section dues box on this notice. These funds, which are directly transferred to CALACS from ACS National, allow the Section to keep the costs of monthly section meetings low (one might be surprised at what some restaurants want to charge these days for rubber chicken dinners), fund grants to needy schools for chemistry equipment, and offset the costs of other member activities and services. $15 per year might not seem like much, but as with voting, our contributions taken together make a big difference for what the Section can offer to our members and the public within the California Section. Speaking of voting, remember also to vote for our local section officers when the ballots appear in early Fall!

September California Section Joint Meeting with the Golden Gate Polymer Forum

Title: Direct Hierarchical Assemblies Using Secondary Interactions
Speaker: Ting Xu Assistant Professor of Chemistry, UCB, LBNL Faculty Scientist
Time: Thursday, September 22, 6:00 PM social hour, 7:00 PM dinner, 8:00 PM presentation
Location: Michaels Restaurant, 2690 North Shoreline Boulevard, Mountain View, CA
Cost: vegetarian $20, chicken $25 fish $30, + $5 if reservations are made after Sept 15
Reservations: Please register (for both dinner or talk-only) by email to office@calacs.org, or call the office at (510) 351-9922. When mailing a check in advance, please made out to "California Section ACS" and send to the Cal Section office, 2950 Merced St. #225, San Leandro CA 94577, postmarked no later than September 15.
Directions: US-101 S, Take exit 400A for Rengstorff Ave/Amphitheatre Parkway, Sharp right onto Rengstorff Ave (signs for Amphitheatre Pkwy), Turn left onto N Shoreline Blvd, Keep right at the fork, Turn left,Turn right, Continue straight

Abstract:

With rapid developments in chemistry, many molecular building blocks can be readily synthesized. Controlled assembly of functional building blocks over multiple length scales has great potential to advance technologies and will impact human health, renewable energy and environment. However, generating hierarchically structured materials in a manner similar to that seen in nature represents a fundamental scientific challenge.Dr. Xu will focus on some recent advances in directed self-assemblies over multiple length scales in multi-component systems including peptides and proteins, nano-particles, organic semiconductors, and polymers. These efforts can lead to functional materials with features down to the molecular level and contain inherent biological, electronic and optical properties for catalyst, filters, lithography, optical devices and regenerative medicines. Equally important is the focus of efforts on achieving this using secondary interactions to ensure long-term sustainability. Dr. Xu will also discuss some opportunities these studies present as well as challenges to advance the field of nano-materials.

Biography:

Professor Ting Xu received a M.S in Polymer Physics from Changchun Institute of Applied Chemistry, Chinese Academy of Science in 1999 and a Ph.D from the Department of Polymer Science and Engineering at the University of Massachusetts, Amherst in 2004. She was a joint postdoctoral fellow between the University of Pennsylvania and the Cold Neutrons for Biology and Technology (CNBT) Partnership Program at NIST before she jointed UC, Berkeley in January 2007.

Among her awards are 2007 DuPont Science and Technology Grant recipient; 2008 3M Nontenured Faculty Award recipient; 2008 DuPont Young Professor Award recipient; 2009 ONR-Young Investigator Award recipient; named as one of "Brilliant 10" by Popular Science Magazine in 2009; 2010 Li Ka Shing Woman Research Award recipient; 2011 Camille-Dreyfus Scholar-Teacher Award recipient; and 2011 ACS Arthur K. Doolittle Award recipient.

Her current research efforts focus on fundamentally understanding the hierarchical self-assembly of complex systems

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The Women Chemists Committee,
California Section of the American Chemical Society
2011 Fall Meeting
Saturday October 1, 2011, 10 AM
Presentation, Lunch and a Tour of the
Lawrence Berkeley National Laboratory Cyclotron

Some Career Highlights and Influence of Marie Curie on Women Scientists

By Professor Darleane Hoffman

Cost: $10 for lunch (sandwich buffet, beverages, fruit)
Reservations: RSVP by Wednesday, September 21, to the Section office by e-mail at office@calacs.org or call (510) 351-9922.
To pre-pay: Please mail checks made out to "California Section ACS" to the Cal Section office, 2950 Merced St. #225, San Leandro CA 94577, no later than Friday, September 16, 2011.

