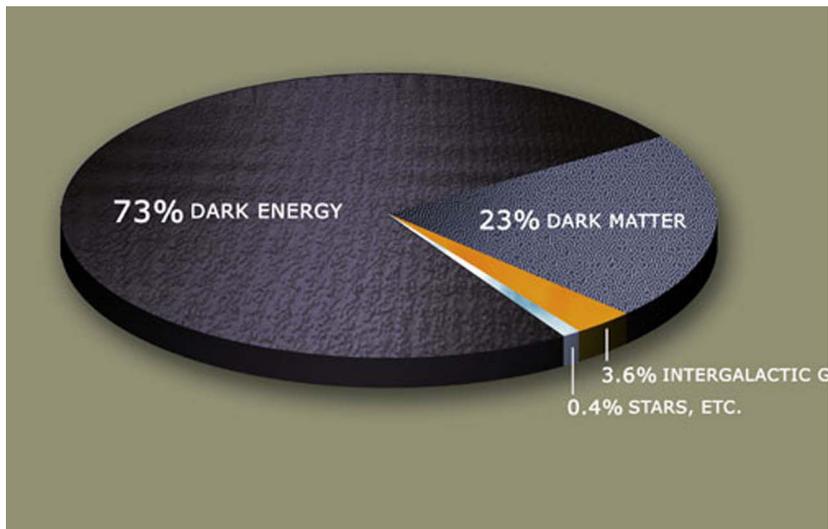


# THE VORTEX

AMERICAN CHEMICAL SOCIETY  
VOLUME LXXIV NUMBER 1

CALIFORNIA SECTION  
January 2013



How much Dark Energy is in our solar system or galaxy?  
Find out at the January 22 meeting. See page 4.

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## Chair's Message

Wally Yokoyama

Welcome back from the Holidays. I want to thank the section members who have generously volunteered their time in bringing exciting chemistry programs to the public by planning and working at the many local community and educational activities in 2012. Some of these activities include Earth Day in Martinez, a booth at the Solano Stroll in Albany, National Chemistry Week at MLK Middle School in Berkeley, Science Café in Lafayette, Tour of Sierra Nevada Brewery in Chico, and many others. The Section also had many successes at the national level. One of our own, Dr. Marinda Wu, was elected 2013 President of ACS and Drs. Head-Gordon, Latimer and Sobolev were elected ACS Fellows. We had a great loss with the death of one of our most stalwart volunteers, Dr. Glenn Fuller who had dedicated most of his life to California section community activities including Project SEED.

The future of the U.S. economy is highly dependent on an educated, especially technically and scientifically knowledgeable, work force. This is particularly true in the Bay Area, a region known worldwide for its innovative climate and high technology industries. Students are first introduced

to chemistry in high school and their teachers may inspire them to pursue careers in chemistry. In order to recognize the contribution of chemistry teachers the section has a monetary award and recognition program for high school teachers, the Lloyd Ryland Outstanding Chemistry Teacher Award. The award is supported by a generous gift to the Section by Mr. Ryland. The Section also sponsors an Educational Grants program for high school or college chemistry programs to provide equipment necessary for chemistry education.

Project SEED is a national program supported locally by large and small chemistry related industries. The California Section has the second largest program in the U.S. In particular, we want to recognize the contribution of Chevron Oil for its generous support to the SEED summer research program for over 30 years and to a former Chevron employee, Dr. Elaine Yamaguchi for her management of the program. We need more industrial chemists participation at the local level to inspire students to interesting and exciting careers in chemistry and related industries.

We have had many recent years of excellent programming and leadership, and I know that we can maintain that momentum in 2013. I look forward to chairing the Section this year and continuing the valuable local section activities.



*SCIENCE CAFE*  
*Co-Sponsored by*  
*Lafayette Library and Learning Center Foundation*  
*California Section ~ WCC of the American Chemical Society*

Tuesday, January 22, 2013  
Science Cafe - Dark Energy and the Runaway Universe  
WHEN: Tuesday, January 22nd

Doors Open 6:30 p.m. ~ Program 7:00 to 8:00 p.m.

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

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Join us to hear Alex Filippenko, Professor of Astronomy, UC Berkeley, as he discusses the expansion of our Universe and how it is speeding up with time, driven by mysterious “dark energy.” Dating back to 1998, observations revealed that the expansion rate of the Universe is speeding up with time, rather than slowing down due to gravity as expected. This discovery was honored with the 2011 Nobel Prize in Physics to the team leaders. The origin of the repulsive “dark energy,” creating

the runaway Universe, may be the biggest unsolved mystery in physics.

