

**PROCEEDINGS  
of the  
PACIFIC DIVISION  
AMERICAN ASSOCIATION for the ADVANCEMENT of SCIENCE**

**Volume 28, Part I**

**14 August 2009**

**90<sup>th</sup> ANNUAL MEETING of the AAAS, PACIFIC DIVISION**

**PROGRAM WITH ABSTRACTS**



**CALIFORNIA ACADEMY of SCIENCES  
and the  
SAN FRANCISCO STATE UNIVERSITY  
SAN FRANCISCO, CA  
14 – 19 August 2009**



**CALIFORNIA  
ACADEMY OF  
SCIENCES**



## San Francisco State University Map – Location key

Administration (ADM) -- J8-9	Coppola Theatre -- H6	Health Center (SHS) -- G6	Mail Services -- E5	Police -- D4	Temporary Buildings -- F9
Amer. Language Institute (ALI) -- G7	Corporation Yard -- D4	Hensill Hall (HH) -- G9-10	Maloney Field (hardball) -- E2-3	Recycling -- E-F6	Tennis Courts -- D2
Bookstore -- H7	Creative Arts (CA) -- I6	HSS -- H-19	Mary Park Hall (MPH) -- F2	Science (SCI) -- G-H9	Thornton Hall (TH) -- F8
Burk Hall (BH) -- H-G6	Dining Center (City Eats) -- G3	Humanities (HUM) -- H5	Mary Ward Hall (MWH) -- G2-3	Seven Hills Center -- F3	The Towers (Cent. Sq.) -- G4
Business (BUS) -- H/I-8/9	Ethnic Studies & Psych. (EP) -- G6	Jack Adams Hall (SC) -- H7	McKenna Theatre (CA) -- I6	Shipping & Receiving -- D5	University Park North -- A5-E9
Cesar Chavez Student Center -- H7	Facilities -- D4	Knuth Hall (CA) -- I6	Memorial Grove -- G7-8	Softball Field -- H1-J2	University Park South -- J2-J9
Car Rental / Lot 25 -- B4	Fine Arts (FA) -- H6	Labor Archives -- B5	One Stop Center -- G5	Stud. Housing Office (MWH) -- G3	Village at Cent. Sq. -- G3-4
Child Care Center (Assoc. Stud.) -- F2	Garden of Remembrance -- H6	Library (LIB) -- J7-8	Parking Garage (main) -- E-F5	Student Services (SSB) -- G5	
Chidren's Campus -- C3-D4	Greenhouse -- F9	Library Annex I & II -- D3-4	Parking & Transportation -- D4	Studio Theatre (Creative Arts) -- I6	
Conference Ctr. (The Towers) -- G4	Gymnasium (GYM) -- G7-8	Little Theatre (CA) -- I6	Physical Therapy -- G7	Sutro Library -- B5	



**Map of San Francisco State University.** The parking structure is colored blue; the buildings in which the meeting will take place are colored yellow; the Seven Hills Center is colored red; the Cesar Chavez Student Center is colored orange.

***PROCEEDINGS***  
*of the*  
***Annual Meeting***  
*of the*  
***AAAS, PACIFIC DIVISION***

***Volume 28, Part I***

***14 August 2009***

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***PROGRAM with ABSTRACTS***

**90<sup>th</sup> Annual Meeting of the Pacific Division of the  
American Association for the Advancement of Science**

***San Francisco State University  
and the  
California Academy of Sciences  
San Francisco, CA  
14 – 19 August 2009***

*Contents accurate as of 22 July 2009.  
Times and/or locations of events may change.  
Please refer to the “Changes” flyer for updated information.*





## Future Pacific Division Meetings

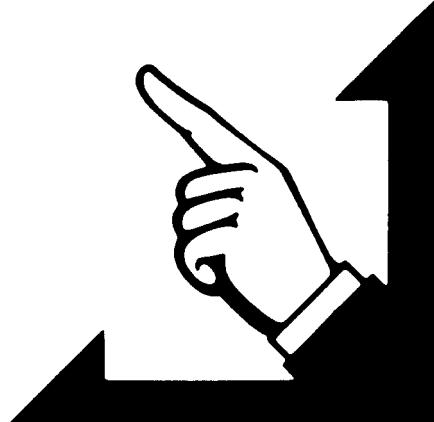
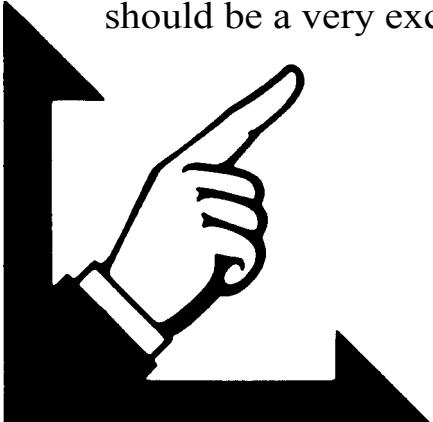
**Mark your BlackBerry, your BlueBerry, or  
whatever flavor Berry you carry  
with these important events!**

### **13 – 17 June 2010 in Ashland, OR**

Meeting again on the campus of Southern Oregon University in beautiful Ashland, the program will feature a number of workshops, some very special field trips, the opportunity to attend some of the best Shakespeare in the U.S., and, of course, a complete technical program of symposia, contributed papers, contributed posters, and special lectures. *New this year* will be an exhibit of science-related art. Please see page 24 of these *Proceedings* for additional information and directions on how to submit works for this exhibit.

### **12 – 16 June 2011 in San Diego, CA**

We'll be returning to the Spanish Renaissance architecture of the University of San Diego, sitting on the bluffs overlooking San Diego and Mission Bay. In addition to a wide array of programs already being planned, the Seventh World Mummy Congress will join us. This should be a very exciting meeting!



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San Francisco State University..... Inside Front Cover

## POLICIES

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### Publication

Publication of symposia or other technical sessions or talks that have been prepared under the auspices of the AAAS, Pacific Division requires written permission of the AAAS, Pacific Division as well as that of the individual organizers and speakers.

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Abstracts and summaries published in this Proceedings reflect entirely the individual views of the authors and not necessarily that of the AAAS, Pacific Division, its Council, Executive Committee or its officers. Presentation of ideas, products or publications at this AAAS, Pacific Division meeting or the reporting of them in news accounts does not constitute endorsement by the AAAS, Pacific Division.

### Standards of Conduct

On April 14, 1978, the AAAS Board of Directors adopted the following position statement regarding standards of conduct at AAAS meetings:

"The Board takes it for granted that all who attend the Annual Meetings of the Association will conduct themselves with consideration for others and with particular consideration for those who generously give their time and thought to the sessions. Differing opinions will continue to be heard and respected. We recognize that there are areas of science that are both controversial and troubling. The Annual Meeting can serve as an effective forum to consider such issues, so long as procedures of orderly debate and fairness are followed. Courtesy and abusive behavior have no place in the annual Meeting. When excesses occur they do great injury to the Association and to the process of discussion. They cannot be condoned."

The AAAS, Pacific Division, as part of the larger organization, ascribes to this position and will, if necessary, take appropriate measures to assure adherence to it.

### No Smoking Rule

On December 30, 1971, the AAAS Council approved a motion requesting that persons in attendance refrain from smoking at Council meetings and scientific and public sessions. The AAAS, Pacific Division ascribes to this policy and asks that all persons who attend the meeting comply with this ruling.

### Meeting Development

The technical programs of AAAS, Pacific Division meetings are developed by proposals submitted by individuals and/or groups of individuals and overseen by the Executive Committee and Executive Director of the Division. Symposium planners are responsible for developing lists of presenters that represent fairly the topic at hand. Papers submitted separately from symposia, referred to as Contributed Papers and Contributed Posters, are reviewed by section chairs prior to their inclusion in the program.

All program review is based on scientific significance, timeliness, balance, and clarity of organization. In the case of symposia and workshops, this review is based on materials provided by planners or submitters and does not include a technical examination of individual presentations.

### Student Awards of Excellence

The Council, Executive Committee and officers of the AAAS, Pacific Division are committed to encouraging the scientific development of students by offering them a friendly yet scientifically robust environment in which to present their research results. Part of that environment includes evaluating student presentations and rewarding students' superior efforts. To that end, the Division has developed an extensive program of student Awards of Excellence that are given at both the sectional and divisional levels. More information about this program may be found on page 13 of this Proceedings.

## Planning Committee for the 90<sup>th</sup> Annual Meeting

**Chair at San Francisco State University:**  
*John E. Hafernik*, Department of Biology, San Francisco State University, San Francisco, CA.

**Chair at the California Academy of Sciences:**  
*Terrence L. Gosliner*, Department of Invertebrate Zoology and Geology, California Academy of Sciences, San Francisco, CA.

### **Program Development:**

*William B.N. Berry*, Department of Earth and Planetary Sciences, University of California, Berkeley, CA  
*Robert L. Chianese*, English, California State University, Northridge, CA

*H.K. Choi*, Department of Biology, California State University Dominguez Hills, Carson, CA

*Robert Christiansen*, U.S. Geological Survey (Retired), Menlo Park, CA

*Kenneth A. Cornell*, Chemistry and Biochemistry, Boise State University, Boise, ID

*J. Thomas Dutro, Jr.*, U.S. Geological Survey (Retired), Washington, D.C.

*Stephen Frost*, Department of Anthropology, University of Oregon, Eugene, OR

*Terrence Gosliner*, California Academy of Sciences, San Francisco, CA

*John E. Hafernik*, Department of Biology, San Francisco State University, San Francisco, CA

*Walter Carl Hartwig*, Touro University College of Osteopathic Medicine, Mare Island, CA

*Frank Jacobitz*, Department of Engineering, University of San Diego, San Diego, CA

*Alan E. Leviton*, California Academy of Sciences, San Francisco, CA

*Michael D. MacNeil*, USDA Agricultural Research Service, Miles City, MT

*Carl A. Maida*, Schools of Dentistry and Medicine, University of California, Los Angeles, CA

*Owen M. McDougal*, Department of Chemistry and Biochemistry, Boise State University, Boise, ID

*Donald J. McGraw*, Ephraim, UT

*D. Jeffrey Meldrum*, Department of Biological Sciences, Idaho State University, Pocatello, ID

*J. Kenneth Nishita*, California State University Monterey Bay, Seaside, CA

*Henry Oman*, Seattle, WA

*Michael Parker*, Department of Biology, Southern Oregon University, Ashland, OR

*Panos Photinos*, Department of Chemistry, Physics, Materials Science and Engineering, Southern Oregon University, Ashland, OR

*Anne A. Sturz*, Associate Dean, University of San Diego, San Diego, CA

*Richard Van Buskirk*, Department of Environmental Studies, Pacific University, Forest Grove, OR

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*John Hafernik*, San Francisco State University, San Francisco, CA

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*D. Jeffrey Meldrum*, Idaho State University, Pocatello, ID

*Wolff-Michael Roth*, University of Victoria, Victoria, B.C.

*Anne A. Sturz*, University of San Diego, San Diego, CA

### **Counselor, non-voting:**

*Alan E. Leviton*, California Academy of Sciences, San Francisco, CA

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# Pacific Division



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### PRESIDENTIAL NOMINATING COMMITTEE

**Terrence Gosliner**

California Academy of Sciences

### EXECUTIVE DIRECTOR

**Roger G. Christianson**

Southern Oregon University

14 August 2009

Dear Conference Attendees:

Welcome to the 90<sup>th</sup> Annual Meeting of the Pacific Division of the AAAS jointly sponsored by the California Academy of Sciences and San Francisco State University. We have an extraordinarily exciting program this year in a vibrant and cosmopolitan location. The central theme of the meeting, “Sustainability in an Evolving World,” manifests in various guises. Some sessions take place at the newly opened Academy museum, an icon for green building technology. Other sessions take place at the SFSU campus, where faculty and students grapple with global and local environmental issues related to a pluralistic society. We have special celebrations for the 150<sup>th</sup> anniversary of the publication of *On the Origin of the Species* by Charles Darwin and the 200<sup>th</sup> anniversary of Darwin’s birth. I hope you will take full advantage of this opportunity to find new intellectual insight, cultural understanding, and urban adventure. I look forward to seeing you at the social events, public lectures, workshops, and field trips, as well as the technical sessions.

*Anne Sturz*

Anne Sturz, Ph.D.  
President, AAAS, Pacific Division



Photo courtesy Anne A. Sturz

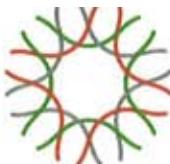
Office of the Executive Director

American Association for the Advancement of Science, Pacific Division  
Southern Oregon University • 1250 Siskiyou Boulevard • Ashland, OR 97520-5071

Tel: 541-552-6747 Fax: 541-552-8457

E-mail: rchristi@sou.edu

Website: <http://pacific.aaas.org>



CALIFORNIA  
ACADEMY OF  
SCIENCES

55 Music Concourse Drive  
Golden Gate Park  
San Francisco, California 94118  
[www.calacademy.org](http://www.calacademy.org)

July 2009

Dear AAAS Attendees:

Welcome to the California Academy of Sciences. We like to call it a "natural future institution" because everything we do in our programs of research, education, and public engagement deals with two of the most important and provocative questions of our time: How we got here (the nature of life) and How we will find a way to stay (the challenge of sustainability.)

I also like to call the academy the Kingdom of Wow! Because Wow! is the most often heard exclamation of our visitors. You see, everything we show here is real – real fish, real plants, real specimens of real life – and real is a lot more interesting than an image on a screen.

So enjoy your time in this remarkable building that houses a remarkable organization. Check out the Steinhart Aquarium, the Osher Rainforest, and the other exhibits. Don't forget to leave time for "Fragile Planet" in the Morrison Planetarium. It sets the context for everything else. And don't hold back on a Wow! or two!

Sincerely,

Gregory C. Farrington, Ph.D.  
Executive Director  
William R. and Gretchen B. Kimball Chair

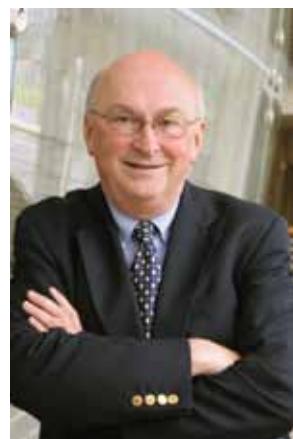


Photo courtesy California Academy of Sciences.



OFFICE OF THE PRESIDENT

August 14, 2009

Dear Colleagues:

On behalf of San Francisco State University, I am pleased to extend a warm welcome to all of you who have gathered here to attend the 90<sup>th</sup> annual meeting of the American Association for the Advancement of Science, Pacific Division.

This will be the sixth time that SF State has hosted this gathering. We were especially eager to do so this year because the meeting would coincide with the opening year of the highly-praised new California Academy of Sciences in Golden Gate Park and with the Academy's two-day symposium on Charles Darwin, enriching the exciting program that AAAS developed for this meeting.

The connection between the California Academy and the University is particularly close. SF State biology Professor John Hafernik -- your President-elect -- is also the Academy's president. Our two institutions have a long history of partnership, a link that serves the University and the community at large superbly well.

The College of Science and Engineering (COSE) is one of SF State's greatest points of pride. Most recently, we were delighted to learn that SF State biology Professor Frank Bayliss, whose programs to find and nurture talented minority students have won SF State national recognition, has been awarded a Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. He will receive it at the White House this fall. Students from those programs are going on to earn Ph.D.s at top institutions around the nation.

Over the next several days, you will focus on the timely and challenging theme of sustainability. The program is rich, the subject central to our shared future. Enjoy all that this conference and this remarkable city and University have to offer.

Sincerely yours,  
  
Robert A. Corrigan  
President



Photo courtesy San Francisco State University





Tim Griffith, California Academy of Sciences

"Fragile Planet – Milky Way" from inside the planetarium at the California Academy of Sciences.

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**GENERAL INFORMATION**

- PACIFIC DIVISION SECTIONS  
SPONSORING SESSIONS  
at the SAN FRANCISCO MEETING**
- Agriculture and Horticultural Sciences
  - Anthropology and Archaeology
  - Atmospheric and Oceanographic Sciences
  - Chemistry and Biochemistry
  - Cell and Molecular Biology
  - Computer and Information Sciences
  - Earth Sciences
  - Ecology, Organismal Biology and Environmental Sciences
  - Education
  - General and Interdisciplinary
  - Health Sciences
  - History and Philosophy of Science
  - Industrial Sciences and Technology
  - Physics and Materials Science
  - Psychology
  - Social, Economic, and Political Sciences

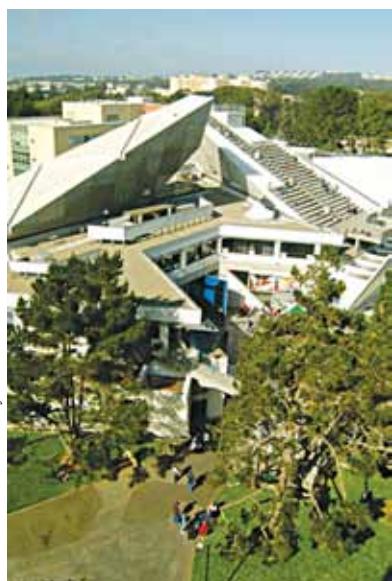
**SAN FRANCISCO UNIVERSITY**

The forerunner of San Francisco State University, the California State Normal School, was founded in 1862 in San Francisco. Two subsequent name changes and three changes of location within the city brought the institution to its present 130-acre campus in southwest San Francisco in 1954. It received university status in 1972.

San Francisco State University is part of the 23 campus California State University—the largest system of public higher education in the country—and is a multipurpose coeducational institution with more than 30,000 students and 1800 faculty members. More than 93 percent of the students come from within the State of California, 22 percent of whom are from the San Francisco Bay Area. Through its eight schools, Behavioral and Social Sciences, Business, Creative Arts, Education, Ethnic Studies, Health and Human Services, Humanities, and Science and Engineering, the University offers undergraduate and graduate instruction for professional and occupational goals as well as liberal arts education. Bachelor's degrees are offered in 115 academic areas, master's degrees in 95 areas, and doctorate degrees in special education (in cooperation with UC Berkeley) and Educational Leadership (Ed.D.). Also offered is an M.S.

## GENERAL INFORMATION

San Francisco State University  
Cesar Chavez Student Center on the SFSU Campus.



in physical therapy leading to a clinical doctoral degree (D.P.T.) and a joint research doctorate with UC San Francisco for licensed physical therapists (D.P.T.Sc.).