Abstract:

Dr. Hoffmann will touch on a few highlights of her career and then discuss some of Marie Sklodowska-Curie's less well -known contributions as *Teacher, Mentor, Research Center Founder, and Director of the Laboratory or "la Patronne"* as she was sometimes called. Her influence as a role model for women scientists will be discussed, both when she was a wife and mother and researcher, and in her later role as a "single mother" after husband Pierre was tragically killed, leaving Marie alone to pursue their scientific research and raise two young daughters, ages 8½ and ~1½ years old. She will also comment on the celebration this year of the 100th anniversary of the Award of the 1911 Nobel Prize in Chemistry to Marie Curie as the sole recipient.

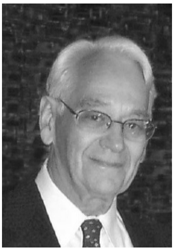
Biography:

Darleane Christian Hoffman, Professor Emerita, University of California, Berkeley (UCB) Chem. Dept. is retired from active teaching, but continues to advise graduate students. She is also Faculty Sr. Scientist in the Nuclear Science Division of Lawrence Berkeley National Laboratory (LBNL), advises students and postdoctoral fellows in addition to serving on several national committees.

Research interests include: rapid chemical separation of short-lived fission products; separation chemistry of lanthanide, actinide and transactinide elements; studies of radionuclide migration in geologic media; studies of fission; heavy ion reactions and production of new heavy element isotopes; *atom-at-a-time* studies of chemical and nuclear properties of the heaviest elements.

She received B. S. and Ph. D. degrees in physical (nuclear) chemistry from Iowa State University, and served as chemist at Oak Ridge National Laboratory and Los Alamos Scientific Laboratory, becoming Division Leader of Chemistry-Nuclear Chemistry and Isotope & Nuclear Chemistry Divisions. She moved to UC Berkeley as Prof. of Nuclear Chem. and LBNL Heavy Element Nuclear & Radiochemistry Group Leader. She was co-founder and first Director of the Seaborg Institute for Transactinium Science at Lawrence Livermore National Laboratory. 19 students have received their Ph. D.s under her direction and she has mentored a host of postdoctoral fellows and students at all levels. She has received major awards and honors and has published 280 articles, numerous book chapters and the book, ***"The Transuranium People: The Inside Story"*** by Hoffman, Ghiorso, Seaborg (2000).

For directions to LBNL see: http://www.lbl.gov/Workplace/Transportation.html
Use main entrance to LBNL off Centennial Rd. Driving up from the Stadium the entrance is above UC Botanical Garden, on your left. Proceed to gate. Ample parking is available.



ELK-N-ACS

Evaldo Kothny

Strontium

The name Strontium is derived from Strontian, a town in Argyle Shire in Scotland. Near this town are limestone beds which contain crusts of strontianite (a carbonate) and celestite (a sulfate) of a peculiar structure. This differentiated material was discovered and described by Adair Crawford and William Cruikshank in 1790. Description of these minerals enticed Humphrey Davy to isolate the metal, which was accomplished in 1808. The element is the number 38 of the series of elements and has a mean atomic weight of 87.

It would be interesting to know if any of our readers remember the chemistry kits that were available in toy stores back in the forties. They contained a small bottle with strontium nitrate. It made reactions similar to calcium and barium, however, it is non-toxic and biologically may partially replace calcium. Besides, it produced a bright red or crimson color when introduced into a flame.