Alex Filippenko, one of the world’s most highly cited astronomers, was the only person to have been a member of both teams that discovered the accelerating expansion of the Universe. Alex was voted the “best professor” on the UC Berkeley campus a record nine times and was the 2006 National Professor of the Year!



### *Installations of Section Officers*

At the December Executive Committee meeting, the following officers were installed.

Chair-elect Mark Frishberg  
Secretary Michael Cheng  
Director Bryan Balazs  
Member-at-Large Alec Brozell  
Councilors Lee Latimer, Eileen Nottoli  
Alternate Councilor Don MacLean



Mark and Kathy Frishberg



## ELK-N-ACS

Evaldo Kothny

### POTASSIUM

The following article is based on articles published in Science 205/4406 10, Aug. 1979, in Chapter 1 of "Trace Element Analysis",

edited by V. Valkovic, John Wiley, New York 1975, and in several encyclopedias and other sources.

#### *Origin of potassium in the galaxies.*

The original Universe started with what is called the Hadron era. This was followed by the Lepton era, then by the neutrino era and then by the radiation era. Thus, during radiation thousands of million photons and neutrinos were transformed into one nucleon of hydrogen. The tenuous gas held together by gravity began a gravitational collapse until its density increased roughly 18 orders of magnitude and its spherical radius decreased accordingly. During this gravitational collapse, the gas, which initially was transparent, heated up and became opaque to the point of emitting radiation itself and initiating a burning process of hydrogen into helium, releasing additional energy. This process is known as the stellar era that is characterized by the presence of stars and galaxies.

The slow contraction that set in and which

converts a part of the hydrogen into helium and higher elements occurs with collision of a pair of nucleons. For this to happen, the temperature must be sufficiently high to allow the reaction to penetrate through the repulsion barrier.

Many low atomic weight elements are produced through a variety of processes in a radiation environment at the prevailing high temperature (3000+ million degrees Kelvin.) They may not only include hydrogen, helium, deuterium, neutrons, etc. but new elements such as Be, C, O, Ne, Mg, Si, Ar, Ca, N. Additional neutrons produced during this initial reaction allow the transformation and growth of larger nuclei. With a statistical equilibrium around Fe, additional nuclei such as V, Sn, Mn, Co, Ni appear in the mix. These processes are slow compared to the beta decay rate (i.e., in the Sun one neutron captured every few thousand years). With this model, it is possible to explain the production of most atomic elements below Ti, which include potassium isotopes of atomic weight 39 and 41 and a small portion of those elements between Cu and Bi. However, bear in mind that the composition of the stars is 99% of hydrogen and helium and only 1% of all other remaining matter combined.

In cosmogenesis it is generally accepted, that smaller celestial bodies (planets, meteorites) are a result of splitting off solid matter from stars (from explosions, collisions). The ensuing cooling of these



(Continued on page 10)



## *The Dirt on Dry Cleaning (Part 1)*

**Bill Motzer**

### *Introduction*

We all like clean clothes and many of us have washing machines and clothes dryers in our homes that we routinely use. We also take some of our clothing to local dry cleaners. But do we actually know what happens to our clothing once we leave it at the drop-off desk? Or is this another case of out-of-sight, out-of-mind?

Dry cleaning is any process by which textiles and garments are cleaned using very little to no water. Modern dry cleaning commonly uses solvents, typically tetrachloroethane (formerly known as perchloroethylene or “perc”), to clean fabrics such as wool that might suffer shrinkage when washed in water or to clean delicate fabrics such as silk and many synthetics that cannot withstand rough treatment from washing machines and clothes dryers. This and subsequent articles will discuss the history, chemistry, and processes involved with a rather unique cleaning method.

### *Dry Cleaning in Ancient Times*

Clothing in ancient times (e.g., during the Egyptian and Babylonian civilizations) were commonly cleaned by washing in stream or river water. Washing clothes in this manner was not a problem because clothing commonly worn in tropical and arid (desert) climates was made from linen woven from flax plant stems. In ancient Egypt (from about 3100 BCE to the collapse of the Ptolemaic dynasty with the death of Cleopatra VII in 30 BCE) linen was the preferred textile. Peasants, workers and others of modest means generally wore nothing; however, a linen head covering known as the shenti was worn by all people. Some clothing may have been dyed with soluble plant dyes; however, most was left in its natural color. Therefore, the “running” of dyes by water washing was not a problem. Although the ancient Egyptians had developed synthetic pigments, these were mostly used in wall paintings, furnishings, statues, and objects

such as cylinder seals, beads, scarabs, inlays, pots and statuettes (see “The First Chemists,” December 2010 Vortex).