The focal point of the campus is the Student Union. With its two dramatic leaning pyramids, it is a campus landmark. The Union houses a number of restaurants, a pub-coffee shop, meeting rooms, and a game center. The major

academic buildings cluster around the Union, on the edges of a grassy quadrangle. The Creative Arts complex is the largest facility of its kind in San Francisco. It contains four theaters, a concert hall, music and drama rehearsal areas, and one of the largest television and radio production facilities in northern California. The Science complex features a modern planetarium, marine biology research facilities, herbarium, vertebrate museum, bioacoustic laboratory, greenhouses, extensively equipped physics and chemistry laboratories, and computer science facilities.

The University Library houses more than 1.1 million titles and subscribes to almost 5,000 print periodicals and scholarly journals and 22,000 electronic journals. It also houses the Frank V. de Bellis Collection of Italian culture. The Sutro Library, with its special collections of historical materials, is situated in a modern building on the north edge of campus.

In addition to the Romberg and Tiburon Centers, the University has two other off-campus field centers for special study; Moss Landing Marine Laboratory, on Monterey Bay, 100 miles south of San Francisco, and the Sierra Nevada Field Campus in the foothills of the Sierra Nevada. The San Francisco State University downtown center, located in the heart of the city, offers classes for personal and professional development, as well as meeting and conference facilities.

San Francisco State University is a multipurpose institution of higher education located in a large, diverse urban setting. Excellence in teaching is the University's primary mission and distinguishing feature, although commitments to research and service to the community are high priorities.

The University enjoys the advantage of being in one of the most exciting and cosmopolitan cities in the world. It is

just minutes away from the San Francisco Zoo, Ocean Beach and Cliff House, Golden Gate Park, California Academy of Sciences and Steinhart Aquarium, De Young Museum of Fine Arts, Strybing Arboretum, Japanese Tea Garden, Exploratorium, and many other nearby museums. It is also less than 20 minutes away from downtown San Francisco, with its numerous fine shops, Fisherman's Wharf, Telegraph Hill (and its spectacular view of the Bay and the Golden Gate Bridge), and numerous other points of interest.

The San Francisco climate during June should be mild, with temperatures not much above 73°F (23°C) or below 50°F (10°C). Fog is always a possibility and participants should be prepared for cool as well as warm weather.

## CALIFORNIA ACADEMY of SCIENCES

Three years after the state of California was admitted into the Union, several men met on the evening of 4 April 1853 to discuss "the founding of an Academy for the development and study of natural phenomena."<sup>1</sup> On the following 16 May a constitution was adopted, bringing into being what was

then called the Academy of Natural Sciences. In 1868 the institution's name was changed to the Academy of Sciences, later renamed the California Academy of Sciences.

The Academy was first located in a small building at 174 Clay Street, but soon moved to an abandoned Baptist church on the southwest corner of California and Dupont Streets, where their meetings and lectures soon attracted public interest. Drawing on donations of land and money from James Lick (of Lick



California Academy of Sciences,  
circa 1895.

Observatory fame), a six story stone building was constructed at 819 Market Street, with occupancy occurring in 1891. By this time the Academy had become one of the West's most popular destinations, hosting 80,000 visitors a year.

The 1906 earthquake and fire proved disastrous for the Academy. Fortunately, the fire didn't reach the Academy's building until the second day, which provided time for the removal of limited numbers of books, some old records, a complete set of publications,



California Academy of Sciences  
following 1906 earthquake.

and a very limited number of specimens. Everything else was lost in the fire. Just prior to the fire, a group of seven scientists set sail for the Galapagos aboard the Schooner Academy. The materials they returned with became the core of the Academy's post-fire collections.

In 1910 the citizens of San Francisco voted to allow the Academy to relocate into Golden Gate Park. The new building was completed and opened to the public in September 1916. Over the decades, the facility grew to include the Steinhart Aquarium (1923), Simson African Hall (1934), Science Hall (1951), the Morrison Planetarium (1952), the Swamp (1963), the Fish Roundabout (1977), and more.

The 1989 Loma Prieta earthquake caused major structural damage to the building, leaving the Academy in need of a new beginning. The Academy took advantage of this unique opportunity and rethought the Academy and the entire museum-going experience. The result was the closure of the Academy in 2003 and the moving of many exhibits to a temporary location at 875 Howard Street to allow for the razing and construction of an entirely new facility designed for the 21<sup>st</sup> century. After razing all but two walls of the African Hall, construction on the new, almost \$500,000,000 structure began in September, 2005. The grand reopening of the Academy was 27 September 2008.

The California Academy of Sciences is now a cutting-edge research and museum facility residing in the largest LEED (Leadership in Energy and Environmental Design) Platinum-rated (the highest rating) building in the world. It is also the largest green museum in the world. Although the Academy is now a single structure, it contains multiple venues, including a 500,000 gallon aquarium, an all-digital planetarium, the Kimball Natural History Museum and a four story rainforest. In addition, there's a new 3-D theater, a lecture hall, a Naturalist Center, two restaurants, an adjacent garden and aviary, a roof terrace, and an Academy store.

The Academy is home to more than 40,000 animals, more than six times the number calling the Academy home in the previous collection of buildings. The new building also houses the Academy science labs and administrative offices, including an extensive library and scientific archive consisting of more than 20 million specimens.

A little-known fact outside of scientific circles (perhaps even within scientific circles?) is that the Pacific Division of AAAS has had a long-standing relationship with the California Academy of Sciences. Staff scientists at the Academy have served as Executive Directors (earlier called Secretary-Treasurers) of the Pacific Division for 72 of the 94 years that the Pacific Division has existed (1919 – 1927, Winthrop W. Sargent, Administration; 1946 – 1973, Robert C. Miller, Zoology; 1973 – 1975, Robert T. Orr, Mammalogy/Ornithology; 1975 – 1998 and 2001, Alan E. Leviton, Herpetology/Biogeography). That honor has been shared by only four other institutions: University of California, Berkeley (1916 – 1918, Albert L. Barrows, Zoology), Stanford



Public Domain

San Francisco burns following the great earthquake in 1906.

University (1928 – 1929, Arthur G. Vestal, Biology; 1930 – 1942, James M. Luck, Biochemistry), University of Montana (1998 – 2001, David E. Bilderback, Plant Physiology) and Southern Oregon University (2002 – present, Roger G. Christianson, Biology) over the lifetime of the Division. Thus, it's no surprise that, as the Pacific Division meets again in San Francisco, the California Academy is alongside the endeavor and contributing substantially to the program.

<sup>1</sup>Information for this section was excerpted from a) an article by J. D. Gunder, "North American Institutions Featuring Lepidoptera," Entomological News, Vol. 40, April, 1929 No. 4) and the following web site of the California Academy of Sciences: <http://www.calacademy.org/academy/about/timeline.php>.

## ANNUAL MEETING

### REGISTRATION

Registration Centers will be set up at both the California Academy of Sciences and San Francisco State University according to this schedule:

*Registration at the California Academy of Sciences*, near the main entrance to the Forum:

Friday, 8:00 a.m. – 3:00 p.m.

Saturday, 8:00 a.m. – 3:00 p.m.

Tuesday, 7:30 a.m. – 3:00 p.m.

*Registration at San Francisco State University*, in the main entry foyer to Hensill Hall (19<sup>th</sup> Ave. entrance, which is actually the third floor of the building):

Sunday, 3:00 p.m. – 7:00 p.m.

Monday, 7:30 a.m. – 4:30 p.m.

Tuesday, 7:30 a.m. – 4:00 p.m.

Wednesday, 7:30 a.m. – 2:30 p.m.

All persons planning to attend the meeting, except for public sessions, should be registered for the meeting and must wear their name badges at all times! On-site registration fees are as follows: full meeting professional, \$110; K – 12, community college teachers, post-docs, and retirees/emeritus, \$60; and student and participating spouses, \$45. One-day on-site professional registration is \$80. Note that if you attend more than one day, you must pay the full registration fee rather than paying day-by-day. Program organizers and presenters registering in the professional category may purchase a full-meeting professional registration at the reduced, one-day rate. To be eligible for this discount, the individual must be listed as an organizer/co-organizer of a program or be making a presentation at the meeting.

## GENERAL INFORMATION

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Special stipends of \$75 were given to the first twenty K – 12 and community college instructors that registered in advance for this meeting. The stipend is not available to teachers who register on-site.

Students were given the opportunity to apply for travel awards of up to \$150 to help defray their costs for the meeting.

*About Field Trips:* Pre-registration for all field trips was required due to limited seating in the vehicles and the need to inform some destinations of the number of people arriving. However, space may be available on some of the excursions. If you didn't preregister for a particular field trip on which you are interested in participating, please inquire at the Registration Center to see if space is still available. At least one member of a family group requesting field trip reservations must be a paid meeting registrant. Participants who are not registered for the meeting will be charged a one-time \$10 field trip registration fee in addition to the fee for the field trip.

*About Workshops:* All workshops are available at no additional charge to persons already registered for the meeting. Some workshops may have limited space available, so it is suggested persons interested in attending arrive early.

*About Refunds:* Requests for refunds must have been in writing and postmarked or date-stamped no later than July 15, 2009. Under extreme hardship conditions beyond a registrant's control, requests for refunds may be honored beyond this date if presented in writing with an adequate explanation of the hardship that precipitated the request for the refund. A \$10 handling fee is applied to all refunds. Additionally, a 3.5% deduction is applied to the total amount for credit card refunds.

## ACCOMMODATIONS and FOOD SERVICE

Because of the timing of this meeting, San Francisco State University (SFSU) was not able to offer any on-campus housing. "Local Hotels and Motels" below gives information about hotels which are offering meeting attendees special rates.

Both the California Academy of Sciences (CAS) and SFSU have a variety of eating establishments located close to the meeting rooms. At the CAS, the Academy Cafe offers a variety of choices in the \$3 – \$11 price range, while the Moss Room offers more of an upscale atmosphere and selection ranging from \$8 – \$14 for appetizers and \$18 – \$29 for entrees. At SFSU, the Cesar Chavez Student Center offers a wide selection of eateries, each with their unique cuisine. Prices range from \$1 – \$12.50, with many items under \$5. As an added bonus, a variety of food items are sold out of the SFSU Biology Department stockroom on the fifth floor of Hensill Hall. Staff from the stockroom will also have a table set up near the Registration Center in the lobby area of the main entrance to Hensill Hall with limited snack items for sale.

## LOCAL HOTELS

### and MOTELS

As you might imagine, there are many hotels and motels in all price ranges in the San Francisco area. Unfortunately, not many of them are close to SFSU or CAS. The following three hotels, located in the vicinity of San Francisco International Airport, are offering special rates for meeting attendees. Hotel search engines such as hotels.com or expedia.com are also places to find the best deals for lodging.

Please make your reservations for housing directly with the hotel/motel of your choice. Note that the AAAS, Pacific Division lists the following hotels for information only, not as an endorsement for any specific commercial enterprise.

#### *Radisson Hotel SFO Bayfront*

5000 Sierra Point Parkway

Brisbane, CA 94005

415-467-4400

*Rate:* \$115/night for one or two persons

\$125/night for three or four persons

#### *Includes:*

parking

airport shuttle

high speed internet

indoor swimming pool

fitness center

*Cafe and bar* on the premises.

#### *Proximity to meeting*

approx. 10 miles to SFSU (14 minute drive)

approx. 10.5 miles to CAS (19 minute drive).

#### *Hampton Inn San Francisco–Airport*

300 Gateway Boulevard

South San Francisco, CA 94080

650-876-0200

*Rate:* \$129/night for one to four persons in a room

#### *Includes:*

parking

local calls

airport shuttle

breakfast buffet

high speed internet

fully equipped business center

guest laundry room

indoor swimming pool

fitness center

evening manager's reception every Mon – Wed

#### *Proximity to meeting*

approx. 11 miles to SFSU (15 minute drive)

approx. 12 miles to CAS (21 minute drive).

#### *Homewood Suites by Hilton*

2000 Shoreline Court

Brisbane, CA 94005

650-589-1600

*Rate:* \$109/night for up to four persons in a Studio Suite

\$119/night for up to four persons in a King Suite

*Includes:*

parking  
airport shuttle  
high speed internet  
fully equipped kitchen with refrigerator  
hot breakfast  
evening manager's reception Mon – Thurs

*Proximity to meeting*

approx. 10 miles to SFSU (14 minute drive)  
approx. 10.5 miles to CAS (19 minute drive).

### **TRAVEL to the MEETING and PARKING**

San Francisco is served by all major airlines and many commuter airlines through San Francisco and Oakland International Airports, by Amtrak (through Oakland), by the Greyhound Bus Line, or by automobile via U.S. 101 and Interstate Highway 280. San Francisco State University (SFSU) is located at 1600 Holloway Avenue and the California Academy of Sciences (CAS) is located at 55 Music Concourse Drive in Golden Gate Park.

#### **Travel to CAS by Automobile:**

*From the North Bay/Golden Gate Bridge toll plaza, merge onto CA-1 S toward 19th avenue/Golden Gate Park. Drive two miles to Cabrillo Street. Turn right on Cabrillo, then right again on 14th Avenue. Proceed one block north to Balboa Street and turn right. Cross Park Presidio Boulevard and turn right onto 8th Avenue. Continue on 8th into Golden Gate Park. Once in the park make a right turn onto John F. Kennedy Drive and then an immediate left onto Hagiwara Tea Garden Drive (a one-way street). The Academy will be to your left. For direct access to the Concourse Parking Facility, follow the above directions except turn right onto 10th Avenue rather than 8th Avenue. Follow 10th Avenue into the parking structure.*

*From the East Bay/I-80 West, after exiting the Bay Bridge, merge onto US-101 N/Central FWY toward the Golden Gate Bridge. US-101 N/Central FWY becomes Octavia Blvd. Continue on Octavia Blvd. and turn left onto Fell Street (about 0.3 miles). Stay straight to go onto Kezar Drive, which becomes Lincoln Way. Turn right off of Lincoln Way onto 9th Avenue. 9th Avenue becomes Martin Luther King, Jr. Drive. From MLK, Jr. Drive, turn right onto Music Concourse Drive. The CAS will be on the right. For access to the Concourse Parking Facility, continue past the CAS on Music Concourse Drive and follow signs to the parking facility, whose entrance is on Fulton Street at 10th Avenue.*

*From the South Bay, merge onto I-380 W toward I-280/San Bruno. Then merge onto I-280 N toward San Francisco. Keep left to take CA-1 N via Exit 49B toward 19th Avenue/Golden Gate Bridge. Then turn slightly left onto 19th Ave/CA-1 N. Continue to follow CA-1 N (about 3.4 miles). Turn right onto Martin Luther King, Jr. Drive, then left onto Music*

Concourse Drive. The CAS will be on the right. To access the Concourse Parking Facility, continue past the CAS on Music Concourse Drive and follow the signs to the facility, which has an entrance off of Fulton Street at 10th Avenue.

#### **Parking at the CAS:**

Limited street parking is located throughout Golden Gate Park and the neighboring areas. If coming from the north, the Concourse Parking Facility is located on Fulton Street and 10th Avenue. From the south, enter the park from 9th Avenue and Lincoln Street, then take a right on Music Concourse Drive to enter the garage. Please note that on weekends and holidays the garage often fills to capacity early in the day. Public transportation is highly encouraged during these times.

Accessible parking is available in the Music Concourse Parking Facility. There are 15 wheelchair accessible spots near the elevator. The front entrance to the museum can be accessed from the garage by elevator.

#### **Travel to the CAS by Public Transit:**

*Muni to Golden Gate Park*

The #44-O'Shaughnessy bus stops across from the Academy at the Music Concourse on Tea Garden Drive (southbound) and in front of the Academy on Music Concourse Drive (northbound).

The #5-Fulton and the #21-Hayes stop at 8th and Fulton Streets, just outside the park. From 8th Avenue, go into the park and turn right on John F. Kennedy Drive. Then turn left onto Music Concourse Drive.

The N-Judah Muni Metro streetcar, which is wheelchair-accessible, stops at 9th Avenue and Irving Street. To reach the Academy, travel north on 9th Avenue into the park. 9th Avenue becomes Martin Luther King, Jr. Boulevard. Continue on MLK, Jr. Blvd. until Music Concourse Drive, where you should turn right and continue to the Academy entrance.

*From City Hall/Civic Center (Living Bus Shelter)*

There are four options:

Take the N-Judah from Muni Metro station at Van Ness Avenue and Market Street.

Take the Muni #5-Fulton bus at McAllister and Polk Streets.

Take the Muni #21-Hayes bus at Hayes and Larkin Streets.

Take the #74X-CultureBus at McAllister and Larkin Streets.

*From Fisherman's Wharf*

Take the Muni F trolley to Market Street. Transfer to the N-Judah at Embarcadero Station.

*From Union Square/Downtown*

Take the N-Judah from the underground Muni Metro station at Powell and Market Streets.

Take the #74X-CultureBus at Geary and Powell Streets.

*From CalTrain Depot*

Take the N-Judah from 4th and King station.

*From BART*

## GENERAL INFORMATION

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Transfer from *any downtown BART station* (Embarcadero, Montgomery, Powell, or Civic Center) to the Muni N-Judah OR transfer from Glen Park station to Muni bus #44-O'Shaughnessy.

If you are staying at an airport hotel, you can take the hotel shuttle to San Francisco International Airport and then ride the BART to any downtown BART station (Embarcadero, Montgomery, Powell, or Civic Center) and transfer to the Muni N-Judah OR transfer from Glen Park station to Muni bus #44-O'Shaughnessy.

### Travel to SFSU by Automobile:

*Coming from the North Bay on US-101 S*, cross the Golden Gate Bridge and then take the 19<sup>th</sup> Avenue/Highway 1 S exit. Follow 19<sup>th</sup> Avenue to campus, located to the right at Holloway Ave. To drive to the campus parking structure, turn right onto Holloway Ave. Bear right onto Font Blvd. and then turn right onto Lake Merced Blvd. Almost immediately turn right onto State Drive, which is the entrance to the parking garage. Please refer to the map on the inside of the front cover of this *Proceedings* for directions to the science complex (Hensill Hall and Science), where the meeting rooms are.

*Coming from the East Bay on I-80 W*, take I-80 West across the Bay Bridge to Highway 101 South. Take 101 South to I-280 toward Daly City. Take the San Jose Avenue/Mission St. exit (second Mission St. exit, which immediately follows the Ocean Avenue exit), bearing right onto Sagamore Street to Brotherhood Way to Junipero Serra Boulevard North. Take Junipero Serra Boulevard to Holloway Avenue, turn left on Holloway Avenue to campus at 19<sup>th</sup> Avenue.