Strontium carbonate resembles both chemically and physically its parent material, limestone. Like limestone, it slowly dissolves in carbonic acid saturated water. It fuses at 774 C, its hardness is 3.5 - 4 and its specific gravity is 3.7. The solubility of strontium compounds are considerably higher in hot water. This characteristic is useful when employing the hydroxide as a clarifying agent for beet sugar refining. However, its mainly use is in pyrotechnics. Strontium can also be useful in archeology: the isotopic content in tooth enamel with its limited local variability can be compared with the bone content of the same individual subject which permits drawing some conclusions about its age or original location.

The metal is totally insoluble in concentrated nitric acid, but dissolves very quickly in diluted acids.

Deposits containing strontium compounds have not only been found in Scotland. Commercial quantities were extracted from deposits in Germany, Mexico, Spain and California. In California, strontianite and celestite are found in both limestone deposits and in dry lake borates.

Non-radioactive isotopes are those of atomic weight 84, 86, 87 amd 88. Radioisotopes are those of atomic weight 89 and 90. In general these latter isotopes are of artificial production. The one of big concern is the isotope of atomic weight 90. The fallout from atomic experiments or from bombs collects on surfaces. If the dust falls on edible vegetation, the strontium will be disguised by the calcium content of such vegetation, thus it may be ingested and mixed with the calcium ever present. In the worst scenario, contaminated grass is ingested by milk producing cattle, thus radioactive strontium appears in milk. Uptake and assimilation of calcium contaminated with radioactive strontium does the most harm in children during bone formation and in the years thereafter. (half life =25 years.)

Available strontium can be analyzed from soil extracted with normal ammonium acetate. The values obtained are usually between 0.5 and 32 mg/kg of soil, although the net content may be between 50 and 1000 mg of strontium per kg of soil.

Strontium is not rare, even though so little is heard about it. Rocks such as granite bear nearly 300 ppm and basalt nearly 500 ppm. It is highest in limestone at nearly 600 ppm. Seawater has about 8 mg per liter, whereas freshwater (lakes, rivers) contains only 0.05 mg per liter (150 times less than seawater).

Vegetation quickly adapts to the presence of strontium. Therefore the content in ash may reflect its presence in soil (usually Sr content in plant material is a minimum of 2 up to 3000 mg/kg dry matter, ten times higher in ash). It seems to accumulate in algae (dry matter content varies from 60 to 1600 mg/kg). Animal or fish tissue contains about 15 mg/kg. Strontium content is highest in bones (36 - 100 mg/kg). A 70 kg person may bear a total of about 320 mg Sr.

And now a final question. Can anyone sense the excitement of this discovery as it was then? Nowadays hard work precedes a fleeting discovery of perhaps four atoms of a new element surviving a few seconds.

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The Sanitary Revolution (Part 2)

Bill Motzer

Introduction

In Part 1 (*The Vortex*, June 2011) I discussed how drinking water chlorination and filtration helped to virtually eliminate water borne diseases in developed countries in the 20th century. However, this "Sanitary Revolution" would have been incomplete without treatment of the subsequent wastewater and sewage. We get up in the morning and turn on the tap, make breakfast, wash our dishes, and use the bathroom – flushing the toilet without thinking of what happens to the drained waste water. The common expression for this is "out of sight, out of mind." Without sewage treatment, life in modern urban environments would be impossible; therefore, the second part of the Sanitary Revolution is the modern physical and chemical treatment of wastewater and sewage.

Modern sewage is created by residential, institutional, commercial and industrial establishments; it includes household waste water mixed with other liquids discharged from toilets, baths, showers, and kitchens commonly disposed of via sewers, but in rural areas it may be discharged to septic systems. Sewage can also include liquid waste from industry and commercial establishments such as restaurants. In some areas it may include storm water runoff in a combined sewer system; however this is generally avoided because large amounts of precipitation runoff cause high inflows that reduce Publically Owned Treatment Work (POTW) plant efficiencies and result in spills and overflows to streams, rivers, and bays. Combined systems also require larger, more expensive, treatment.