Wool clothing was also worn by the ancient Egyptians but was considered as an “impure” material and therefore it was forbidden to be worn in temples and sanctuaries. Because of its scarcity, wool was sometimes used for overcoats that only the wealthy could afford. By 3000 BCE, the ancient Egyptians had developed sophisticated methods for cleaning wool that included a complex mixture composed of an aqueous soda solution, clay, vinegar (acetic acid), slaked lime (calcium oxide), a caustic potash (lye) solution, and vegetable-based surfactants such as soap wort.

The ancient Greeks used more wool in their clothing and most likely began experimenting with nonaqueous substances for cleaning such textiles. Such dry cleaning may have been practiced in Greece as early as 1600 to 1100 BCE by the Mycenaeans because the term “dry cleaner” is included in a list of over 100 occupations inscribed on Mycenaean clay tablets. These “dry cleaners” probably used grease-absorbent earths and sands to remove spots from clothing.

To launder their famous white woolen togas, ancient Romans improved and perfected the Greek dry cleaning process, which continued to be used into the 1800s. This improved dry cleaning process used several different materials and chemicals including a type of clay known as fuller’s earth – used to absorb oil, dirt, and grease from woolen fabrics. A mixture of lye and ammonia was used to remove other stains (e.g., wine). These ancient cleaners were called “fullers” because the fulling process generally involves scouring and milling (thickening) the cloth by pounding with the fuller’s feet, hands, or a club.

Fuller’s earth clays are complex aluminum silicates usually with high magnesium oxide content and high sorptive capacities. Such clays are commonly composed of the minerals montmorillonite (smectite) or palygorskite (attapulgite) or a mixture of the two. The ancient Romans mined clay

*(Continued on page 7)*

(continued from page 6)

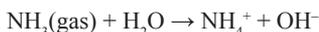
for bricks and pottery but the most famous deposits were in the Bath region of Roman Britain, where fuller's earth occurs in the Lower Greensand, a glauconitic sandstone formation in the west of England.

Lye was primarily derived from wood ash (see "California's First Analytical Chemist?," November 2011 Vortex) by soaking hard wood ashes (potash) in boiling water to leach out both potassium hydroxide (KOH) and potassium carbonate ( $K_2CO_3$ ).

The Romans knew about and had access to ammonium chloride ( $NH_4Cl$ ) deposits from near the Temple of Amun in ancient Libya. These ammonium salts were called "sal ammoniacus" (salt of Amun) because of their proximity to the temple. However, most ammonia usage in Roman dry cleaning was derived from fermented urea [carbamide or  $(NH_2)_2CO$ ] that's contained in urine. Human urine is about 95% water with urea concentrations ranging from 9,300 to 23,300 mg/L. Therefore, this "stale" urine, often called "wash," was the principal source of ammonium salts that assisted in cleansing and whitening the cloth. The general urea to ammonia reaction is:

$$(NH_2)_2CO + H_2O \rightarrow NH_3 + H_2NCOOH$$
$$\rightarrow 2NH_3(gas) + CO_2(gas)$$

(urea) + (water) → (ammonia) + (unstable carbamic acid) → (ammonia) + (carbon dioxide). This gaseous ammonia reacts with water forming ammonium and hydroxide ions:



Laundries generally obtained urine from farm animals, or from special pots located at public latrines. Such *Fullonicae* became very prominent, large industrial laundries, with at least one in every town with a substantial population and many became the largest employer in a district. Urine collection became so profitable that fuller's guilds were formed, ultimately becoming an important political constituency. Subsequently, the Roman emperor Vespasian (69 to 79 CE) imposed and collected a tax on public urinals. However, most fulling labor was performed by slaves who worked the cloth while ankle deep in tubs of fermented animal/human urine.

Finally, whitening was also enhanced by exposing cleaned togas to sulfur dioxide ( $SO_2$ ) produced by open burning of native sulfur. Surface native sulfur deposits are common to the volcanic regions surrounding Rome and Sicily, where in ancient times the "Sicilian process" was used. This involved the stacking of mined sulfur in brick kilns built on sloping hillsides. Some sulfur was pulverized, spread over the stacked ore, and then ignited, resulting in the melting of free sulfur, which ran downhill to be collected in pits. Eventually, surface deposits played out, and miners began exploiting underground sources that ultimately dotted the Sicilian landscape with labyrinthine mines. Ancient mining was labor-intensive, mostly conducted by slaves and condemned criminals who worked under horrific conditions.