To get directly to the parking garage stay on Brotherhood Way and turn right onto Lake Merced Blvd. Turn right onto State Drive which is the third light after turning onto Lake Merced Blvd. and leads directly to the parking garage. Please refer to the map on the inside of the front cover of this *Proceedings* for directions to the science complex (Hensill Hall and Science), where the meeting rooms are.

*Coming from the South Bay on US-101 N*, take I-280 N and exit at 19<sup>th</sup> Avenue. Take Junipero Serra Boulevard to Holloway Avenue, turn left on Holloway Avenue to campus at 19<sup>th</sup> Avenue. To drive to the parking structure, continue on Holloway Ave. and bear right onto Font Blvd. Then turn right onto Lake Merced Blvd and almost immediately turn right onto State Drive, which is the entrance to the parking garage. Please refer to the map on the inside of the front cover of this *Proceedings* for directions to the science complex (Hensill Hall and Science), where the meeting rooms are.

### Parking at SFSU

Visitor parking at San Francisco State University is in the large Lot 20 Parking Garage, located central to the campus (please refer to map on the inside of the front cover of this *Proceedings*). Note that Level 4i Orange to 4n Orange and the roof level is restricted to staff and faculty between 7:00 a.m.

and 5:00 p.m. Monday – Friday. The garage is open 24 hours a day, seven days a week. Cost as of March 2009 is \$1.00 per hour with a \$5.00 maximum. Pay stations will accept quarters, \$1, \$5 and \$10 bills. To enter the parking garage, turn east onto State Drive from Lake Merced Boulevard.

### Travel to SFSU by Public Transit:

#### By MUNI:

The following MUNI bus lines service the SFSU campus.

**M** – *Oceanview-* streetcar from downtown and Balboa Park Station.

**17** – Park Merced to West Portal Station.

**18** – 46th Avenue/Zoo, Sunset and Richmond Districts, Palace of the Legion of Honor.

**26** – Valencia to Ocean View, Balboa Park BART station, Glen Park Station, Mission District to 5th and Mission.

**28** – 19th Avenue to Daly City BART station, Sunset and Richmond Districts, Golden Gate Bridge, Fort Mason. (28L-limited service Monday-Friday only).

**29** – Sunset to Ingleside, Excelsior, Bayview districts and Candlestick Park.

#### By BART:

Take any San Francisco bound BART train to the Daly City BART station. From the Daly City BART station take MUNI's 28 line. Be sure to obtain a transfer (good for one ride to and from BART) from the machine in the lobby before exiting the station. Exit at the 19<sup>th</sup> Avenue and Holloway Avenue stop. SamTrans' 3B line also serves the campus from the Daly City BART station.

If you are staying at an airport hotel, you can take the hotel shuttle to San Francisco International Airport and then ride the BART to the Daly City station to pick up the MUNI 28 line to campus.

## REGISTRATION CENTER

The Registration Center will be set up as follows:

*14 and 15 August and 18 August* at the California Academy of Sciences, near the entrance to the Forum.

*16 – 19 August* at San Francisco State University in the main entrance lobby (third floor, which is street level for 19<sup>th</sup> Avenue) of Hensill Hall.

Hours are:

*Friday (CAS)* 8:00 a.m. – 3:00 p.m.

*Saturday (CAS)* 8:00 a.m. – 3:00 p.m.

*Sunday (SFSU)* 3:00 p.m. – 7:00 p.m.

*Monday (SFSU)* 7:30 a.m. – 4:30 p.m.

*Tuesday (SFSU)* 7:30 a.m. – 4:00 p.m.

*Tuesday (CAS)* 7:30 a.m. – 3:00 p.m.

*Wednesday (SFSU)* 7:30 a.m. – 2:30 p.m.

## MESSAGES

To leave a message for a meeting registrant or to contact

AAAS, Pacific Division staff, call 541-292-1115. Please note that this line will be monitored only between the dates of 13 August and 20 August. After those dates, please use the regular Pacific Division number, 541-552-6869, in order to contact Pacific Division staff.

### BREAKS

Mid-morning and mid-afternoon breaks are scheduled, as appropriate, for each session. Refreshments will be served during break times at a location near Registration Centers at both the CAS and SFSU.

### MEETING ROOMS, COMPUTERS, and POWERPOINT PRESENTATIONS

This year's technical sessions will meet in various classrooms and other facilities of San Francisco State University and also in the Theatre (Forum) at the California Academy of Sciences. Meeting rooms at SFSU will be equipped with Intel-based Macintosh computers running PowerPoint 2008, and standard computer projectors. Speakers presenting in the Theatre at the CAS should have been informed by their program organizers as to the equipment available. PowerPoint presentations may be loaded onto computers only from a CD-ROM or thumb/USB/flash drive. Be sure, when saving your PowerPoint presentation, that it will open on the platform available in the room in which you will be speaking.

Speakers requiring other specialized equipment such as slide or overhead projectors must have made their requests known when they submitted their abstracts. If available, specialized equipment will be provided. If rental costs are incurred, payment is the responsibility of the requestor.

### DATES, TIMES and LOCATIONS of PRESENTATIONS

The meeting rooms, times of presentations, and abstracts for the meeting are published in this "Program with Abstracts" issue of the *Proceedings* (Volume 28, Part I), which is given to each meeting registrant.

### POSTER SESSIONS

Posters are assigned a display space of 40" tall x 60" wide (1 m x 1.5 m). By action of the Council of the Pacific Division in order to assure fairness, all student posters must fit within the assigned display space to be eligible for student Awards of Excellence. Posters are grouped by discipline and subject matter.

There will be two poster sessions, one Monday afternoon and the other starting Tuesday morning. Each will include both students and professionals. Presenters should have their posters in place no less than 10 minutes prior to the beginning of their session and must be available for at least one hour during the session in order to discuss their results with interested persons. All posters must be removed within 30 minutes of the end of the session.

Student posters will be judged for Awards of Excellence. Students must be present with their posters until they have talked with all of their judges.

Additional information about posters, student judging of posters, etc., is found on page 51 of these *Proceedings*.

Presenters assume full responsibility for the security of their poster materials. Unclaimed posters will be discarded at the close of the technical sessions of the meeting on Wednesday.

### STUDENT AWARDS for EXCELLENCE

The AAAS, Pacific Division offers each affiliated society and section participating in the annual meeting the opportunity to recognize outstanding student participants through the presentation of Awards of Excellence and cash prizes of \$150 for first place and \$75 for second place. Additionally, each winner receives a one-year student membership in AAAS, which includes weekly issues of *Science* magazine and full electronic access to AAAS member pages. Societies often supplement these awards with their own cash prizes.

For this meeting, seven Division-wide awards are available: Laurence M. Klauber Award for Excellence (unrestricted); Geraldine K. Lindsay Award for Excellence in the Natural Sciences; J. Thomas Dutro, Jr. Award for Excellence in the Geosciences; Presidents' Award for Excellence (unrestricted); Rita W. Peterson Award for Excellence in Science Education; Best Poster Award (for posters only but otherwise unrestricted); and the AAAS-Robert I. Larus Travel Award, which provides travel and other expenses for the awardee to attend the 2010 national meeting of AAAS in San Diego, CA, 18–22 February 2010 for the purpose of presenting their winning presentation as a poster. The Klauber, Lindsay, Dutro, Presidents', Peterson, Best Poster, and Larus awards are given to those students whose presentations are judged the most significant in the advancement or understanding of science.

To be eligible for a sectional award or one of the Divisional awards, a student must register for the meeting, present the paper or poster, and be the principal research investigator. Student presentations, oral and poster, are judged on their abstracts, content, style of delivery or presentation, and audiovisual aids and/or handouts (if used). The evaluation forms for both oral and poster presentations are posted on the Division's meeting web page. Students who are competing for Awards of Excellence are invited to be guests of the Division at the annual Banquet Tuesday evening, 18 August. Festivities that evening include the presentation of student awards. Students were asked to indicate on the Advance Registration Form if they were planning to attend the banquet. Those who responded positively were provided a ticket along with their other registration materials. If you are a student who is in competition for an Award of Excellence and you do not have a ticket for the banquet, please inquire at the Registration Desk to see whether any tickets are still available.

## GENERAL INFORMATION

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**IMPORTANT NOTE:** All judging for student awards ends by 3:00 p.m. on Tuesday, at which time the judges go into closed session to determine the winners. If you are a student wishing to compete for an Award of Excellence and your oral symposium presentation is scheduled later Tuesday afternoon or Wednesday, you must, in addition to presenting orally as part of the symposium, prepare a poster for presentation earlier in the week. Your presentation will be judged as a poster and you will be in the pool of potential prize winners. Double presentations (both poster and oral) may only occur if your presentation is part of a symposium. All oral contributed paper sessions are scheduled to ensure that student presenters are judged prior to the cut-off on Tuesday afternoon.

### SPECIAL EVENTS

The following special events are planned for the meeting.

**Sunday Evening Plenary Lecture.** 16 August, 7:00 p.m. in SCIENCE 201 on the San Francisco State University campus. Dr. Robert Chianese will present his popular lecture, *Ecological Awareness in American Landscape Art: Depicting and Repairing the American Wasteland*. For event details, please refer to listing below under PUBLIC LECTURES.

**Sunday Evening Welcome Wagon and Cracker Barrel Reception.** 16 August, 8:00 p.m. in the Greenhouse (just north of Hensill Hall), San Francisco State University. This reception, hosted by the San Francisco State University Biology Department, begins immediately following Dr. Chianese's lecture and continues until about 9:15 p.m. All registrants and their families are invited to enjoy the conviviality of this event, which will include a selection of soft drinks, chips, pretzels and good conversation. Please wear your registration badge.

**Monday Noon Public Lecture.** 17 August, 12:15 p.m. in SCIENCE 201 on the San Francisco State University campus. Dr. Donald McGraw will talk about *Millennial Biology: The National Science Foundation and the Life Sciences, 1975 to 2005*. For event details, please refer to listing below under PUBLIC LECTURES.

**Monday Evening Plenary Lecture.** 17 August, 7:00 p.m. in the Seven Hills Center on the San Francisco State University campus. Dr. Cathryn Newton will describe her fascination with *Shipwrecks as Fossils*. For event details, please refer to listing below under PUBLIC LECTURES.

**Monday Evening President's Reception.** 17 August, 8:00 p.m. at the Seven Hills Center, San Francisco University. Dr. Robert A. Corrigan, President of San Francisco State University, will welcome conference attendees at an informal hosted reception from 8:00 p.m. – 9:15 p.m. All registrants and their families are invited to enjoy this relaxed occasion. Non-registered family members are welcome, but must be accompanied by a registrant. Please wear your registration badge.

**Tuesday Noon Public Lecture.** 18 August, 12:15 p.m. in SCIENCE 201 on the San Francisco State University campus. Dr. Lynne Elkin will give an historical perspective on *Specific*

*Events Delaying Recognition of Franklin's Contribution to DNA Structure.* For event details, please refer to listing below under PUBLIC LECTURES.

**Tuesday Evening Student Awards Banquet.** 18 August, 6:00 p.m. in the Seven Hills Center at San Francisco State University. Tuesday evening will be an exciting time for students as Division representatives will announce the names of student winners of Awards of Excellence and also winners of the Division's Laurence M. Klauber Award for Excellence (unrestricted), Geraldine K. Lindsay Award for Excellence in the Natural Sciences, J. Thomas Dutro, Jr. Award for Excellence in the Geosciences, Rita W. Peterson Award for Excellence in Science Education, the President's Award for Excellence (unrestricted), the Best Poster Award (for poster presentations only but otherwise unrestricted), and the AAAS Robert I. Larus Travel Award, which provides for travel and other expenses for the awardee to attend the 2010 annual meeting of AAAS in San Diego, CA 18 – 22 February, in order to present his/her winning presentation as a poster.

The Klauber, Lindsay, Dutro, Presidents', Best Poster, Peterson, and AAAS Larus awards are given to those students whose presentations are judged the most significant in the advancement or understanding of science. Eligible students must: (1) register for the meeting, (2) present the paper or poster being judged, and (3) be the principal research investigator. Student presentations, oral and poster, are judged on their abstracts, content, style of delivery or presentation, and audiovisual aids and/or handouts (if used). The evaluation forms (oral and poster) are posted on the Division's web site.

The evening's events will take place in the Seven Hills Center on the San Francisco State University campus (see map on the inside of the front cover of these *Proceedings*). A hosted reception (non-alcoholic drinks only) will begin at 6:00 p.m., followed by dinner service at about 6:45 p.m. Three entrees are available for dinner: *Vegetarian Moussaka* (roasted eggplant layered with lentils, potatoes and feta cheese, topped with a creamy bechamel sauce and parmesan cheese, baked until golden brown and bubbling and served with an oregano and pine nut pilaf); *Shrimp Struedel Chardonnay* (flaky phyllo dough wrapped around a mixture of pink shrimp, onions, mushrooms, roasted red peppers, and herbs, baked until golden brown and served with a Chardonnay cream sauce); and *Prime Rib of Beef* (prime rib of beef roasts coated with garlic and herb crust, slowly roasted to medium-rare, carved, served with Cabernet jus, creamy horseradish sauce, a buttery mini popover, and sour cream and chive mashed potatoes). All entrees include fresh seasonal vegetables, a green salad, dinner rolls and butter, and dessert. There are a limited number of tickets available and people were asked to sign up in advance. If you are interested in attending the banquet but do not yet have a ticket, please ask at the Registration Center to see if any tickets are still available.

Following dinner will be the announcement of student presentation awards, and then Dr. Anne A. Sturz (Department of

Marine Science and Environmental Studies, University of San Diego, CA and President of the Pacific Division) will give the Presidential Lecture. Please note that student award winners are asked to stay to the end of the evening's activities in order to participate in a group photograph. The evening should end by 9:30 p.m.

**Wednesday Morning Business Meeting of the Council of the Pacific Division.** The Council of the AAAS, Pacific Division will hold its annual breakfast and business meeting in the Blakeslee Room on top of Thornton Hall on the San Francisco State University campus starting at 7:00 a.m. on Wednesday, 19 August. The Council will elect officers, Executive Committee and Council members, discuss programs for the 2010 and 2011 annual meetings, and transact such other business as is required by the Division's By-Laws. This is an open meeting and Pacific Division members with an interest in the governance of the Division are welcome to attend.

**Wednesday Noon Public Showing of Students of Consequence.** 19 August, 12:15 p.m. in SCIENCE 201 on the San Francisco State University campus. For event details, please refer to listing below under PUBLIC LECTURES.

### PUBLIC LECTURES

All members of the public are invited to attend these lectures at no charge (except for the Presidential Lecture, for which there is a charge \$35 to attend the banquet).

**Sunday Evening Plenary Lecture.** 16 August, 7:00 p.m. in SCIENCE 201 on the San Francisco State University campus. Dr. Robert Chianese (Professor Emeritus, Department of English, California State University, Northridge, CA) will present his popular lecture, *Ecological Awareness in American Landscape Art: Depicting and Repairing the American Wasteland*. Dr. Chianese has published an artist's book of photographs with poems, chap books, and individual poems. As an academic, he has published essays in the humanities and American art history, an anthology of utopian literature, and numerous critical articles about the humanities and their relations to science and technology. He is currently chair of the General and Interdisciplinary Section of the AAAS, Pacific Division.

**Monday Noon Public Lecture.** 17 August, 12:15 p.m. in Room 201 of the Science Building at San Francisco State University. Dr. Donald McGraw, chair of the AAAS, Pacific Division's History and Philosophy of Science Section, will present the talk, *Millennial Biology: The National Science Foundation and the Life Sciences, 1975 to 2005*. Dr. McGraw is a former Associate Provost at the University of San Diego. He currently is contracting with the National Science Foundation to write a history of the Biological Sciences at NSF during the 30 year period, 1975 to 2005, which is the topic of this talk.

**Monday Evening Plenary Lecture.** 17 August, 7:00 p.m. in the Seven Hills Center, San Francisco State University. Dr. Cathryn Newton (Dean Emerita and Professor of Interdisciplinary Sciences, Syracuse University, Syracuse, NY) will

present her talk, *Shipwrecks as Fossils*. Dr. Newton is known for her research in paleobiology and paleoecology, including work on ancient biogeography. Her research emphasizes interdisciplinary approaches to marine mass extinction and environmental change. She has published widely in leading scientific publications, and has served as editor-in-chief of Paleogeography, Paleoceanography and Paleoecology.

**Tuesday Noon Public Lecture.** 18 August, 12:15 p.m. in SCIENCE 201 on the San Francisco State University campus. Dr. Lynne Elkin (Professor Emerita of Biological Sciences, California State University East Bay, Hayward, CA) will present her talk, *Specific Events Delaying Recognition of Franklin's Contribution to DNA Structure*. Dr. Elkin is a recognized authority on the life and work of Dr. Rosalind Franklin. Since 1999, she has delivered over 40 lectures in the United States and England based on her research into the events surrounding the life of Rosalind Franklin, especially during the early 1950s when competition to discern the structure of DNA was especially keen and Rosalind Franklin's research played a pivotal role.

**Tuesday Evening AAAS, Pacific Division Presidential Lecture.** Tuesday, 18 August, about 8:15 p.m. in the Seven Hills Center on the San Francisco State University campus. Following the presentation of student awards at the Student Awards Banquet, Dr. Anne A. Sturz (Department of Marine Science and Environmental Studies, University of San Diego, CA and President of the Pacific Division) will present the Presidential Lecture.

**Wednesday Noon Public Showing of Students of Consequence.** 19 August, 12:15 p.m. in SCIENCE 201 on the San Francisco State University Campus. Though not quite a public lecture, this program should engender a high degree of interest in those who are concerned about high school education in the United States. Dr. Jay Vavra (High Tech High, San Diego, CA) will present a special showing of *Students of Consequence*, a 32 minute film produced by students at High Tech High to document their trip to Tanzania to learn about the African bushmeat problem and help authorities come up with ways to definitively differentiate between legal and illegal bushmeat sources. High school students *can* make a difference! Following the film, Dr. Vavra will be available to comment and answer questions.

### FIELD TRIPS

All field trips are open to meeting registrants and their families. At least one member of a family must be registered for the meeting. Family members who are not registered for the meeting will be charged an additional one-time-only \$10 field trip registration fee. This fee is paid only once for this meeting, regardless of how many field trips in which a non-registrant participates.

Due to limited space, advance registration is required for all field trips. Reservation and payment of field trip fee(s) were included on the Advance Registration Form. If there is

## GENERAL INFORMATION

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a field trip in which you are interested in participating but did not sign up for in advance, please ask at the Registration Center to ascertain whether or not a ticket may still be available.