Brief History of Sewage Disposal

Designed sewage disposal dates back to at least 4000 BCE (~6,000 years ago) in what is now Iraq. Dwellings had percolation systems, commonly installed 10 to 15 meters under houses that were used to drain wastes. These consisted of round, vertical cesspits lined with perforated brick. By ~2800 BCE, houses of wealthy inhabitants in Mohenjo-Daro (now in Pakistan) contained a separate latrine room with lavatories built into the outer walls. These were "Western-style" toilets made from brick topped with wooden seats. They were connected to vertical chutes through which wastes dropped into sewers that ultimately drained to large cesspits or directly to the Indus River. At Skara Brae in Orkney, Scotland (3100 to 2500 BCE) some houses contained primitive indoor plumbing pipes and drains or troughs that carried dwelling water and wastes out to a nearby creek.

From approximately 2700 to 1500 BCE, the Minoan civilization on the island of Crete constructed paved roads and streets with well designed drainage systems in which household water and sewage were drained away through buried clay pipes. Evidence also exists for flush toilets, with overhead reservoirs that were filled and flushed by servants or slaves. The Roman Republic and Empire (~500 BCE to 400 CE) was noted for construction of numerous Roman aqueducts supplying clean water to cities, industry, and agriculture. Rome itself was supplied by 11 aqueducts with a combined length of 350 km; most were constructed below ground with only a few above ground supported by arches. The Romans made major advancements in sanitation; they are particularly known for their public baths and residential plumbing and flush toilets were connected to a complex sewer system that carried waste water away to the Tiber River.

With the fall of the Roman Empire and start of the European "Dark" or Middle Ages, most drainage and sewer systems fell into disrepair and disuse, not to be resurrected for hundreds of years. Hygienic and recreational bathing ceased with wastes routinely thrown into the streets. This period is also known as "the Descent from Cleanliness;" it apparently did not occur in Asian cultures. Until the late 1500s, people became increasingly careless about how and where they deposited bodily wastes; public elimination became so blatant that waste disposal protocols had to be devel-

(Continued on page 14)

The July 19th issue of C&EN reported on the outstanding performance of the four high school students of the USA team at the recent International Chemistry Olympiad (IChO) in Ankara, Turkey. They are Konstantin Borisov of North Allegheny Senior High School in Pennsylvania, Joe Tung of Gretchen A. Whitney High School in California, Tayyab Shah of Vestal High School in New York, and Elmer Tan of John P. Stevens High School in New Jersey. But did you know that there is a local connection with the California Section and this annual event? Starting with the Olympiad exam at the local level next April 2012 led by Al Verstuyft in conjunction with other volunteers from both our section and the Santa Clara Valley Section, the students' scores from this exam will be assessed with those of other sections to come up with the team for the 2012 IChO, and this is where the California Section comes into the story.

Our current Section Chair, Bryan Balazs, is also the Chair of the 2012 IChO, and he is busy working with ACS staff and many others to organize this event, which will be at the University of Maryland, College Park. The attached picture is of Bryan at the Turkey Olympiad, where the official transfer of the IChO flag from Turkey to the US occurred. The next year promises to be busy, as Bryan will be dealing with a host of logistics problems, made even more complex by the mix of over 600 mentors, students, guests and dignitaries from 70 different countries, with the resultant challenges in terms of language, dietary, and cultural issues. The Olympiad next year will be July 21-30, and Bryan would be happy to fill you in with more details on the event; he can be contacted at bb@llnl.gov.

2011 California Section Election

The California Section, ACS, will be holding an election in the fall for these positions:

Chair-elect (three year term, Chair-elect, then Chair, and, following, Immediate Past Chair)
Treasurer (two year position, ex officio member of the Board of Trustees)
Director (two year term)
Member-at-Large (five open positions, nominal two year terms)
Councilors (three open positions, three year terms)
Alternate Councilors (three open positions, three year terms)

The Chair-elect, Treasurer, and Director are also members of the Section's Board of Directors. All the elected persons are members of the Section's Executive Committee. The Member-at-Large positions are open to Student Members of the Section as defined by the American Chemical Society.