In subsequent articles, I will discuss both the history and chemistry of modern solvent dry cleaning and the problems associated with such use.



*44th Western Regional Meeting  
October 2-5, 2013*

*Nine months and counting*

Jointly sponsored by the California and Santa Clara Valley Section, the 44th Western Regional Meeting will take place at the Hyatt Regency Hotel in Santa Clara, October 2-5, 2013

*Essence of Modern HPLC/UHPLC:  
Perspectives, trends and opportunities  
Michael W. Dong, PhD*

Date: Thursday, Jan 24, 2013. Reception: 5:00, Talk: 6:00  
Place: Chevron Research, 100 Chevron Way, Richmond, CA  
Reservations: office@calacs.org (510-351-9922).  
RSVP: By Friday, Jan 18, 2013

Directions: From SF Bay Bridge Take 80 North (Towards Sacramento), Exit Right on 580 at 80/580 Split. Continue about 6 mi from the split and take Richmond Pkwy/ Pt Richmond Exit. Chevron parking is directly across from the offramp. Pdf maps available from the office.

*Summary:*

The advent of ultra-high-pressure LC (UHPLC) and its successful commercialization in recent years has resulted in a modern HPLC platform capable of higher speed, resolution, precision and sensitivity. Currently, all major HPLC manufacturers have some types of low-dispersion UHPLC product offerings with upper pressure limits ranging from 15,000 to 19,000 psi. Many practitioners believe that the transformation from HPLC to UHPLC as the standard platform is already complete.

In this talk, the essence of modern HPLC as the premier analytical technique for research and quality control is discussed. The many attributes of HPLC responsible for its longevity and predominance are described with their incremental performance improvements afforded by new instrumental and column technologies. The historical developments, recent advances in UHPLC and future trends are summarized with their impacts on myriad industries and research activities. Common HPLC corollaries, myths and faux pas, often missed by beginners or experienced practitioners, are examined.

*Biography:*

Dr. Michael W. Dong is a Senior Scientist at Genentech, South San Francisco. Prior to joining Genentech, he was the Research Director at Synomics Pharma, a Research Fellow at Purdue Pharma, Senior Staff Scientist at Applied Biosystems / Perkin-Elmer, and a Section-Head at Hoechst Celanese. He holds a Ph.D. in Analytical Chemistry from the City University of New York, and a Certificate in Biotechnology, UC Santa Cruz. He has been invited to present numerous courses at national meetings (ACS, Pittcon, EAS, HPLC, CACO) on HPLC / UHPLC, pharmaceutical analysis, and drug development process. He is an Instructor on drug quality fundamentals at UC Santa Cruz extension. He has published over 80 journal articles and articles, and 3 books on chromatography and analytical chemistry including a best-seller in chromatography, "Modern HPLC for Practicing Scientists", Wiley, 2006 and co-edited the "Handbook of Pharmaceutical Analysis by HPLC", Elsevier/Academic Press, 2005. He is an editorial advisory board member of LC.GC magazine and American Pharmaceutical Review.

-----  
*Announcement*

American Chemical Society Historic Chemical Landmark awarded to USDA Albany Laboratory in 2013 for "Development of Chemical Basis of Food Flavor." Prior to Dr. Dong's main talk there will be a short announcement of the ACS award for the concurrent development of the early gas chromatograph and mass spectrometer in the 1950s that allowed Bay Area scientists to elucidate the structure of volatile flavor molecules. Today's nano level instruments arose from those humble instruments built in garages.

## *The Division of Chemistry and the Law Establishes the Howard and Sally Peters Award for Non-Traditional Careers in Chemistry*

The ACS Division of Chemistry and the Law (CHAL) has created an award regarding non-traditional careers in chemistry in honor of chemists Howard and Sally Peters— long-



term members of the Santa Clara Valley Local Section. This is the first award established by CHAL in more than twenty years, and it was presented for the first time to both Howard and Sally to recognize their significant lifetime contributions to non-traditional careers in chemistry. Howard has laboratory research experience in high explosives at SRI International, Menlo Park and is now retired after a 30-year career as a patent attorney in the Silicon Valley. Sally has laboratory research experience at Geneva College, Beaver Falls, Pennsylvania and the Department of Chemistry at Stanford University. She is now retired after 28 years as a chemical information specialist with XEROX PARC in Palo Alto, CA.