A full refund will be granted if a trip is cancelled by the Division. If a registrant cancels via e-mail or written notification received in the Pacific Division office no later than 15 July 2009, the registrant will receive a refund of the fee(s) paid less a \$10 processing fee. If paid by credit card, an additional 3.5% of the original charge will be deducted from the amount being refunded to help pay for fees charged to the Division by credit card companies. With the exception of the Division cancelling a field trip, no refunds will be granted after 15 July.

Please note that departure times are absolute and return times are approximate. Also, all excursions depart from the lower (State Drive) entrance to the SFSU parking structure (see map on the inside of the front cover of these *Proceedings*).

### Sunday, 16 August

**Field Trip #1: Presidio Field Excursion.** Departs from in front of the lower entrance to the SFSU parking structure (east end of State Drive – please refer to the inside of the front cover of these *Proceedings*) at 9:00 a.m.; returns about 4:00 p.m. [Note: A Pacific Division representative will be present to provide participants with meeting materials, so please arrive early!] Includes transportation, box lunch and applicable fees. Cost: \$25 per person.

The Presidio of San Francisco was in constant use as a military post for two centuries, beginning in 1776 when Spanish soldiers established a fort in the vicinity of El Polin springs in the Tennessee Hollow watershed. After a brief occupation by the Mexican army, the U. S. Army occupied the site in 1846. Some San Francisco citizens camped in the Presidio after their homes had been destroyed in the 1906 earthquake. Today, the Presidio is the nation's largest urban national park. The U. S. Army transferred it to the National Park Service in 1994. A number of major environmental restoration projects are underway within the Presidio as well as archeological sites that have unearthed elements of the past history of the area.

Led by William B.N. Berry (Department of Earth and Planetary Sciences, University of California, Berkeley, CA) and Mark Frey (Presidio Trust, San Francisco, CA), this excursion will visit El Polin Springs, significant restoration sites, and sites that address park programs in issues of sustainability.

CAUTION: there will be about a ten minute walk on paved streets at one point along the way.

**Field Trip #4: San Andreas Fault on the San Francisco Peninsula.** Departs from in front of the lower entrance to the SFSU parking structure (east end of State Drive – please refer to the inside of the front cover of these *Proceedings*) at 8:30 a.m.; returns about 2:30 p.m. [Note: A Pacific Division representative will be present to provide participants with meeting

materials, so please arrive early!] Includes transportation, box lunch, road log, and applicable fees. Cost: \$50 per person..

The coastal region south of San Francisco is both the boundary between land and sea and also the North American and Pacific plates of the Earth's crust. As such, it is an area of distinctive geologic features ranging from interesting landforms to major Earth structures. Dominant among these is the San Andreas Fault, an active crustal break that has been the source of major earthquakes since its origin millions of years ago. On this field trip, led by Ray Pestrong (Department of Geosciences, San Francisco State University), participants will visit the Fault in a number of locations that display some of its many surficial expressions, and study other geologic sites that owe their uniqueness to its presence. These include natural geologic features like landslides and coastal erosion, and examples of major man-made structures built within the fault zone.

### Wednesday, 19 August

**Field Trip #2: Pigments, Perfumes and Poisons at the San Francisco Botanical Garden. 12:30 p.m. – 5:00 p.m. Field**

**Trip #2:** This excursion departs from the lower entrance to the SFSU parking structure (east end of State Drive – please refer to the inside of the front cover of these *Proceedings*) promptly at 12:30 p.m.; returns at approximately 5:00 p.m. Includes transportation, applicable fees, and box lunch. Cost: \$25 per person.

The San Francisco Botanical Garden (<http://www.sfbotanicalgarden.org>), located in Golden Gate Park, is a most scenic place that contains an extensive collection of plants from all over the world. Led by Dr. Margareta Séquin (Department of Chemistry, San Francisco State University, San Francisco, CA) our half-day plant chemistry field trip on "Pigments, Perfumes and Poisons" will take us to some of the Botanical Garden's sections where we'll explore really interesting plants and their chemistry. The Garden of Fragrance will provide us with many smells (and their molecules) from flowers and leaves. The Redwood Trail will lead us through a unique plant community to the large section on California native plants. There we will get acquainted with some of the rich plant diversity of California, and we'll investigate plant pigments (and some related chemistry of color) and extensive plant defenses. At the conclusion of the tour there will be time to explore more of the Botanical Garden or to shop for plant books and nature-related items at the excellent San Francisco Botanical Garden Bookstore.

CAUTION: this excursion will include about two miles of walking on possibly muddy trails. Wear comfortable walking shoes and clothing appropriate for potentially chilly, foggy weather.

### Thursday, 20 August

**Field Trip #3: Jasper Ridge Biological Preserve.** This excursion departs from the lower entrance to the SFSU parking structure (east end of State Drive – please refer to the inside of the front cover of these *Proceedings*) promptly at 7:30 a.m.; returns at approximately 2:30 p.m. Includes transportation, applicable fees, and box lunch. Cost: \$40 per person.

Led by Philippe Cohen (Administrative Director, Jasper Ridge Biological Preserve) and Cindy Wilber (Education Coordinator, Jasper Ridge Biological Preserve), this field trip will include some or all of the following components.

- *Research taking place at the Preserve.* The research ranges from invasive species ecology to the Jasper Ridge Global Change Experiment. The Jasper Ridge Global Change Experiment is a ten-year experiment that has exposed grassland plots to four global environmental changes, including elevated carbon dioxide, warming, nitrogen deposition, and precipitation. Stanford Researchers are also studying the affects of invasive ants on Jasper Ridge ecosystems. In particular, they are studying the spread of Argentine ants through Jasper Ridge, and how they are affecting important mutualisms between native ant and blue butterflies. In addition, they are exploring ways to control for Argentine ants in plant nurseries and in open space preserves.
- *Searsville Dam and surrounding environs* and the cornucopia of issues associated with trying to decide the future of a 120+ year old dam. Searsville Dam is a prototype for the challenges of managing old dams in sensitive environments. We will meet on the dam for an overview of the dam, its reservoir, and the complex web of issues surrounding its operation and future.
- *Hike through some of the richest habitat in the Santa Cruz mountains.* Although the Preserve is a little less than 1,200 acres, its habitats represent over 10% of the California flora. This remarkable biological diversity will be readily visible as we hike through a broad range of habitats, from riparian woodland to serpentine grassland, from wetlands to oak savanna and chaparral.
- *Brief tour of Jasper Ridge's award winning green building,* the Leslie Sun Field Station. Learn about the many energy and material saving strategies used in Stanford's first green building - the Leslie Shao-ming Sun Field Station. In 2005, the American Institute of Architects Committee on the Environment honored the building as one of the nation's eight most sustainable projects in 2005.

CAUTION: This excursion includes about two hours/four miles of hiking, with a couple of steep sections over which a person in reasonably good shape should have no problem. Be sure to wear appropriate hiking shoes and bring a hat and sunscreen. There is some occasional poison oak along the trails and roads, so long pants rather than shorts are recommended.

**Field Trip #5: Natural History of Marin County.** This excursion departs from the lower entrance to the SFSU parking structure (east end of State Drive – please refer to the inside of the front cover of these *Proceedings*) promptly at 8:30 a.m.; returns at approximately 4:00 p.m. Includes transportation, applicable fees, brief habitat descriptions and species lists of dominant organisms, and box lunch. Cost: \$50 per person.

Marin County has a rich diversity of habitats and an especially diverse assemblage of plant communities. Led by Terry Gosliner, Curator of Invertebrate Zoology, California Academy of Sciences, this full-day excursion will take you to many of these diverse areas spanning both the North American and Pacific Plates.

The trip will depart from San Francisco State University campus, crossing the Golden Gate Bridge and stopping at Bootjack Picnic Area at Mount Tamalpais State Park. Here we will hike about 1.5 miles each way through mixed evergreen, chaparral and serpentine habitats to observe the profoundly different habitats and abrupt changes depending on soil types.

From Mt. Tamalpais we will travel to Pt. Reyes National Seashore, stopping at several key locations along the way. The differences between plant communities as we transition from the North American Plate to the Pacific Plate will be evident as we enter Bishop Pine forests, coastal scrub and strand communities, ending at the Point Reyes Lighthouse. We return via Sir Francis Drake Boulevard, passing by Samuel P. Taylor State Park and returning back across the Golden Gate Bridge.

CAUTION: Coastal California can be hot (in the 90s) and may also include fog and strong winds and temperatures in the 50s at Pt. Reyes. It is important to have sun block, hats and protective clothing. It is advisable to dress in layers depending on the weather. Also, be sure to wear hiking shoes or boots suitable for the three mile hike. Be prepared for moderately steep portions of trails and then more level walks along a fire road.

## WORKSHOPS

All workshops are available to all meeting registrants without additional fees. As with all of the technical program for this meeting, all workshop participants must be registered for the meeting. Persons coming solely for the Bio-Rad workshops are offered a special Bio-Rad-Only meeting registration fee. In order to help workshop developers in their planning, pre-registrants were asked to indicate their interest in attending each of the workshops. Some workshops have limited space. If you are concerned about whether a workshop still has room, please inquire at the Registration Center.

Descriptions of all workshops may be found starting on page 41 of these *Proceedings*.

## PROGRAM AT A GLANCE

FRIDAY – 14 AUG	MONDAY – 17 AUG	TUESDAY – 18 AUG	WEDNESDAY – 19 AUG
<b>SYMPORIUM</b> <b>Darwin and the Galapagos</b> <i>California Academy of Sciences Forum Theatre</i> 9:00 AM – 5:00 PM	<b>CONTRIBUTED PAPERS</b> <b>Working on Darwin</b> <i>HENSILL 206</i> 8:10 AM – 11:55 AM	<b>SYMPORIUM</b> <b>Sustainability as a Way of Life</b> <i>California Academy of Sciences Forum Theatre</i> 8:30 AM – 5:00 PM	<b>Business Meeting of the Council of the Pacific Division</b> <i>Blakeslee Room (Top of Thornton Hall)</i> 7:00 AM – 10:00 AM
	<b>CONTRIBUTED PAPERS</b> <b>Joint Session: Anthropology; Cell and Mol Bio; Ecol, Org Bio and Env Sci; Indust Sci and Technology Sections</b> <i>HENSILL 201</i> 8:15 AM – 12:00 PM	<b>SYMPORIUM</b> <b>Recent Advances in Pharmacology and Toxicology</b> <i>HENSILL 113</i> 8:40 AM – 4:15 PM	<b>SYMPORIUM</b> <b>Project-Based Learning and the Culture of Science Education in the 21<sup>st</sup> Century</b> <i>HENSILL 206</i> 8:30 AM – 1:00 PM
<b>SATURDAY – 15 AUG</b>	<b>SYMPORIUM</b> <b>San Francisco Bay: Tracking and Understanding a Changing Estuary</b> <i>SCIENCE 101</i> 8:25 AM – 6:00 PM	<b>SYMPORIUM</b> <b>Evolutionary Innovations</b> <i>HENSILL 543</i> 9:00 AM – 4:20 PM	<b>SYMPORIUM</b> <b>Near Earth Objects</b> <i>HENSILL 543</i> 8:30 AM – 12:00 PM
<b>SYMPORIUM</b> <b>Darwin and the Galapagos</b> <i>California Academy of Sciences Forum Theatre</i> 9:00 AM – 5:00 PM	<b>SYMPORIUM</b> <b>Materials Science and Nanotechnology</b> <i>HENSILL 439</i> 8:55 AM – 12:00 PM	<b>SYMPORIUM</b> <b>Evolution of Cooperation</b> <i>SCIENCE 101</i> 9:00 AM – 5:00 PM	<b>WORKSHOP</b> <b>Forging California's Path to Net Zero Energy</b> <i>HENSILL 201</i> 10:00 AM – 3:00 PM
	<b>SYMPORIUM</b> <b>Conservation in an Urban National Park</b> <i>HENSILL 543</i> 9:00 AM – 4:30 PM	<b>WORKSHOP</b> <b>Bio-Rad</b> <i>HENSILL 530</i> 9:00 AM – 3:30 PM	<b>NOON FILM SHOWING</b> <b>"Students of Consequence"</b> <i>SCIENCE 201</i> 12:15 PM – 1:00 PM
<b>SUNDAY – 16 AUG</b>	9:00 AM – 4:00 PM	<b>CONTRIBUTED PAPERS</b> <b>Joint Session: Psych; Soc, Econ and Pol Sci Sections</b> <i>HENSILL 667 (AM) &amp; 530 (PM)</i> 9:00 AM – 12:00 PM	
<b>FIELD TRIP</b> <i>San Andreas Fault</i> 8:30 AM – 2:30 PM	<b>NOON PUBLIC LECTURE</b> <b>"Millennial Biology: The National Science Foundation and the Life Sciences"</b> <i>SCIENCE 201</i> 12:15 PM	<b>POSTER SESSION</b> <b>POSTER SESSION II</b> <i>HENSILL THIRD FLOOR HALL</i> 9:30 AM – 1:30 PM	
<b>FIELD TRIP</b> <i>Presidio Field Excursion</i> 9:00 AM – 4:00 PM	<b>POSTER SESSION</b> <b>Poster Session I</b> <i>HENSILL THIRD FLOOR HALL</i> 12:00 PM – 4:00 PM	<b>CONTRIBUTED PAPERS</b> <b>Education Section</b> <i>HENSILL 439</i> 10:15 AM – 12:00 PM	<b>FIELD TRIP</b> <i>Jasper Ridge Biological Preserve</i> 7:30 AM – 2:30 PM
	<b>WORKSHOP</b> <b>Discovering Darwin</b> <i>HENSILL 439</i> 1:00 PM – 4:30 PM	<b>NOON PUBLIC LECTURE</b> <b>"Specific Events Delaying Recognition of Franklin's Contribution to DNA Structure"</b> <i>SCIENCE 201</i> 12:15 PM	<b>FIELD TRIP</b> <i>Natural History of Marin County</i> 8:30 AM – 4:00 PM
	<b>SYMPORIUM</b> <b>New Humanities... Darwin and Culture</b> <i>HENSILL 667</i> 1:15 PM – 5:00 PM	<b>FIELD TRIP</b> <b>Pigments, Perfumes and Poisons at the San Francisco Botanical Garden</b> 12:30 PM – 5:00 PM	
	<b>SYMPORIUM</b> <b>Good Science....: Communicating Science to the Public</b> <i>HENSILL 113</i> 1:30 PM – 4:50 PM	<b>SYMPORIUM</b> <b>Weird Life</b> <i>HENSILL 206</i> 1:30 PM – 5:00 PM	
	<b>CONTRIBUTED PAPERS</b> <b>Sustainability: Joint Session including Ag and Hort Sci; Earth Sci; Ecol, Org Bio and Env Sci; Gen and Interdisc Sections</b> <i>HENSILL 206</i> 1:30 PM – 5:00 PM	<b>CONTRIBUTED PAPERS</b> <b>Joint Session: Comp and Info Sci; Physics and Mat Sci</b> <i>HENSILL 667</i> 1:30 PM – 3:15 PM	
	<b>CONTRIBUTED PAPERS</b> <b>Joint Session: Chem and Biochem; Health Sci</b> <i>HENSILL 201</i> 1:55 PM – 4:20 PM	<b>WORKSHOP</b> <b>Science Education for New Civic Engagements and Responsibilities (SENCER)</b> <i>HENSILL 439</i> 1:30 PM – 5:00 PM	
<b>EVENING PLENARY LECTURE</b> <b>"Ecological Awareness in American Landscape Art"</b> <i>SCIENCE 201</i> 7:00 PM	<b>EVENING PLENARY LECTURE</b> <b>"Shipwrecks as Fossils"</b> <i>SEVEN HILLS CENTER</i> 7:00 PM	<b>STUDENT AWARDS BANQUET</b> <i>SEVEN HILLS CENTER</i> 6:00 PM	
<b>WELCOME WAGON – CRACKER BARREL RECEPTION</b> <i>GREENHOUSE</i> 8:00 PM	<b>SFSU PRESIDENT'S RECEPTION</b> <i>SEVEN HILLS CENTER</i> 8:00 PM	<b>PACIFIC DIVISION PRESIDENT'S LECTURE</b> <i>SEVEN HILLS CENTER</i> APPROX 8:15 PM	

	Sustainability	Social Sciences	Physics and Materials Sciences	History of Science	Health Sciences	General and Interdisciplinary	Evolution	Environmental Sciences	Education	Ecology	Earth Sciences	Computer and Information Sciences	Chemistry and Biochemistry	Biology, Organismal	Biology, Cell and Molecular
Symposia:															
Friday															
Darwin and the Galapagos, Part I (25)	•														
Saturday															
Darwin and the Galapagos, Part II (26)	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Monday															
Conservation in an Urban National Park (29)															
Good Science Is Only Part of the Job: Communicating Science to the Public (31)															
Materials Science and Nanotechnology (28)															
Materials Science Education (28)															
New Humanities and Science Convergence: Darwin and Culture (30)															
San Francisco Bay: Tracking and Understanding a Changing Estuary (27)															
Tuesday															
Evolution of Cooperation: Theoretical and Experimental Analysis (34)															
Evolutionary Innovations: Where Ecology, Development and Macroevolution Intersect (35)															
Recent Advances in Pharmacology and Toxicology (33)															
Sustainability as a Way of Life: Learning, Practice and Experience (32)															
Weird Life (page 36)															
Wednesday															
Near-Earth Objects: A Threat and Response Update (38)															
Project-Based Learning and the Culture of Science Education in the 21st Century (37)															
Contributed Paper Sessions:															
Monday															
Morning Joint Session (43)															
Working on Darwin (43)															
Afternoon Joint Session (45)															
Sustainability, A Special Theme Joint Session (44)															
Tuesday															
Science and Technology Education Section (47)															
Morning Joint Session (47)															
Afternoon Joint Session (48)															
Workshops:															
Monday															
Bio-Rad, Sessions 1 – 3 (39)															
Discovering Darwin (39)															
Tuesday															
Bio-Rad Sessions, 4 – 6 (40)															
Forging California's Path to Zero Net Energy Usage (40)															
Lectures:															
Sunday Evening: Ecological Awareness in American Landscape Art (19)															
Monday Noon: Millennial Biology: The National Science Foundation and the Life Sciences, 1975 to 2005 (19)															
Monday Evening: Shipwrecks as Fossils (19)															
Tuesday Noon: Specific Events Delaying Recognition of Franklin's Contribution to DNA Structure (19)															
Video Presentation:															
Wednesday Noon: Students of Consequence (19)															

**Interest Matrix**

This interest matrix is designed to help individuals identify programs of interest. It is by no means exhaustive, nor is it absolutely authoritative. We encourage attendees to explore as many of the different programs as their time and interests allow.