If you wish to be a candidate for any of these positions or want further information, please contact Paul Vartanian, chair of the Section Nominations and Election Committee pfvartanian@gmail.com, (510) 763-0195] or leave your contact information with the Section Office, (510) 351-9922, for a return call. Thank you for considering getting involved in the governance of the California Section.

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involving de novo designed peptide and peptidomimetics, block copolymers and nanoparticles and apply it toward generating functional materials exhibiting novel properties.

CATALYST FOR POSITIVE CHANGE
Marinda Wu, Candidate for ACS President-Elect
California Section

As a 40-year ACS member, I am dedicated to serving members' needs and our profession. Years on the ACS Board have strengthened my resolve to act as a catalyst for positive change!

Global competition, escalating underemployment, eroding science/engineering enrollment, widespread science illiteracy, and record budget deficits are among many challenges facing our profession. Innovative and strong leadership is needed to tackle tough challenges.

I work hard to turn challenges into opportunities by creatively thinking through problems, building bridges, and getting things done. If elected, I will serve our members' interests by:

- Advocating to improve the U.S. job climate
- Supporting lifelong professional growth
- Promoting science literacy & education
- Building bridges for strategic collaboration

Businesses need tax credits, competitive trade policies and fewer regulatory, economic, and IP barriers to foster new technologies and jobs in the U.S. We must explore innovative ways to equip members for today's competitive global work environment and help with retraining, drawing upon the untapped potential of senior chemists.

Local section members and students need more career support--ever more apparent when I present ACS career workshops. ACS meetings and journals must be at the forefront of science & technology plus fortify job stability and professional growth.

For three decades, I forged partnerships between industry, academia, government, and communities. I gained technical, managerial, and entrepreneurial experiences at large and small chemical companies, including start-ups. Visit www.marindawu.com for details on my priorities and extensive ACS involvement at local, division, regional, and national levels.

Society needs to gain a better appreciation for science! I partner with a local library on monthly Science Cafes to improve the public's perception of science. I have long been an Ambassador for Chemistry working in public outreach.

I have not only the energy and commitment, but the passion, understanding and leadership experience to represent your interests and work together to turn challenges into opportunities. I welcome input at marindawu@gmail.com and ask for your vote.

Editor's Note

A longer statement can be read on the Section's website, www.acs.org

ACS: Of, By, and For the Members

By Dennis Chamot
Candidate for ACS President-elect

Chemical professionals in industry, academia and all levels of government have suffered from employment cut backs, minimal salary increases or salary freezes, and enormous uncertainty about the future. Off-shoring R&D has accelerated in recent years, while the nation's economy experiences the slowest and longest recovery from recession in decades.

So what can the ACS president do?

First, we have to recognize that empty oratory serves no purpose. I do not make promises I cannot keep, but I keep the promises I make.

Second, the problems facing chemical professionals have many causes. ACS cannot solve them alone, but our Society must be much more actively involved in the debates searching for solutions.

I accepted the invitation to run for ACS president primarily because of the huge problems we face. I have the experience to be more than a figure head, and I would like to make a difference.

I have been an active and influential member of the Board of Directors since 2002. I co-founded the national Division of Professional Relations and was its chair, Councilor, and newsletter editor. I chaired the Committee on Economic and Professional Affairs (CEPA), the Committee on Project SEED, and the Budget and Finance Committee during the bleak years of 2008-2009 (for more, visit www.dennischamot.org).

Outside of ACS, I have presented congressional testimony, and served on advisory panels at NSF, U.S Department of Education, NIOSH, Department of Labor, and the National Research Council. As a senior manager at the National Academy of Sciences, I often interact with government, industrial and academic leaders.