The award presentation occurred at a dinner following the CHAL Executive Committee meeting held on Sunday, August 19, 2012 during the 244th American Chemical Society National Meeting in Philadelphia, PA. It was first announced at the CHAL reception held Monday, August 20, 2012 at the Chemical Heritage Foundation.

The award presented to Howard and Sally was the first of many annual presentations with plans to recognize one or two ACS members each year. Recipients of the award will be those who have significantly contributed to or who have been significantly involved in non-traditional careers in chemistry. An ACS plaque and an honorarium for future Peters Awards will be provided. Further details about the Peters Award will be featured in the coming months on CHAL's official ACS website which can be found at [www.chemistryandthelaw.org](http://www.chemistryandthelaw.org).

Howard was instrumental in establishing CHAL as a subdivision of the Division of Chemical Information (CINF) during the 1980s. Sally was a Charter Member of CHAL. They have 50 years of combined membership in CHAL, about 50 years of service on the ACS Council, and 80 years of ACS membership. The Peters are often better known as Mr. & Mrs. Chocolate for their long-running fun presentations on "Chocolate-Food of the Gods" in many nationwide venues.

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(continued from page 5)

fragments stops the atomic processes and differentiation by parting begins. On Earth, during the first parting, molten magma and gases separate into the inner and outer core, mantle, and crust, although the boundaries between these layers are not strongly defined. The core seems to consist of molten iron with a similar composition as that of iron meteorites (iron, nickel, silicon, carbon, sulfur and phosphorus plus minor elements, possibly Co, Ru, Pd, Cr, Mo and V). As the magma further cools, the heavier fractions (containing Fe oxides and dunite/olivine) sink in the silicate mix and crystallize as basalt in the outer core carrying with it S, P, Cr, Ti, Cu, Co, Ni, Zn.

Afterwards, the bulk of the magma crystallizes and collects in the mantle. The composition is similar to the outer core but the magma now collects most of the Na and K silicates. The igneous rocks of the following layer, the crust, consist of gabbro, diorites, granite and gneiss, all four crystallizing in this sequence. About 60% of the crust represent feldspars whereas the remainder consist of amphiboles, pyroxenes, mica and quartz. Potassium is mostly contained in feldspars and mica.

In the third parting, all exposed rocks are hydrolized. Potassium, same as sodium and calcium, dissolves in water (oceans) with the interplay of carbon dioxide, sulfur compounds and other acidic substances. Since potassium has an absorptive affinity to clay, it partially remains in the soil mixture together with insoluble oxides, silicates, quartz and other hydrous oxides. Basalt hydrolizes into serpentine.

Potassium content in grams per kilogram substance.

Granite	33
Basalt	5 to 8
Dunite	0.1
Crust	2
Kaolin	0.2
Clay	27
Coal	2.9

Ethiology of a name.

In the Old Testament, Potassium was named *NETER*. The old Greeks named it *NITRON*, and the Arabs referred to it as *NATRON*. In the write-ups appearing in the 14<sup>th</sup> and 15<sup>th</sup>

century, the alchemist Geber (Latinized Arab name of Jabir-ibn-Hayyan, an alchemist who lived in the 8th century) was credited for coining the names *NITRUM*, *ALKALI* and *SODA*. The salts from the Soda Lake in northern Egypt were famous for embalming. Thus Soda is another original name for sodium, and natron became the symbol for sodium (Na). Confusion ended after the 16<sup>th</sup> century, when the substances' names denoted their origin, such as *SAL TARTARI*, *SAL VEGETABILE*, *SAL LIXIVOSUM* (alkali carbonate), *NITRUM*, *SALTPETER*, and *SODA*.

Around 1750-1800, the extract from wood ashes (formerly denoted as one of the "salts") was also called "Pot ash" (Pottasche in German), the origin of Potassium. "Alkali", was split into *AL-KALI*, which originated the term *KALI*, the origin of the symbol K for Kalium, an identical term for potassium.

Everybody is familiar with tides, an effect of the attraction of the moon and sun onto the oceanic waters. Less familiar is the same effect on the Earth's crust. The motion of the tides on movement of the crust creates each time a tiny expansion and contraction (about one millimeter which equals 2 - 4 cm a year). During expansion, gaps are refilled with semisolid basalt, called pillow lava. After cooling and contraction, the solidified lava exerts lateral pressure which pushes the continental plates apart. On a grand scale, the plates build up mountain ranges, originate subduction on the continental margins, heat up and melt rocks by friction and releases gases creating volcanoes. After erosion of the mountain ranges and comminution of rocks to soil, these processes were the origin of fresh potassium containing material. Thus, this potassium in soil is now available for vegetation.



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