The numbers following the titles of programs identify the pages on which the program may be found in these *Proceedings*.

## Attention ARTISTS!

We are seeking art with a science pedigree!!

Planned in conjunction with the 91<sup>st</sup> annual meeting of the AAAS, Pacific Division, to be held at Southern Oregon University in mid-June 2010, is an art exhibit, or more specifically, an art/science exhibit.

Do you have any artworks based on your research or studies in the sciences you would like to include in this exhibit? If so, we would like to see your work. Or, please suggest to us, or forward this announcement to your colleagues who might be interested.

To be considered, please send an email with attached jpeg(s) (2MB limit each; 10MB total) or a CD/DVD to:

Michael Crane, Director  
Schneider Museum of Art  
Southern Oregon University  
1250 Siskiyou Blvd.  
Ashland, OR 97520  
541-552-8484  
[cranem@sou.edu](mailto:cranem@sou.edu)

Please copy all submissions to both:

Roger Christianson AAAS, Pacific Division Southern Oregon University 1250 Siskiyou Blvd. Ashland, OR 97520 541-552-6747 <a href="mailto:rchristi@sou.edu">rchristi@sou.edu</a>	Robert Chianese Department of English California State University 18111 Nordhoff Street Northridge, CA 93130 <a href="mailto:robert.chianese@csun.edu">robert.chianese@csun.edu</a>
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For each submission, be sure to include a statement describing the work's connection to science.

Questions? Contact Michael Crane or Roger Christianson (see information above).

# GENERAL SESSIONS

Sunday, 16 August 2009

## EVENING PLENARY LECTURE\*

San Francisco State University

SCIENCE 201

*Sunday*

7:00 PM

**1 Ecological Awareness in American Landscape Art: Depicting and Repairing the American Wasteland,** ROBERT L. CHIANESE (California State University, Northridge, CA).



Photo courtesy Robert Chianese.

Monday, 17 August 2009

## NOON PUBLIC LECTURE\*

San Francisco State University

SCIENCE 201

*Monday*

12:15 PM - 1:00 PM

**2 Millennial Biology: The National Science Foundation and the Life Sciences, 1975 to 2005,** DONALD J. McGRAW (Ephraim, UT).

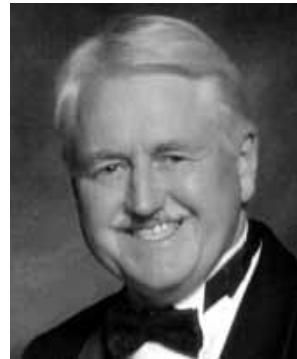


Photo courtesy Donald McGraw

## Welcome Wagon – Cracker Barrel

### RECEPTION

San Francisco State University

GREENHOUSE

(just north of Hensill Hall)

*Sunday*

8:00 PM

Hosted by the San Francisco State University Biology Department, this reception begins immediately following Dr. Chianese's lecture and continues until about 9:15 p.m. All registrants and their families are invited to enjoy the conviviality of this event, which will include a selection of soft drinks, chips, and good conversation. Please wear your registration badge.

## EVENING PLENARY LECTURE\*

San Francisco State University

Seven Hills Center

*Monday*

7:00 PM

**3 Shipwrecks as Fossils,** CATHRYN R. NEWTON (Dean Emerita and Professor of Interdisciplinary Sciences, The College of Arts and Sciences, Syracuse University, Syracuse, NY).



Photo courtesy Syracuse University

## SFSU PRESIDENT'S RECEPTION

San Francisco State University

Seven Hills Center

*Monday*

8:00 PM

San Francisco State University President Robert Corrigan will host an informal reception following Dr. Newton's talk. All participants and their families are invited to enjoy this relaxed occasion. Non-registered family members are welcome, but must be accompanied by a registrant. Please wear your registration badge.

\*The public is invited to attend this program at no charge.

## GENERAL SESSIONS

**Tuesday, 18 August 2009**

### NOON PUBLIC LECTURE\*

San Francisco State University

SCIENCE 201

Tuesday

12:15 PM

*4 Specific Events Delaying Recognition of Franklin's Contribution to DNA Structure,*  
**LYNNE OSMAN ELKIN**  
(California State University  
East Bay, Hayward, CA).



Photo Courtesy Lynne Elkin

### RECEPTION and STUDENT AWARDS BANQUET

San Francisco State University

Seven Hills Center

Tuesday

6:00 PM

A hosted reception, beginning at 6:00 p.m., will feature soft drinks and juices. Dinner will be served around 6:45 p.m. Be sure to bring your dinner ticket with you, as it is needed to not only verify that you are on our dinner list but it also tells the servers your choice of entree. Tickets to the banquet cost \$35 and needed to be purchased in advance. Students in competition for Awards of Excellence may attend the banquet as guests of the Division. However, they must also have requested a ticket in advance (at no charge). If you do not have a ticket but would like to attend the banquet, please check at the Registration Center no later than 3:00 p.m. on Tuesday to check ticket availability. Following dinner will be the announcement of the winners of the sectional and division-wide student Awards of Excellence. *Student award winners are asked to stay until the end of the program so that photographs may be taken of the group.* After announcement of the award winners, Dr. Anne Sturz (University of San Diego, San Diego, CA) will present the Presidential Lecture. The evening should end by 9:30 p.m. or earlier.



Photo courtesy Anne Sturz

**Wednesday, 19 August 2009**

### MEETING of the COUNCIL of the PACIFIC DIVISION

San Francisco State University

Blakeslee Room

(at the top of Thornton Hall)

Wednesday

7:00 AM - 10:00 AM

The Council of the AAAS, Pacific Division will hold its annual breakfast and business meeting starting at 7:00 a.m. at the top of Thornton Hall in the Blakeslee Room. The Council will elect officers, discuss programs for the 2010 and 2011 annual meetings, and transact such other business as is required by the Division's By-laws.

### NOON PUBLIC SHOWING of *Students of Consequence\**

San Francisco State University

SCIENCE 201

Wednesday

12:15 p.m.

Though not quite a public lecture, this program should engender a high degree of interest in those who are concerned about high school education in the United States. Dr. Jay Vavra (High Tech High, San Diego, CA) will present a special showing of *Students of Consequence*, a 32 minute film produced by students at High Tech High to document their trip to Tanzania to learn about the African bushmeat problem and help authorities come up with ways to definitively differentiate between legal and illegal bushmeat sources. High school students can make a difference! Following the film, Dr. Vavra will be available to comment and answer questions.



Photo courtesy Jay Vavra



Photo courtesy Jay Vavra

\*The public is invited to attend this program at no charge.

# TECHNICAL SESSIONS

**1100** (time italicized and underlined) identifies a student presentation

\* identifies the speaker from among several authors listed

**63** (bolded number) is the abstract number

## I. SYMPOSIA

**Friday, 14 August 2009**

### **Darwin and the Galapagos, Part I**

California Academy of Sciences

Forum

Friday

9:00 AM – 5:00 PM

Program Organizer: *Michael Ghiselin* (California Academy of Sciences, San Francisco, CA)

Sponsored by the California Academy of Sciences.

This program commemorates the bicentennial of the birth of Charles Darwin and the 150th anniversary of the publication of *On the Origin of Species*. A collaborative effort between the California Academy of Sciences and the Pacific Division of the American Association for the Advancement of Science (AAAS), this symposium is dedicated to the memory of the late Robert I. Bowman, former Professor of Biology at San Francisco State University, who had a lifelong interest in Galapagos finches. The Academy itself has a long history of involvement in scientific activities in the Galapagos Archipelego. After the destruction of its building in the San Francisco earthquake and fire of 1906, the collections from the Galapagos expedition of 1905 – 1906 were crucial to the reestablishment of its facilities. The Academy has the best collection of Galapagos materials in the world.

Session chair: *Michael T. Ghiselin*

**9:00 Welcoming statements**

**9:30 6 Robert Irwin Bowman (1925-2006) Remembered,**  
**ALAN E. LEVITON and MICHELE L. ALDRICH**  
(California Academy of Sciences, San Francisco, CA).

**10:00 7 Charles Darwin: Besides Galapagos,** **JERE H. LIPPS** (Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley, CA).

**10:45 BREAK**

**11:15 8 Recreating Darwin's Experiences as a Geologist Using Texts, Sites, and Specimens,** **SANDRA HERBERT** (Department of History, University of Maryland Baltimore County, Baltimore, MD).

**12:00 9 Tracing Darwin's Geological Footsteps on Isla Santiago (James Island),** **SALLY A. GIBSON** (Department of Earth Sciences, University of Cambridge, UK).

**12:45 LUNCH**

**2:15 10 Darwin, the Galapagos and His Changing Thoughts about Species Origins: 1835-37,** **JONATHAN HODGE** (History and Philosophy of Science, Department of Philosophy, University of Leeds, UK).

**3:00 BREAK**

**3:30 11 Going Public on the Galapagos: Reading Darwin between the Lines,** **MICHAEL T. GHISELIN** (Department of Invertebrate Zoology, California Academy of Sciences, San Francisco, CA).

**4:15 12 Darwin: The Botanist on the Beagle,** **DUNCAN M. PORTER** (Department of Biological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA).

Note: This symposium continues on Saturday, 15 August. Please refer to page 28 for the Saturday schedule.

Saturday, 15 August 2009

**Darwin and the Galapagos, Part II**

California Academy of Sciences

Forum

Saturday

9:00 AM – 5:00 PM

Program continues from page 27.

Session Chair: *Michael T. Ghiselin*

- 9:00 13** *A Damned Creation: The Galapagos Before Darwin*, **EDWARD J. LARSON** (Humanities Division, Pepperdine University, Malibu, CA).

- 9:45 14** *Collecting Evolution: The Untold Story of the Vindication of Charles Darwin by the 1905-06 Galapagos Expedition of the California Academy of Sciences*, **MATTHEW J. JAMES** (Department of Geology, Sonoma State University, Rohnert Park, CA).

**10:30 BREAK**

- 11:00 15** *Darwin, Barnacles and the Galapagos: A View through a 21<sup>st</sup> Century Lens*, **ROBERT VAN SYOC** (Department of Invertebrate Zoology and Geology, California Academy of Sciences, San Francisco, CA).

- 11:45 16** *The Fishes of the Galápagos Archipelago*, **JOHN E. MCCOSKER<sup>1</sup>\*** and **RICHARD H. ROSENBLATT<sup>2</sup>** (<sup>1</sup>California Academy of Sciences, San Francisco, CA; <sup>2</sup>Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA).

**12:30 LUNCH**

- 2:00 17** *Collecting Galapagos and the Pacific: How Rollo Howard Beck Shaped Our Understanding of Evolution*, **JOHN P. DUMBACHER** (Department of Ornithology and Mammalogy, California Academy of Sciences, San Francisco, CA).

- 2:45 18** *The Evolution of Darwin's Finches*, **PETER R. GRANT** and **B. ROSEMARY GRANT** (Department of Zoology, Princeton University, Princeton, NJ).

**3:30 BREAK**

- 3:45 19** *Darwin and the Galápagos: What Darwin Would Like to Have Known*, **FRANK J. SULLOWAY** (Institute of Personality and Social Research, University of California, Berkeley, CA).

- 4:30 Discussion and Closing**

**Monday, 17 August 2009**

***San Francisco Bay: Tracking and Understanding a Changing Estuary***

SCIENCE 201

Monday

8:25 AM – 6:00 PM

Program organizers: *John Largier* (Bodega Marine Laboratory, University of California, Davis, CA), *Sarah Cohen* and *Kathy Boyer* (Romberg Tiburon Center, San Francisco State University, San Francisco, CA), and *Terrence Gosliner* (California Academy of Sciences, San Francisco, CA).

Sponsored by the Pacific Division Section on Ecology, Organismal Biology and Environmental Sciences.

San Francisco Bay is changing – owing to the multiple influences of watershed changes, changing human use of the Bay, climate change, and management priorities. With attention to evolving issues, this symposium features invited presentations on changing biophysical systems in the Bay and the research science that has led to new understanding of these changes. It builds on previous AAAS symposia and the volumes edited by Hollibaugh (1996) and Conomos (1979), with a focus on the Bay proper, i.e., west of Carquinez Strait.

Session chair: *John Largier*

**8:25 Introductions, Context, and Welcome**

**8:30 20 Climate Change From Both Ends: Projected Sea Level Rise and Inflow Changes in San Francisco Bay, NOAH KNOWLES** (U.S. Geological Survey, Menlo Park, CA; ).

**8:55 21 Morphological Change of the San Francisco Estuary, BRUCE JAFFE<sup>1\*</sup>, THERESA FREGOSO<sup>1</sup>, AMY FOXGROVER<sup>2</sup>, MICK VAN DER WEGEN<sup>3</sup>, DANO ROELVINK<sup>3</sup>, NEIL GANJU<sup>4</sup>, KATE DALLAS<sup>5</sup>, PATRICK BARNARD<sup>1</sup>, DAN HANES<sup>1</sup>, JOHN CHIN<sup>6</sup>, DON WOODROW<sup>6</sup>, MARY McGANN<sup>6</sup>, LYNN INGRAM<sup>7</sup>, SHAWN HIGGINS<sup>8</sup>, MARK MARVIN-DIPASQUALE<sup>6</sup> and ELENA NIELSEN<sup>9</sup> (<sup>1</sup>United States Geological Survey, Pacific Science Center, Santa Cruz, CA; <sup>2</sup>Virginia Institute of Marine Science, Gloucester Point, VA; <sup>3</sup>UNESCO-IHE, 2601 DA Delft, The Netherlands; <sup>4</sup>United States Geological Survey, Woods Hole Science Center, Woods Hole, MA; <sup>5</sup>University of California Santa Cruz, Santa Cruz, CA; <sup>6</sup>United States Geological Survey, Menlo Park, CA; <sup>7</sup>University of California Berkeley, Berkeley, CA; <sup>8</sup>Kamman Hydrology and Engineering, Inc., San Rafael, CA; <sup>9</sup>United States Geological Survey, Portland, OR).**

**9:20 22 A New Regime of Decreased Sediment and Carbon Supply in the San Francisco Estuary, DAVID H. SCHOELLHAMER<sup>1\*</sup>, SCOTT A. WRIGHT<sup>1</sup>, ELIZABETH A. CANUEL<sup>2</sup>, JUDITH Z. DREXLER<sup>1</sup>, and LESTER J. MCKEE<sup>3</sup> (<sup>1</sup>U.S. Geological Survey, Sacramento, CA; <sup>2</sup>Virginia Institute of Marine Science, Gloucester Point, VA; <sup>3</sup>San Francisco Estuary Institute, Oakland, CA).**

**9:45 23 Historical Landscapes of the San Francisco Bay Area: New Perspectives on the Past and the Future, ROBIN GROSSINGER<sup>1\*</sup>, JOSH COLLINS<sup>1</sup>, LESTER MCKEE<sup>1</sup>, PETER BAYE<sup>2</sup>, LAUREL COLLINS<sup>3</sup>, ROBERT LEIDY<sup>4</sup>, and JANET SOWERS<sup>5</sup> (<sup>1</sup>San Francisco Estuary Institute, Oakland, CA; <sup>2</sup>Annapolis, CA; <sup>3</sup>Watershed Sciences, Berkeley, CA; <sup>4</sup>Wetlands Regulatory Office, U.S. Environmental Protection Agency, San Francisco, CA; <sup>5</sup>William Lettis and Associates, Walnut Creek, CA).**

**10:10 BREAK**

**10:30 24 Central San Francisco Bay: The Circulation Crossroads of San Francisco Bay, MARK STACEY<sup>1\*</sup>, JOHN LARGIER<sup>2</sup>, TOBY GARFIELD<sup>3</sup>, STEPHEN MONISMITH<sup>4</sup>, THOMAS POWELL<sup>1</sup>, JONATHAN FRAM<sup>5</sup>, and EDWARD GROSS<sup>4,6</sup> (<sup>1</sup>University of California Berkeley; <sup>2</sup>University of California Davis (Bodega Marine Lab); <sup>3</sup>Romburg Tiburon Center, San Francisco State University; <sup>4</sup>Stanford University; <sup>5</sup>University of California Santa Barbara; <sup>6</sup>Bay Modeling).**

**10:55 25 Historical and Present-Day Bathymetric Changes and Sediment Transport Patterns in and around the Golden Gate, PATRICK L. BARNARD<sup>1\*</sup>, DAN M. HANES<sup>1</sup>, LI H. ERIKSON<sup>1</sup>, BRUCE JAFFE<sup>1</sup> and KATE DALLAS<sup>2</sup> (<sup>1</sup>United States Geological Survey, Pacific Science Center, Santa Cruz, CA; <sup>2</sup>University of California Santa Cruz, Department of Earth and Planetary Sciences, Santa Cruz, CA).**

**11:20 26 Primary Production in the Northern San Francisco Estuary: Recent Insights From Carbon and Nitrogen Productivity Studies, ALEXANDER E. PARKER<sup>\*</sup>, RICHARD C. DUGDALE, FRANCES P. WILKERSON and AL MARCHI (Romburg Tiburon Center, San Francisco State University, Tiburon, CA).**

**11:45 27 Contaminants in San Francisco Bay: Current Status and Advances in Science and Management Over the Past 15 Years, JAY A. DAVIS<sup>1\*</sup>, LESTER J. MCKEE<sup>1</sup>, MARGARET D. SEDLAK<sup>1</sup>, SAM**

## SYMPOSIA – Monday

N. LUOMA<sup>2</sup>, A. RUSSEL FLEGAL<sup>3</sup>, CYNTHIA L. BROWN<sup>4</sup>, THOMAS MUMLEY<sup>5</sup>, KAREN TABERSKI<sup>6</sup> and INGE WERNER<sup>6</sup> (<sup>1</sup>San Francisco Estuary Institute, Oakland, CA; <sup>2</sup>John Muir Institute of the Environment, University of California Davis, Davis, CA; <sup>3</sup>University of California Santa Cruz, Santa Cruz, CA; <sup>4</sup>US Geological Survey, Menlo Park, CA; <sup>5</sup>San Francisco Bay Regional Water Quality Control Board, Oakland, CA; <sup>6</sup>University of California Davis, Davis, CA).