As ACS president, I will engage in direct discussions with corporate and elected leaders, both to encourage short term actions and to explore longer term options. The future of chemistry in the United States is at risk, and we must be more proactive in working on realistic solutions to very difficult problems.

The strength of ACS is its members. If we do what is best for our members, we will be doing what is best for ACS, and for chemistry. I seek your support so that I may work with you to make things better!

Editor's Note

A longer statement can be read on the Section's website, www.acs.org

September Historical Events In Chemistry
by Leopold May

September 1, 1909 Rohm & Hass Co. was founded on this date.

September 4, 1913 Stanford Moore who was born on this date, did research on enzymes. He shared the Nobel Prize in Chemistry in 1972 with William H. Stein for their contribution to the understanding of the connection between chemical structure and catalytic activity of the active centre of the ribonuclease molecule and Christian B. Anfinsen for his work on ribo nuclease, especially concerning the connection be tween the amino acid sequence and the biologically active conformation.

September 6, 1906 Luis J. Leloir who isolated glucose 1,6-diphosphate and uridine diphosphate glucose; was born on this day. He also synthesized trehalose with E. Cabib in1953 and sucrose with C. Cardini and J. Chiriboga in 1955. He received the Nobel Prize in Chemistry in 1970 for his discovery of sugar nucleotides and their role in the biosynthesis of carbohydrates.

September 9, 1877 Aleksandr E. Arbuzov , who was born on this date, studied organophosphorous compounds and the rearrangement of phosphite esters (Michaelis-Arbu zov reaction

September 13, 1886 One hundred and twenty-five years ago on this date, Robert Robison was born. He was a researcher in plant pigments, alkaloids and phenanthrene derivatives and received the Nobel Prize in Chemistry in 1947 for his investigations on plant products of biological importance, especially the alkaloids.

September 14, 1961 Fifty years ago on this date, Analtech, inc., the manufacturer of products for thin layer chromatography, was founded as Custom Service Chemicals. Its name was changed on January 8, 1965 to Analtech, Inc.

September 14, 1936 Seventy-five years ago on this date, Ferid Murad, a researcher in role of NO and cyclic GMP; was born. He shared Nobel Prize in Physiology or Medicine in 1998 system with Robert F. Furchgott and Louis J. Ignarro for their discoveries concerning nitric oxide as a signaling molecule in the cardiovascular system.

September 19. 1861 One hundred and fifty years ago on this date, Alexandre M. Butlerov presented the first definition and use of the term, “chemical structure”, before the Speyer Congress.

September 24, 1895 André Frédéric Cournand, who performed the first clinical heart catheterization, was born on this date. He shared the Nobel Prize in Physiology or Medi - cine in1956 with Werner Forssmann and Dickenson W. Richards for their discoveries concerning heart catheterization and pathological changes in the circulatory systeem.

September 26, 1886 One hundred and twenty-five years ago on this date, Archibald V. Hill, a researcher on oxygen consumption of muscular action, was born. In 1922, he shared the Nobel Prize in Physiology or Medicine for his discovery relating to the production of heat in the muscle and Otto F. Warburg for his discovery of the fixed relationship between the consumption of oxygen and the metabolism of lactic acid in the muscle.

September 28, 1852 One hundred and twenty-five years ago in 1886, Henri Moissa discovered fluorine (F, 9). He invented an electric furnace in which he prepared metal carbides and silicon carbides. In 1906, he received the Nobel Prize in Chemistry in recognition of the great services rendered by him in his investigation and isolation of the element fluorine, and for the adoption in the service of science of the electric furnace called after him. He was born on this date.

Additional historical events can be found at Dr. May’s website, http://faculty.cua.edu/may/ChemistryCalendar.htm.

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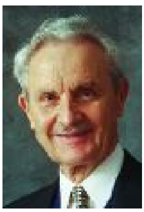
A World Without Chemistry?