### 12:10 LUNCH

- 1:30 **28 Temporal and Spatial Distributions of Benthic and Pelagic Grazers: How Do They Affect Phytoplankton Dynamics in San Francisco Bay?** JAN THOMPSON<sup>1\*</sup>, LISA LUCAS<sup>1</sup> and WIM KIMERER<sup>2</sup> (<sup>1</sup>United States Geological Survey, Menlo Park, CA; <sup>2</sup>Romberg Tiburon Center, San Francisco State University, Tiburon, CA).
- 1:55 **29 Climate Shift, Crabs, Shrimp, Fish and Phytoplankton in San Francisco Bay,** JAMES CLOERN (USGS, Menlo Park, CA).
- 2:20 **30 Restoration of Eelgrass (*Zostera marina*) Habitats in San Francisco Bay: A Rapidly Evolving Understanding of Limitations and Opportunities,** KATHARYN E. BOYER<sup>1</sup>, SANDY WYLLIE-ECHEVERRIA<sup>2</sup>, SARAH COHEN<sup>1</sup>, KEITH MERKEL<sup>3</sup>, NATALIE COSENTINO-MANNING<sup>4</sup>, and MARK FONSECA<sup>5</sup> (<sup>1</sup>Romberg Tiburon Center, San Francisco State University, Tiburon, CA; <sup>2</sup>Friday Harbor Laboratories, University of Washington, Friday Harbor, WA; <sup>3</sup>Merkel and Associates, San Diego, CA; <sup>4</sup>NOAA Fisheries Restoration Center, Santa Rosa, CA; <sup>5</sup>National Ocean Service/NOAA, Beaufort, NC).
- 2:45 **31 New Perspectives on the Wetlands of San Francisco Bay: Their Past, Present, and Future Relationships to the Bay and Its Watersheds,** JOSH N. COLLINS<sup>1\*</sup>, LETITIA GRENIER<sup>1</sup>, ROBIN M. GROSSINGER<sup>1</sup>, LESTER J. MCKEE<sup>1</sup>, JOHN CALLAWAY<sup>2</sup>, FRANCES MALAMUD-ROAM<sup>3</sup>, and ELIZABETH B. WATSON<sup>4</sup> (<sup>1</sup>San Francisco Estuary Institute, Oakland, CA; <sup>2</sup>University of San Francisco, San Francisco, CA; <sup>3</sup>California Department of Transportation, Oakland, CA; <sup>4</sup>El Centro de Investigación Científica y de Educación Superior, Ensenada, B.C. México).

### 3:10 BREAK

- 3:30 **32 Trends of Waterbird Populations in San Francisco Bay: Top-Down Assessment of Ecosystem Health,**

JOHN Y. TAKEKAWA<sup>1\*</sup>, SUSAN DE LA CRUZ<sup>1</sup>, NICOLE ATHEARN<sup>1</sup>, MICHAEL CASAZZA<sup>1</sup>, JOSH ACKERMAN<sup>1</sup>, JILL DEMERS<sup>2</sup>, JOHN KELLY<sup>3</sup>, NADAV NUR<sup>4</sup>, NILS WARNOCK<sup>5</sup>, MICHAEL PERLMUTTER<sup>6</sup>, and ROBIN GROSSINGER<sup>7</sup> (<sup>1</sup>USGS Western Ecological Research Center, Sacramento, CA; <sup>2</sup>San Francisco Bay Bird Observatory, Milpitas, CA; <sup>3</sup>Audubon Canyon Ranch, Marshall, CA; <sup>4</sup>PRBO Conservation Science, Petaluma, CA; <sup>5</sup>University of California Wildlife Health Center, Davis, CA; <sup>6</sup>Audubon Society; <sup>7</sup>San Francisco Estuary Institute, San Francisco, CA).

- 3:55 **33 Cascading Threats, Constrained Management and the Future of Invasive Species in San Francisco Bay,** EDWIN GROSHOLZ<sup>1\*</sup>, CHELA ZABIN<sup>1</sup>, ANDY CHANG<sup>1</sup>, BILL BENNETT<sup>2</sup> and BRENDA GREWELL<sup>3</sup> (<sup>1</sup>Department of Environmental Science and Policy, University of California, Davis, CA; <sup>2</sup>Center for Watershed Sciences, University of California, Davis, CA; <sup>3</sup>USDA Agricultural Research Service, Davis, CA).
- 4:20 **34 Screening of the 1974 PBS NOVA Film, "Inside the Golden Gate," with Introduction and Follow-up Discussion,** FREDERIC H. NICHOLS (U. S. Geological Survey, Menlo Park, CA, retired).
- 4:30 *Video: 1974 PBS NOVA "Inside the Golden Gate"*
- 5:20 *General Discussion*

## Materials Science and Materials Science Education

HENSILL HALL 439

Monday

8:55 AM – 12:00 PM

Program organizers: Panos Photinos and Ellen Siem (Department of Physics and Engineering, Southern Oregon University, Ashland, OR), Phillip G. Collins (Department of Physics and Astronomy, University of California, Irvine, CA), Shalini Prasad (Department of Electrical and Computer Engineering, Portland State University, Portland, OR), and Jeremy Qualls (Department of Physics and Astronomy, Sonoma State University, Rohnert Park, CA).

Sponsored by the Pacific Division Sections on Physics and Materials Science, and Science and Technology Education

## Materials Science

Session Chairs: Panos Photinos and Jeremy Qualls

- 8:55 *Welcome and Announcements*

**9:00 35 Nanomonitors: Electrical Immunoassays for Protein Biomarker Profiling, SHALINI PRASAD<sup>1,2</sup>, MANISH BOTHARA<sup>1</sup>, THOMAS BARRETT<sup>3</sup> and JOHN CARRUTHERS<sup>4</sup>** (<sup>1</sup>Department of Electrical and Computer Engineering, Portland State University, Portland, OR; <sup>2</sup> Department Electrical Engineering, Arizona State University, Tempe, AZ; <sup>3</sup>Department of Medicine, Oregon Health Sciences University, Portland, OR; <sup>4</sup>Department of Physics, Portland State University, Portland).

**9:20 36 Nanomonitor Technology for Glycosylation Analysis, GAURAV CHATTERJEE<sup>1\*</sup>, VINAY J. NAGRAJ<sup>2</sup>, PETER WIKTOR<sup>2</sup>, SERON EATON<sup>2</sup> and SHALINI PRASAD<sup>1</sup>,** (<sup>1</sup>Department of Electrical Engineering, Arizona State University, Tempe, AZ; <sup>2</sup>Center for Bioelectronics and Biosensors, The Biodesign Institute at Arizona State University, Tempe, AZ).

**9:40 37 Low Dimensional Boundary States, JEREMY S. QUALLS and BRAD YEARWOOD** (Department of Physics and Astronomy, Sonoma State University, Rohnert Park, CA).

## 10:00 BREAK

**10:20 38 Thickness Dependence of Thin Film Samaria Doped Ceria Oxygen Sensor, RAHUL SANGHAVI<sup>1</sup>, M. NANDASIRI<sup>2,3</sup>, S. KUCHIBHATLA<sup>2</sup>, P. NACHIMUTHU<sup>2</sup>, M.H. ENGELHARD<sup>2</sup>, V. SHUTTHANANDAN<sup>2</sup>, W. JIANG<sup>2</sup>, S. THEVUTHASAN<sup>2</sup>, ASGHAR KAYANI<sup>3</sup>, and S. PRASAD<sup>1</sup>** (<sup>1</sup>Department of Electrical Engineering, Arizona State University , Tempe, AZ; <sup>2</sup>EMLSL, Pacific Northwest National Laboratory, Richland, WA; <sup>3</sup>Physics Department, Western Michigan University, Kalamazoo, MI).

**10:40 39 Phase Transitions and Ferroelectricity in  $\text{NaSb}_3\text{F}_{10}$ , R. J. CHRISTIE, P. WU, P. PHOTINOS and S. C. ABRAHAMS** (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR).

## Materials Science Education

Session Chair: Shalini Prasad

**11:00 40 Introducing Nanophysics and Nanotechnology at the Undergraduate Level: Physics Majors and Non-Science Majors, ELLEN SIEM** (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR).

**11:20 41 Conceptual Approach to Teaching Nanoscience to Undergraduates, PRASHANT SHARMA** (Department of Physics, Suffolk University, Boston, MA).

**11:40 42 The First Undergraduate Materials Science Degree in Oregon, GEORGE QUAINOO and ELLEN SIEM** (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR).

## *Conservation in an Urban National Park*

HENSILL HALL 543

Monday

9:00 AM – 4:30 PM

Program Organizers: *Tania Pollak* (Presidio Trust, San Francisco, CA) and *John Hafernik* (Department of Biology, San Francisco State University, San Francisco, CA).

Sponsored by the Pacific Division section on Ecology, Cell Biology and Environmental Sciences

Encompassing 80,000 acres and adjacent to cities containing 1.7 million people, the Golden Gate National Recreation Area (GGNRA) is one of the world's largest urban national parks. The GGNRA is also nationally and internationally renowned for its beauty and recreational opportunities. These parklands support historic resources alongside valuable ecological resources, including 33 federally listed rare plant and animal species. This proximity to urban communities, and high visitor use, provide both challenges for protection of park resources and opportunities to engage the public in conservation, monitoring and restoration of those resources.

This symposium focuses on this urban national park's challenges and opportunities, its recognition that resources cannot be conserved without the community's participation, and its efforts to inspire that community to move from park user to park volunteer. The symposium also addresses the park's efforts at sustainability related to resource conservation and park management.

Session Chair: *Tania Pollak*

## 9:00 Introductory Comments

**9:05 43 The Evolving People and Landscapes of the West, EMILYN SHEFFIELD** (Department of Recreation and Parks Management, California State University Chico, Chico, CA).

**9:35 44 Ecological Restoration in National Parks: Case Examples from Golden Gate National Recreation Area, SUSAN L. FRITZKE** (National Park Service, Golden Gate National Recreation Area, Natural Resources and Science, Fort Mason, San Francisco, CA).

## SYMPOSIA – Monday

**10:05 45 Restoration of Remediation Sites, MARK FREY<sup>1</sup> and LEWIS STRINGER<sup>2</sup> (<sup>1</sup>Presidio Trust, San Francisco, CA; <sup>2</sup>National Park Service, Fort Mason, San Francisco, CA).**

### 10:35 BREAK

**11:00 46 Rare Plants and Citizen Science in the GGNRA, MICHAEL CHASSE (National Park Service, Golden Gate National Recreation Area, Natural Resources and Science, San Francisco, CA).**

**11:30 47 Conserving and Managing Extremely Rare Species: The Presidio Manzanita (*Arctostaphylos montana* subsp. *ravenii*), V. THOMAS PARKER (Department of Biology, San Francisco State University, San Francisco, CA).**

### 12:00 LUNCH

**1:00 48 Species Invasion in California Ecosystems: Linking Changes in Plant Composition to Changes in Local and Global Climate, LAURIE KOTEEN<sup>1\*</sup>, JOHN HARTE<sup>1,2</sup> and DENNIS BALDOCCHI<sup>2</sup> (<sup>1</sup>Energy and Resources Group, University of California, Berkeley, CA; <sup>2</sup>Department of Environmental Science, Policy and Management, University of California, Berkeley, CA).**

**1:30 49 Bees, Beetles, and Spiders: Species Assemblage Patterns Within the San Francisco Presidio, MISHA T. LEONG<sup>1\*</sup> and JOHN HAFERNIK<sup>2</sup> (<sup>1</sup>Department of Environmental Science, Policy and Management, University of California, Berkeley, CA; <sup>2</sup>Department of Biology, San Francisco State University, San Francisco, CA).**

**2:00 50 Assessment of a Stream Restoration Project Using Benthic Macroinvertebrates in an Urban Park, THE RESA L. SHELTON\* and JOHN HAFERNIK (Department of Biology, San Francisco State University, San Francisco, CA).**

### 2:30 BREAK

**3:00 51 Sustainable Nursery Practices, MICHELE LASKOWSKI (Golden Gate National Parks Conservancy, Presidio Restoration Nursery, Fort Mason, San Francisco, CA).**

**3:30 52 Sustainable Approaches to Park Management, AIMEE VINCENT (Operations Department, Presidio Trust, San Francisco, CA).**

**4:00 Discussion**

## New Humanities and Science Convergences:

### Darwin and Culture

HENSILL HALL 667

Monday

1:15 PM – 5:00 PM

Program organizers: *Robert L. Chianese* (Department of English, California State University, Northridge, CA) and *Carl A. Maida* (Schools of Dentistry and Medicine, University of California, Los Angeles, CA)

Sponsored by the Pacific Division General and Interdisciplinary Section.

This symposium explores the influence of Darwinian ideas that extend beyond biology into all branches of culture—from ecology, anthropology, economics, sociology and law, to such areas as art, literature, and design. Just how influential has evolution become in various academic disciplines, and how does it serve as a theoretical basis or even a metaphor for contemporary culture in its many forms today?

Does society evolve in Darwinian fashion, or is this just a metaphor to characterize change itself? Some speak of economies evolving in various stages as if it were a living species; does the analogy have some basis in biological fact? How can any one writer's or artist's or thinker's work be said to evolve? Is contemporary architecture an evolutionary outgrowth of previous forms or a simple shift of design, materials and function? How much does the idea of sustainability, as it applies to cultural matters, resemble the sustainability of natural systems?

Session Chair: *Robert L. Chianese*

**1:15 Welcome and Introductory Comments**

**1:25 53 Not Everything Is Darwin: Evolution and Archival Change Theory in Light of Field-Theoretic Thought, FRED MASSARIK (University of California Los Angeles, Anderson Graduate School of Management, Los Angeles, CA).**

**1:50 54 Darwin's Orchids: Cross-Pollination from Two or Three Perspectives, BARBARA YABLON MAIDA (University of California Los Angeles, Department of Geography, Los Angeles CA).**

**2:15 55 How the Mouth Evolved into an Organ of Love, GEORGE W. BERNARD (Departments of Oral Biology, Medicine and Neurobiology, UCLA Schools of Dentistry and Medicine, Los Angeles, CA).**

**2:40 56 Community as Experience: Dewey, Darwin, and Aesthetic Ecology, CARL A. MAIDA (University of California, Center for the Health Sciences, Los Angeles, CA).**

**3:05 BREAK**

- 3:20 57 Victorian Poets Adapt to Darwin, ROBERT LOUIS CHIANESE** (California State University Northridge, Department of English, Northridge CA).
- 3:45 58 Darwin: C.P. Snow and Also Fundamentalism, G. ARTHUR MIHRAM<sup>1</sup> and DANIELLE MIHRAM<sup>2</sup>** (<sup>1</sup>Princeton, NJ; <sup>2</sup>University Libraries and Department of French and Italian, University of Southern California, Los Angeles, CA).
- 4:10 59 Educating for the Future: The Need for an Evolutionary Process in Teaching and Learning, SUSAN MASSARIK ASLAN** (Los Angeles Unified School District, Somis, CA).
- 4:35 Discussion of the Presentations**

**3:05 BREAK**

- 3:20 62 Blazing Your Own Trail: Writing Directly to the Public, MICHAEL WHITE** (Department of Genetics and Center for Genome Sciences, Washington University School of Medicine, Washington University, St. Louis, MO).
- 3:50 63 Constructive Debates When Science and Politics Mix, EUGENIE SCOTT** (National Center for Science Education, Oakland, CA).

***Good Science is Only Part of the Job:  
Communicating Science to the Public***

HENSILL HALL 113

Monday

1:30 PM – 4:50 PM

Program organizer: *Henry J. Campbell* (Ion Publications, Folsom, CA)

Sponsored by the Pacific Division General and Interdisciplinary Section.

As science has become a larger part of the cultural landscape, researchers have frequently found themselves navigating the difficult waters of policies and politics. It has become increasingly necessary for scientists to work with the media to insure accurate portrayals of science issues so there can be better understanding by the public and therefore better decisions by policy makers. Each of the presentations will address how scientists can be better equipped to manage different media when sharing research and information with the public.

Section Chair: *Henry J. Campbell*

**1:30 Introductory Comments:**

- 1:35 60 Interacting with Science Journalists, GREG CRITSER** (Pasadena, CA).
- 2:05 61 Journals? We Don't Need No Stinking Journals, MICHAEL EISEN** (Department of Molecular and Cell Biology, and Genomics Division of the Lawrence Berkeley National Lab, University of California, Berkeley, CA).

Tuesday, 18 August 2009

*Sustainability as a Way of Life:  
Learning, Practice, and Experience*

California Academy of Sciences

Forum

Tuesday

8:30 AM – 5:00 PM

Program organizers: *Robert Louis Chianese* (California State University, Northridge, CA) and *Carl A. Maida* (University of California, Los Angeles, CA).

Program sponsored by the Pacific Division General and Interdisciplinary Section.

The ongoing process of achieving sustainable systems is transforming many areas of modern life and culture: housing, building and community design, agriculture, energy use and transportation, waste management, forestry, business and economics, as well as personal life style, community values, and social relationships. This symposium examines sustainability as it impacts and transforms our daily lives. We will explore a wide range of topics and questions, including:

- Does sustainability represent a new paradigm for personal, community, and global cooperation, or is its impact limited to a few areas of economics and the environment?
- As we move further in the twenty-first century up the path toward more sustainable living, just how will our lives be changed?
- How have the arts, architecture, and design been influenced by sustainability in both their content and methods of production?
- What do plans for making sustainability a part of study across the curriculum mean for education and its goals?
- What are the implications for shifting our attention from “maxima” to “optimums” as social ideals?
- How might competitiveness as a goal be affected?
- Are we being asked, perhaps impossibly, to shift or abandon some basic and valuable elements of our humanness in the pursuit of more efficient and sustainable ways of living?
- How is personal consciousness shaped by having to take into account the global consequences of everyday living decisions?
- Will intimate relationships and love itself be transformed by sustainable practices?
- Does dedication to sustainable living involve a new ethic?

**8:30** Welcome, Introductions and Brief Remarks by AAAS Pacific and Arctic Division Executive Directors *Roger G. Christianson* and *Lawrence Duffy* **CARLA. MAIDA** (UCLA Schools of Medicine and Dentistry, University of California Los Angeles, Los Angeles, CA).

**8:45** Overview of the Symposium and Framing of the Topic: Does Economic Crisis Lead to a More Sustainable Way of Life? **ROBERT L. CHIANESE** (Department of English, California State University, Northridge, CA).

**9:00** **64** Sustainability: How the Idea Evolved and Where It Will Lead Us, **JURGEN SCHMANDT** (Houston

Advanced Research Center and University of Texas, Austin, TX).

**9:30** **65** Mainstreaming Sustainability: The Opportunity Presented by Climate Change, **PAUL M. E. BUNJE** (Institute of the Environment, University of California Los Angeles, Los Angeles, CA).

**10:00 BREAK**

**10:15** **66** Evaluating and Designing Urban Food Systems: The Role of Local Initiatives, **ALISON M. MEADOW** (Department of Anthropology, University of Alaska Fairbanks, Fairbanks AK).

**10:45** **67** Coming to Terms with Northern Foods, Northern Futures, **S. CRAIG GERLACH, LAWRENCE K. DUFFY** and **PHILLIP A. LORING** (Department of Anthropology, University of Alaska, Fairbanks, AK).

**11:15** **68** Ecologies of Hope: Cross-Cultural Perspectives on Sustainability and Social Justice, **KRISTA HARPER** (Department of Anthropology and the Center for Public Policy and Administration, University of Massachusetts, Amherst, MA).

**11:45 LUNCH**

**1:45** **69** Going Green in Cartoon Sitcoms, **MARTY RAPP SAYLES** (Department of English, California State University Northridge, Northridge, CA).

**2:15** **70** Chiropractic for Sustainability – Aligning Ourselves, Our Business Systems, and Our Change Initiatives for Lasting and Intended Impacts, **JONATHAN KEVLES** (Clean Energy Solutions Campaign, Sierra Club, San Francisco, CA).

**2:45** **71** The San Diego Bay Study: Community-Based Conservation, **JAY VAVRA** (High Tech High, San Diego, CA).

**3:15 BREAK**

**3:30** **72** An Arctic Dimension of Sustainability: Resource Development, Legacies, and Education, **LAWRENCE K. DUFFY** (Department of Chemistry and Biochemistry, University of Alaska Fairbanks, Fairbanks, AK).

**4:00** **73** Bootstrapping into Resilience: Science Education as/for Sustainability, **WOLFF-MICHAEL ROTH** (University of Victoria, Victoria, BC).

**4:30** Discussion of the Presentations

**Recent Advances in  
Pharmacology and Toxicology**

HENSILL HALL 113

Tuesday

8:40 AM – 4:15 PM

Program organizers: *Kristen Mitchell and Kenneth Cornell* (Department of Chemistry and Biochemistry, Boise State University, Boise, ID)

Program sponsored by the Pacific Division sections in Cell and Molecular Biology, and Chemistry and Biochemistry.

The development of novel therapeutic strategies requires a detailed understanding of mechanisms that regulate homeostasis, along with an appreciation of the delicate balance that exists between the pharmacological and toxicological effects of chemical compounds. This session will focus on recent advances in understanding the pharmacological and toxicological effects of drugs, chemicals and environmental contaminants. Investigators are invited to present research on the identification of targets for new drug development, new drug screening strategies, and novel mechanisms of drug action. Emphasis will also be placed on the identification of mechanisms of toxicity for drugs, chemicals and environmental contaminants, as well as novel approaches to toxicity testing.

Session Chairs: *Kristen Mitchell and Kenneth Cornell*

**8:40 Welcome and Introductions**

**8:45 74 Biochemical Analysis of Parasitic Protozoan Methylthioadenosine Nucleosidases as a Target for Antibiotic Therapies, DANIEL QUAPP\* and KENNETH A. CORNELL** (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; danielquapp@u.boisestate.edu).

**9:15 75 Evaluation of MTA/SAH Nucleosidase Inhibitors as *B. burgdorferi* Antibiotics and Biofilm Suppressors, TONY MARTINEZ\* and KENNETH A. CORNELL** (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; tonymartinez@u.boisestate.edu).

**9:45 76 The Tumor Suppressor p53 Regulates DNA End Joining Activity in Normal Human Oral Keratinocytes, AURIELLE MODSTER\* and KI-HYUK SHIN** (University of California Los Angeles School of Dentistry, 10833 Le Conte Ave., Los Angeles, CA 90095; aurielle.modster@gmail.com).

**10:15 BREAK**

**10:30 77 Finding MRSA's Kryptonite: Computational Directed Combatant Pentapeptides, REED B. JACOB\*, KENNETH A. CORNELL, and OWEN**

**M. McDougal** (Department of Chemistry and Biochemistry, Boise State University, ID 83725; greengiant99@gmail.com).

**11:00 78 Worms, Brains, and Copper – A Recipe for Neural Damage, BRUCE A. O'GARA** (Department of Biological Sciences, Humboldt State University, Arcata, CA 95521; Bruce.OGara@humboldt.edu).

**11:30 79 The Impact of Environmental Toxins on Bone Health: Mechanisms of Cadmium-induced Osteotoxicity, SARA J. HEGGLAND** (Department of Biology, The College of Idaho, Caldwell, ID 83605; shegland@collegeofidaho.edu).

**12:00 LUNCH**

**1:30 80 Asbestos Autotoxicus: Inhalation Toxicology and Pathogenic Autoantibodies, JEAN C. PFAU** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; pfaujean@isu.edu).

**2:00 81 In Vivo Regulation of Hepatocyte Proliferation by the Aryl Hydrocarbon Receptor, KRISTEN A. MITCHELL** (Department of Biological Sciences, Boise State University, Boise, ID 83725; kristen-mitchell@boisestate.edu).

**2:30 82 Retinoic Acid Induces Cardiac Stem Cell Differentiation Via Activation of L-type Calcium Channels and Calcium Signaling, ROUEL S. ROQUE<sup>1,2\*</sup>, T.J. BARTOSH<sup>2</sup>, and JEFFERY D. MOLKENTIN<sup>3</sup>** (<sup>1</sup>Department of Basic Sciences, Touro University Nevada, Henderson, NV 89014; <sup>2</sup>Department of Cell Biology and Genetics, University of North Texas HSC, Fort Worth, TX 76107; and <sup>3</sup>Department of Molecular Cardiovascular Biology, Cincinnati Children's Hospital Medical Center, Cincinnati, OH 45229; rouel.roque@tun.touro.edu).

**3:00 BREAK**

**3:15 83 Pt(II) Complexes of 4,4'-disubstituted-2,2'-bipyridine: Structure and Cytotoxicity, BYRON BENNETT<sup>1</sup>, R. DAVID GRIGG<sup>1</sup>, VAN VO<sup>3</sup>, ZEYNEP G. KABULOGLU-KARAYUSUF<sup>3</sup>, VIKAS SEHDEV<sup>2</sup>, SARA GILMORE<sup>2</sup>, JAMES C.K. LAP<sup>2</sup>, and ALOK BHUSHAN<sup>2</sup>** (<sup>1</sup>Department of Chemistry, Idaho State University, 921 South 8<sup>th</sup> Ave., Stop 8023, Pocatello, ID 83209-8023; <sup>2</sup>Department of Biomedical and Pharmaceutical Sciences, College of Pharmacy, and ISU Biomedical Research Institute, Idaho State University, 921 S. 8<sup>th</sup> Ave., Pocatello, ID 83209; <sup>3</sup>Chemistry Department, University of Nevada

## SYMPOSIA – Tuesday

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Las Vegas, 4505 Maryland Parkway, Las Vegas, Nevada 89154: bennbyro@isu.edu).

- 3:45 84 Pharmacologic Targeting of Bacterial Cell "Phones": Can You Hear Me Now?** **KENNETH A. CORNELL** (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; ken-cornell@boisestate.edu).

**10:00 87 The Evolution of Greenbeard Cooperation and Mating System Transitions in Vertebrates,** **BARRY SINERVO<sup>1</sup>, ALEXIS CHAINE<sup>2</sup> and DONALD B. MILES<sup>3</sup>** (<sup>1</sup>Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, CA; <sup>2</sup>Station d'Ecologie Expérimentale du CNRS à Moulinis, Saint-Girons, France; <sup>3</sup>Department of Biological Sciences, Ohio University, Athens, OH).

### 10:20 BREAK

#### ***The Evolution of Cooperation: Theoretical and Experimental Approaches***

SCIENCE 101

Tuesday

9:00 AM – 5:00 PM

Program organizer: Andrew G. Zink (Department of Biology, San Francisco State University, San Francisco, CA)

Program sponsored by the Pacific Division Ecology, Organismal Biology and Environmental Sciences Section.

Explaining cooperative associations remains one of the greatest challenges of evolutionary biology. This symposium highlights theoretical and empirical approaches to understanding the evolution of cooperation at two distinct levels of organization: individuals within populations and species within communities. Recent reviews have highlighted the need for theoretical integration of these two areas of research and this symposium is an important step toward that goal. The program is organized into four main areas: 1) cooperation between mated pairs, 2) cooperation between parents and their offspring, 3) cooperation among individuals in large animal societies, and 4) cooperation between symbiotic species. Specific topics addressed within each of these four areas are intentionally broad in order to facilitate discussions and an exchange of ideas across different levels of biology. The impressive range of study organisms reveals both the breadth of the field and the great potential for novel collaborations among researchers that work on the evolution of cooperation.

Session Chair: Andrew G. Zink

#### **Mating Systems**

##### **9:00 Introductory Remarks, ANDREW G. ZINK**

- 9:20 85 Cooperation and Conflict in a Biparental Cichlid Fish,** **RONALD M. COLEMAN** (Department of Biological Sciences, California State University, Sacramento, CA).

- 9:40 86 Vocal Duets Facilitate Cooperation Between Mates,** **LAURYN BENEDICT** (Museum of Vertebrate Zoology and Department of Integrative Biology, University of California, Berkeley, CA).

#### **Parents and Offspring**

**10:40 88 Demographic Aspects of the Evolution of Sociality: Food Sharing in the Family and Beyond,** **RONALD D. LEE and CARL BOE** (Department of Demography, University of California, Berkeley, CA).

**11:00 89 Cooperation and Conflict Over Reproductive Skew among Parents and their Offspring,** **ANDREW G. ZINK** (Department of Biology, San Francisco State University, San Francisco, CA).

**11:20 90 Incentives in Animal Teams: Implications for Parental-Investment Theory,** **JOAN ROUGHGARDEN and ZHIYUAN SONG** (Department of Biology, Stanford University).

**11:40 91 Two Conflicts Make a Cooperation?: Parental Aggression and Favoritism within Families,** **DAIZABURO SHIZUKA and BRUCE E. LYON** (Ecology and Evolutionary Biology, University of California Santa Cruz, Santa Cruz, CA).

### 12:00 LUNCH

#### **Societies**

**1:20 92 The Evolution of Multicellularity: A Minor Major Transition?** **RICK GROSBERG<sup>1</sup> and RICHARD STRATHMANN<sup>2</sup>** (<sup>1</sup>Center for Population Biology, University of California, Davis, CA; <sup>2</sup>Friday Harbor Laboratories, University of Washington, Seattle, WA).

**1:40 93 Germline Chimerism and Stem Cell Parasitism in the Colonial Ascidian,** ***Botryllus schlosseri***, **ANTHONY W. DE TOMASO** (Department of MCD Biology, University of California, Santa Barbara, CA).

**2:00 94 Environmental Variation in Allorecognition Behavior in Colonial Marine Invertebrates,** **SARAH COHEN** (Department of Biology, San Francisco State University, San Francisco, CA).

**2:20 95** *The Mechanisms Underlying Individual Behaviors and Sociality of Ants*, NEIL D. TSUTSUI (Department of Environmental Science, Policy and Management, University of California Berkeley, Berkeley, CA).

**2:40 96** *Exploring an Opportunity for Selection Approach for Indirect Fitness Benefits*, ALAN H. KRAKAUER (Department of Evolution and Ecology, University of California, Davis, CA).

**3:00 BREAK**

### Symbioses

**3:20 97** *The Role of Dispersal in the Exploitation of Communal Galling*, DONALD G. MILLER (Department of Biological Sciences, California State University Chico, Chico, CA).

**3:40 98** *The Origins and Evolution of Uncooperative Symbionts*, JOEL L. SACHS (Department of Biology, University of California, Riverside, CA).

**4:00 99** *Fitness Trade-offs in a Horizontally Transmitted Mutualism: Legumes and Rhizobia*, ELLEN L. SIMMS<sup>1</sup>, MARTINE O. EHINGER<sup>1</sup>, TONI MOHR<sup>1</sup>, and JOEL L. SACHS<sup>1,2</sup> (<sup>1</sup>Department of Integrative Biology, University of California, Berkeley, CA; <sup>2</sup>Department of Biology, University of California, Riverside, CA).

**4:20 100** *Genomics of Coral-Algal Symbiosis*, MONICA MEDINA (School of Natural Sciences, University of California Merced, Merced, CA).

**4:40 Concluding Remarks**, ANDREW G. ZINK

### ***Evolutionary Innovations: Where Ecology, Development and Macroevolution Intersect***

HENSILL HALL 543

Tuesday

9:00 AM – 4:20 PM

Program organized by Karen Crow-Sanchez (Department of Biology, San Francisco State University, San Francisco, CA)

Program sponsored by the Pacific Division section on Ecology, Organismal Biology and Environmental Science.

The origin of evolutionary novelties is central to evolutionary developmental biology. Underlying factors associated with innovation include exploitation of existing genetic pathways in new ways via gene duplication, acquisition of new regulatory elements, and

mutations in protein coding sequences. Driving factors and potential constraints include ecological opportunity and evolvability.

Session Chair: Karen Crow

**9:00 Welcome and Announcements**

**9:10 101** *How Genomics Is Reshaping Our Ideas About Evolution*, CHRIS T. AMEMIYA\*, NIL RATAN SAHA, and JERAMIAH SMITH (Benaroya Research Institute at Virginia Mason, Seattle, WA).

**9:40 102** *Origin, Evolution and Variations of the Chordate Body Plan*, BILLIE J. SWALLA (Department of Biology and Friday Harbor Laboratories, University of Washington, Seattle, WA).

**10:10 BREAK**

**10:30 103** *Duplicate Hox Genes in Ray-finned Fishes and Their Role in the Evolution of Novelty and Diversity*, KAREN D. CROW (Department of Biology, San Francisco State University, San Francisco, CA).

**11:00 104** *Genetic Analysis of Loss and Gain Traits in Three-spine Sticklebacks*, CRAIG T. MILLER (Department of Molecular and Cell Biology, Berkeley, CA).

**11:30 105** *Evolutionary Innovations and Multidisciplinary Explanation in Biology: Prospects and Problems*, ALAN C. LOVE (Department of Philosophy, Minnesota Center for Philosophy of Science, University of Minnesota, Minneapolis, MN).

**12:00 LUNCH**

**1:30 106** *The Role of Integration, Intersections and Trees in Providing Insights into Evolutionary Innovations of Snails and Whales*, DAVID R. LINDBERG (Department Of Integrative Biology and Museum of Paleontology, University of California, Berkeley, CA).

**2:00 107** *The Origin and Diversification of *Drosophila* Sex Combs*, ARTYOM KOPP\*, OLGA BARMINA, KOHTARO TANAKA, and CHEN-SIANG NG (Section of Evolution and Ecology, University of California Davis, Davis, CA).

**2:30 108** *The Origin, Function, and Diversification of Eyespot Patterns in Butterflies*, ANTONIA MONTEIRO (Department of Ecology and Evolutionary Biology, Yale University, New Haven, CT).

**3:00 BREAK**

## SYMPOSIA – Tuesday

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- 3:20 109 Innovations and Novel Structures: The Evolution of the Stamen Whorl in Tropical Gingers (*Zingiberaceae*)**, **CHELSEA SPECHT** (Department of Plant and Microbial Biology, University of California Berkeley, Berkeley, CA).

- 3:50 110 Hsp90 and Evolvability: Opportunity or Constraint?** **SUZANNAH RUTHERFORD, CHARLES CAREY, KRISTEN GORMAN, BECKY HOWESMON, CLAIRE MILTON, CHRIS ULANE, and JENNIFER KNAPP** (Division of Basic Science, Fred Hutchinson Cancer Research Center, Seattle, WA).

**Weird Life**  
HENSILL HALL 206  
Tuesday  
1:30 PM – 5:00 PM

Program organizer: *Jill Tarter* (Center for SETI Research, SETI Institute, Mountain View, CA).

Program sponsored by the Pacific Division section on General and Interdisciplinary Studies.

During 2009, Charles Darwin and his contribution to our understanding of the connectedness of all life on Earth (as we know it) will be celebrated numerous times. But what about life as we don't yet know it? In 2007 the National Academy of Sciences released a report on what it called 'Weird Life', life with an alternate biochemistry, life that may not share a common ancestor with all life that we are familiar with today. How would we recognize life based on different biosolvents, different nucleotides, different metabolic pathways? What instruments should we develop to aid human and robotic explorers undertaking a search for other forms of life? Are there extremophiles of the truly weird variety awaiting discovery on Earth, if only we knew how to identify them? These questions are all germane to the young discipline of Astrobiology as it seeks to understand the origins and extent of life here on Earth, and the potential for life beyond Earth.

Session chair: *Jill Tarter*

- 1:30 111 What Is Weird Life — Why Should We Care?** **JOHN BAROSS** (University of Washington, School of Oceanography, Seattle, WA).

- 1:40 112 Life on Earth, Part II,** **CHRIS MCKAY<sup>1</sup>, PAUL C. W. DAVIES<sup>2</sup>, STEVEN A. BENNER<sup>3</sup>, CAROL E. CLELAND<sup>4</sup>, CHARLES E. LINEWEAVER<sup>5</sup> and FELISSA WOLFE-SIMON<sup>6</sup>** (<sup>1</sup>NASA Ames Research Center, Moffett Field, CA; <sup>2</sup>Beyond Center for Fundamental Concepts in Science, Arizona State University, Tempe AZ; <sup>3</sup>Foundation for Applied and Molecular Evolution, Gainesville FL; <sup>4</sup>Department

of Philosophy, University of Colorado, Boulder CO; <sup>5</sup>Planetary Science Institute Research School of Astronomy and Astrophysics, Weston Creek, Australia; <sup>6</sup>Department of Earth and Planetary Sciences, Harvard University, Cambridge, MA).

- 2:10 113 Extremophiles We Already Know and Love: What Do They Suggest?** **ROCCO L. MANCINELLI** (Carl Sagan Center for the Search for Life in the Universe, SETI Institute, Mountain View, CA).

- 2:40 114 Using New Space Agency Technologies to Search for Weird Life,** **SIMON P. WORDEN** (NASA Ames Research Center, Moffett Field, CA).

### 3:10 BREAK

- 3:30 115 How Strange Can Life Be?** **CHRIS IMPEY** (University of Arizona, Department of Astronomy, Tucson, AZ).

- 4:00 116 Distant Biosignatures: Life on Exoplanets,** **JOHN BAROSS** (University of Washington, School of Oceanography, Seattle, WA).

- 4:30 117 Searching for Weird Life of the Intelligent Kind,** **JILL TARTER** (Center for SETI Research, SETI Institute, Mountain View CA).