Attila Pavlath
Senior Emeritus Research Chemist, U.S. Department of Agriculture



International Year of CHEMISTRY 2011

In this International Year of Chemistry, it's a good time to think about the ways that chemistry influences our daily lives. In fact, life without chemistry would be …. well, NOTHING at all! Obviously, chemistry is important for Health & Medicine, and Food & Agriculture, but did you ever consider how it impacts Energy & Transportation, or even Information & Communication? Join us at our next science café as speaker Dr. Atilla Pavlath, Senior Emeritus Research Chemist and Past President of ACS will present an entertaining and informative evening (really) with diverse examples of how chemistry contributes to our everyday lives. Neither lab goggles nor knowledge of chemistry are required!

WHEN: Tuesday, September 27th ~ Doors Open 6:30 PM, Program 7:00-8:00 PM

WHERE: Lafayette Library and Learning Center, 3491 Mt. Diablo Blvd.

RSVP: Reserve@LLLCF.org or (925) 283-6513 x.101

COST: $ 5.00 per person

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Thursday 20 October 2011
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oped. It is believed that the practice of a gentlemen walking closest to the street with a lady was prompted by wastes thrown outward from second-story windows; the Dejecti Efflusive Act passed in Rome allowed one to collect damages if hit by thrown wastes.

By the early 1800s, sewage in major European cities commonly flowed in street ditches or trenches that drained to local streams and rivers. The Thames River became an open sewer and numerous cholera epidemics in London occurred when contaminated surface water polluted unprotected well heads. England's 1848 Public Health Act required such well head protection. However it was The Great Stink of 1858 see (http://www.youtube.com/watch?v=CNwytBDbsrw) that made Parliament address the problem with creation of a modern sewerage system. Constructed between 1859 and 1865, these intercepting sewers were fed by 720 km of main sewers which conveyed contents of 21,000 km of smaller local sewers. Construction of the London interceptor system required removal of 2.7 million m^3 of excavated earth, the use of 318 million brick and 670,000 m^3 of concrete. Similar sewage transfer systems were constructed in Boston, New York, and Chicago. However, sewage remained largely untreated until the 20th century.

By 2008, in the U.S. there were approximately 21,594 operating POTWs that provided waste water collection, treatment and disposal services to 226.4 million people or 74% of the U.S. population.

Modern Sewage Treatment Processes

Typical municipal sewage consists of ~99% water and generally less than one percent solids, normally containing oxygen-demanding materials such as sediments, grease, oil, scum, pathogenic bacteria, viruses, salts, algal nutrients, pesticides, refractory organic compounds, heavy metals, and other solids such as clothing, sponges, and plastic bags. POTWs must remove and treat as much of these materials as possible before discharging treated sewage; they do this through several step processes involving three distinct stages:

Primary treatment in which raw sewage is initially held in basins so that heavier solids can settle out while oil, grease and lighter solids such as plastics float to the surface. Settled and floating materials are removed by screens; the remaining liquid is either discharged or subjected to secondary treatment.

Secondary treatment removes dissolved and suspended biological matter generally by using indigenous micro-organisms and/or adding chemicals that cause flocculation. Supplemental separation processes may add chemicals to remove micro-organisms prior to discharge or tertiary treatment.

Tertiary treatment may be performed if treated waste water is discharged to highly sensitive or fragile ecosystems such as rivers, wetlands, bays or estuaries, and adjacent oceans where coral reefs or fisheries; or groundwater basins with downstream drinking water wells. Tertiary treated waters are commonly disinfected chemically or physically prior to discharge or used for landscape irrigation or for agricultural irrigation.

In Part 3, I'll discuss more about POTW treatment chemistry and what may be the

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of a new element surviving a few seconds. This scenario is hardly comparable with a discovery of substance such as strontium. And that is what is called progress. Are you really satisfied with this kind of progress?

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