**Wednesday, 19 August 2009*****Project-Based Learning and the Culture of Science Education in the 21<sup>st</sup> Century***

HENSILL HALL 206

Wednesday

8:30 AM – 1:00 PM

Program organizers: *Carl Maida* (University of California, Los Angeles, CA) and *Paul Heckman* (University of California, Davis, CA).

Sponsored by the Pacific Division section on Science and Technology Education.

This session will combine didactic, experiential, and reflective activities – essential elements in Project-Based Learning – to engage audience members and presenters in a *professional learning community* experience. The intent is to provide an opportunity for collaborative inquiry and the learning related to it. Project-Based Learning builds on John Dewey's work on experiential, hands-on, student-directed learning, a century ago. According to the Buck Institute for Education, Project-Based Learning is “a systematic teaching method that engages students in learning knowledge and skills through an extended inquiry process structured upon complex, authentic questions and carefully designed products and tasks.” Although the various learning settings and Project-Based Learning projects may resemble each other in terms of their organizational arrangements, the learning is ultimately delivered within a student-teacher relationship. The structure of this relationship and that of the school itself were shaped by an industrial culture that developed during a period of rapid industrialization in the late nineteenth century when the dual revolutions of technology and information processing were transforming the United States. For just as the technological and economic innovations of the Second Industrial Revolution rationalized production and distribution techniques in the material economy, the contemporary “control revolution” has provided new modes of information processing and communication technology to transform the cognitive or symbolic direction of twenty-first century enterprises. During the earlier transition from craft to mass production, schools provided a social context for the task of renegotiating and reframing both occupational techniques and world orientations in light of dramatic technological changes. So, too, have the challenges of the current technological revolution shifted the emphasis of education toward students actively using what they know to explore, negotiate, interpret and create. Project-Based Learning challenges students by acknowledging their roles as participants engaged in producing knowledge. Through an amalgam of knowledge, skills, teamwork, and communication, Project-Based Learning helps to develop habits of mind associated with personal and occupational success in the global economy. Like that of any complex service organization, school culture includes both the quality of interpersonal relations and the informal norms governing various activities, specifically help and trust. This session will examine the quality and nature of the student-teacher relationship in Project-Based Learning, specifically in science education. Learning encounters can be conceived as dialogues, and a distinctive feature of Project-Based Learning is that this relationship is constructed and negotiated through such encounters. Students perceive the value of Project-Based Learning, experience this form of learning, and are rewarded through the responses of

others (including parents, siblings and peers) to their projects through learning encounters. Of particular interest is the nature of the relationship for both the student and the teacher in this process.

Session Chairs: *Carl Maida* and *Paul Heckman*

**8:30 Welcome and Introductions**

**8:45 Introductory Remarks: The Promise of Project-Based Learning for Science Teachers and their Students,** **SHIRLEY MALCOM** (Education and Human Resources Directorate, American Association for the Advancement of Science).

**9:15 Styles of Project-Based Learning**

Moderator:

**PAUL HECKMAN** (Professor and Associate Dean, School of Education, University of California, Davis, CA)

Panelists:

**WILLIAM B. N. BERRY** (Professor, Department of Earth and Planetary Science, University of California, Berkeley, CA).

**MEG BURKE** (Director of Education, California Academy of Sciences, San Francisco, CA).

**JAY VAVRA** (Biology Teacher and Director, Biotechnology Program, High Tech High, San Diego, CA).

**10:00 BREAK**

**10:15 Designing and Planning a Successful Project: From Ideas to Action**  
Breakout Sessions with Panelists

**11:30 Reflections on Project-Based Learning in 21<sup>st</sup> Century Science Education**

Moderator:

**CARL MAIDA** (Professor and Co-Director, UCLA-Howard Hughes Medical Institute Pre-College Science Education Initiative, University of California, Los Angeles, CA).

Panelists:

**SAM BECK** (Director, Urban Semester in New York City, College of Human Ecology, Cornell University, Ithica, NY).

**RICHARD ROBERTS** (Beyond the Bell Branch (retired), Los Angeles Unified School District, Los Angeles, CA).

**KIMBERLY TANNER** (Professor and Director, Science Education Partnership and Assessment Laboratory, San Francisco State University, San Francisco, CA).

**12:15 Film: Students of Consequence: African Bushmeat Expedition**, produced by the Students of Gary and

## SYMPOSIA – Wednesday

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Jerri-Ann Jacobs High Tech High, San Diego, CA. Introduction by *Jay Vavra* (High Tech High, San Diego, CA). Note: this film will be shown in SCI-ENCE 201.

### **Near Earth Objects: A Threat and Response Update**

HENSILL HALL 543  
*Wednesday*  
8:30 AM – 12:00 PM

Program organized by *Rusty Scheiwickart* (former astronaut [lunar module pilot for Apollo 9 and backup commander for first Skylab mission], currently Chairman, Association of Space Explorers Near Earth Object [ASE-NEO] Committee, Sonoma, CA).

Sponsored by the Pacific Division sections on Earth Sciences; Ecology, Organismal and Environmental Sciences; and Physics and Materials Sciences.

Near-Earth objects (NEOs), the cohort of asteroids and comets whose orbits cross that of the Earth, comprise the bullets in the cosmic shooting gallery within which the Earth circulates. While the cosmic environment is essentially constant our knowledge of the specific objects populating the neighborhood within which we orbit the Sun is growing dramatically. We know statistically that there are over a million of these objects which, if they impact Earth, can do serious harm to life on the planet. While today we have discovered and actively track only 0.2% of these objects, the number of such known and cataloged objects will grow to about 40% over the next 10-15 years.

The result of this rapid increase in knowledge will necessitate a response on the part of the international community. We have the technology today to divert over 95% of these potential impact threats given sufficient warning. This capability has not, however, been demonstrated nor are there current commitments to do so.

In the end the technology challenges associated with early warning and deflection may pale in comparison with the international geopolitical challenge of making a coordinated decision of whether or not to respond to a perceived impact threat. Since eliminating the threat of an impact necessarily requires a temporary shifting of impact risk between peoples and nations, the decision to act (or not to act) presents an unprecedented international challenge.

These elements of a societal NEO impact threat response system will each be discussed and summarized.

Session Chair: *Rusty Schweickart*

#### **8:30 Welcome and Announcements**

**8:35 118 The NEO Environment: What We Know and What's Coming,** **DAVID MORRISON** (Director, NASA Lunar Science Institute, and Senior Scientist, NASA Astrobiology Institute, NASA Ames Research Center, Moffett Field, CA).

**9:10 119 NEO Deflection; An Overview and Some Perspective,** **RUSTY SCHWEICKART** (Chairman, B612 Foundation, Sonoma, CA and Chairman, Near Earth Objects (NEO) Committee, Association of Space Explorers (ASE), Houston, TX).

#### **9:45 BREAK**

**10:10 120 Know Then Tow: The Role of Transponder - Gravity Tractor Spacecraft in Asteroid Deflection Campaigns,** **EDWARD LU** (Google, Inc., Mountain View, CA and B612 Foundation, Sonoma, CA).

**10:45 121 The Geopolitics of NEO Deflection and Mitigation,** **RUSTY SCHWEICKART** (Chairman, B612 Foundation, Sonoma, CA and Chairman, Near Earth Objects (NEO) Committee, Association of Space Explorers (ASE), Houston, TX).

#### **11:20 Panel Discussion**

## II. WORKSHOPS

**Monday, 17 August 2009**

***Hands-on with Bio-Rad  
Molecular Biology Kits for Teachers  
Sessions 1 – 3***

HENSILL HALL 530 and 667

*Monday  
9:00 AM – 4:00 PM*

Bio-Rad Corporation of Hercules, CA, presents the following lecture/discussions and hands-on workshops in order to give middle school, high school and university instructors the opportunity to train in molecular techniques and also to try out some of the molecular biology kits they offer to educators. There is no additional charge for these workshops. However, participants must be registered for the meeting. A special “Bio-Rad Workshop Only” meeting registration for those only wishing to attend this portion of the meeting is available at the reduced fee of \$10.00. Be sure to wear your meeting badge to each session. Space is on an “as available” basis; preregistration was requested but is not required. Upon request, Bio-Rad representatives will provide certificates of attendance for those desiring to utilize these workshops for professional development credits.

**9:00 AM – 10:00 AM in HENSILL HALL 667**

***Using Bio-Rad Kits to Start a Biotech Program.*** Biotechnology impacts multiple subject areas and engages students in the rapidly changing scientific landscape. Looking for inquiry-based lab activities that are easy to set up, guaranteed to work, and come with complete curriculum? Join us for an overview of the Biotechnology Explorer program and learn how our kits and research-quality equipment combine to bring relevant real-world lab experiences to your students. The kits can be used individually to enhance your life science, agricultural or health science courses or in series as a complete biotechnology course.

**10:30 AM – 11:30 AM in HENSILL HALL 667**

***Cloning and Sequencing Explorer Series.*** In this unique modular lab series, students are guided through an innovative research workflow identical to those performed in genomics labs worldwide. Learn about this multiple-week lab course, where students combine traditional and cutting edge molecular biology techniques and bioinformatics to clone, sequence, and analyze a housekeeping gene from a plant of your choice ensuring each class produces unique and novel data.

**1:30 PM – 4:00 PM in HENSILL HALL 530**

***Characterize a Novel Gene with GAPDH PCR.*** How do you clone a gene when you don’t know the DNA sequence?

Glyceraldehyde 3-phosphate dehydrogenase (GAPDH) is a vital metabolic enzyme involved in one of the most basic of biological processes – glycolysis in respiration. In this workshop you will use degenerate and nested PCR primers from this highly conserved gene to amplify GAPDH genes from uncharacterized organisms as the first step towards cloning.

Note: This program continues on Tuesday.

***Discovering Darwin***

HENSILL HALL 439

*Monday  
1:00 PM – 4:30 PM*

Organized by *Leó Laporte* (Professor Emeritus, Department of Earth and Planetary Sciences, University of California, Santa Cruz, CA).

The purpose of this workshop is to provide college instructors a basis for offering their own course on Charles Darwin. The presentation will use as a model a web-based course (<http://campus.digication.com/darwin/Home/>) that examines the life and chief work of Darwin. This course was designed and offered by Dr. Laporte for many years for non-majors, both at Brown and at the University of California, Santa Cruz. The web site will be reviewed page by page to describe the content, purpose, and logic of each page/topic, and answer questions on the way. The presentation will not be a reading of each page, line by line, but will instead be a kind of “voice over” as we go through it together. There will be enough time for the presenter’s explication, participants sharing their own possible experiences about teaching some aspect of Darwin, questions about pedagogy, and what in fact happens in the classroom, etc. The overall goal is to enable others to develop their own course. A CD copy of the web site will be made available to all participants at no charge.

## WORKSHOPS – Tuesday

**Tuesday, 18 August 2009**

### ***Hands-on with Bio-Rad Molecular Biology Kits for Teachers***

#### ***Sessions 4 – 6***

HENSILL HALL 530

*Tuesday*

*9:00 AM – 3:30 PM*

This is a continuation of the Bio-Rad workshops from Monday. Please refer to the introductory comments on page 41.

#### **9:00 AM – 10:00 AM**

***Genes in a Bottle™ Kit.*** Can I see your DNA? Introduce your students to molecular biology with their own DNA. In this hands-on workshop you will extract the DNA from your own cheek cells then watch it precipitate. Bring only your imagination and take home your own DNA — in a necklace!

#### **10:30 AM – 11:30 AM**

***pGLO™ Bacterial Transformation Kit.*** Genetic engineering has led to a phenomenal explosion of new health treatments, agricultural applications, and environmental solutions. In this hands-on workshop, you will create your own genetically modified organisms and designer proteins and explore the mechanisms of gene expression and genetic selection. You will transform bacteria with a bioluminescent jellyfish gene that codes for Green Fluorescent Protein (GFP)! AP Biology Lab 6. *All participants will receive a free UV lamp and lab prep DVD!*

#### **1:30 PM – 3:30 PM**

***What's Next after pGLO™ Bacterial Transformation?*** Don't stop at cloning the gene — identify the protein responsible for the green fluorescence! Take white and green colonies from your transformed plates, prepare sample lysates and identify the pGLO protein using polyacrylamide gel electrophoresis. The bacterial proteome contains thousands of proteins, but only the cloned GFP protein glows! Use the phenotypic trait of this protein to quickly identify the protein within the complex mix. DNA > RNA > PROTEIN > TRAIT — Green Fluorescence!

Chemistry, Saint Mary's College).

Initiated in 2001, Science Education for New Civic Engagements and Responsibilities (SENCER) is a national dissemination project funded by the National Science Foundation. SENCER has established and supported an ever-growing community of faculty, students, academic leaders, and others to improve undergraduate STEM (science, technology, engineering and mathematics) education for non-science majors by connecting learning to critical civic questions. In 2007, the SENCER project established five regional SENCER Centers of Innovation (SCI). The SCIs expand the work of SENCER by organizing regional workshops designed to foster a multi- and interdisciplinary approach to science education with a focus on civic engagement. SCI-West is organizing this workshop to provide opportunities for AAAS members to engage SENCER faculty, discuss SENCER approaches, and consider developing regional collaborations. The AAAS Pacific Division SENCER workshop will have four one-hour segments:

- *SENCER Overview and Model Courses* (Amy Shacter, Santa Clara University) A dynamic introduction to the SENCER project including an overview of an interdisciplinary set of SENCER Model courses.
- *Designing a SENCER course* (Amy Shacter, Santa Clara University) An interactive workshop that takes participants through a nine step program to design a SENCER science course.
- *SCI-West Watershed Research Project* (Steve Bachofer, Saint Mary's College) An overview of the watershed research project model being developed by SCI-West including a discussion of ways to become involved.
- *Assessment using the SENCER Self-Assessment of Learning Gains Instrument* (Stephen Carroll, Santa Clara University) An introduction to the SALG instrument and how it can be used to understand perceptions of student learning gains.

### ***Science Education for New Civic Engagements and Responsibilities (SENCER)***

HENSILL HALL 439

*Tuesday*

*1:30 PM – 5:00 PM*

Organized by Amy Shacter (Associate Provost, Office of Research Initiatives, Santa Clara University, Santa Clara, CA) and co-organized by Steve Bachofer (Department of

**Wednesday, 19 August 2009*****Forging California's Path to Zero Net Energy***

HENSILL HALL 201

Wednesday

10:00 AM – 3:00 PM

Organized by *Karina Garbesi* (Professor, Department of Geography and Environmental Studies, California State University East Bay, Hayward, CA) and co-organized by *Len Pettis* (Chief of Plant, Energy and Utilities, California State University, Office of the Chancellor), *Matthew St. Clair* (Sustainability Manager, University of California, Office of the President, Oakland, CA), and *Daniel Press* (Professor, Department of Environmental Studies, University of California, Santa Cruz, CA).

The California Public Utilities Commission's Long-Term Energy Efficiency Strategic Plan establishes an ambitious goal: by 2030 all new commercial buildings will be zero net energy and 50% of existing buildings will be retrofit thereto. Achieving this will require (1) rapid learning and adaptation from early implementation projects and (2) rapid development of the state's professional workforce capacity. The UC/CSU systems are ideally placed to serve both roles, indeed the task is unachievable without our intensive focus thereon. Through phased implementation at campuses distributed throughout the state's climate zones, the two systems will identify and address policy and technical barriers, and highlight planned beta test models to implement zero energy building networks. Requiring intensive collaboration between research, management, and capital planning, the universities will become laboratories of practice, integrating undergraduate and graduate research into the process. While the near-term costs of these investments will be admittedly large, the near-term pay off will be as well, in the civic engagement of our universities and the vital enrichment of the learning environment. The long-term payoffs will be very substantial in terms of cost savings and the environmental legacy we pass on to our children. This workshop seeks to develop a commitment to this process, a common vision for implementation and policy, and to identify critical research needs, key participants, their roles, and the next steps.

**Workshop Goal:** To determine how California's two public university systems, the University of California (UC), and the California State University (CSU), can best support California's Zero Net Energy Buildings (ZNEB) goals and achieve the greatest benefits for higher education by testing and setting the model for carbon neutrality while developing the necessary workforce.

**Preliminary\* Workshop Schedule:****I. Introductions and Context**

**10:00 – 10:30** *The Current Status of UC/CSU Efforts Related to ZNEB, KARINA GARBESI* (California State University East Bay), *LEN PETTIS* (Office of the Chancellor, California State University System), *MATTHEW ST. CLAIR* (Office of the President, University of California System), and *DANIEL PRESS* (University of California, Santa Cruz).

**II. ZNEB Experts Panel and Q&A**

**10:30 – 11:45** Panelists present on key issues, strategies, research and training needs for optimal development of a UC/CSU ZNEB Initiative.

- **STEPHEN SELKOWITZ** (Head, Building Technologies Department, Lawrence Berkeley National Laboratory, Berkeley, CA)
- **KURT YAEGER** (Executive Director, Galvin Electricity Initiative, Retired President and Chief Executive Officer of the Electric Power Research Institute)
- Others to be confirmed

**11:45 – 12:15 LUNCH****III. Presidents and Chancellors Strategy Dialog**

**12:30 – 1:45** How can our universities best realize the current enormous economic and workforce development opportunity, lead the transition to carbon neutrality, and train the workforce needed to achieve the State's building energy goals?

How can the positions of the two university systems be leveraged through collaboration to achieve these goals?

- President **MO QAYOUMI** (California State University East Bay)
- President **DIANNE HARRISON** (California State University Monterey Bay)
- Chancellor **GEORGE BLUMENTHAL** (University of California, Santa Cruz)
- Others to be confirmed

**IV. Participant Breakout Sessions****2:00 – 3:00**

Based on sessions II and III: Should UC and CSU develop a ZNEB Initiative? If so, should the systems collaborate thereon? Sketch out scope. Identify key participants, expertise, and next steps.

- Reports and commitments developed there from to be sent to all workshop participants and other relevant actors.

\*A more complete schedule is available at the conference Registration Center.

**AAAS, Pacific Division**  
announces its  
**91<sup>st</sup> Annual Meeting**  
**Ashland, OR**  
**June 13 – 17, 2010**  
on the campus of  
**Southern Oregon University**

## **Call for Symposium and Workshop Proposals**

**Members of AAAS and its affiliated societies, students, teachers and other scientists** are encouraged to participate in the annual meeting by developing symposia and/or workshops. Persons wishing to develop a program for the 2010 Ashland meeting should e-mail the title, description and other information (see instructions below) to the Pacific Division Executive Director, Roger Christianson, at [rchristi@sou.edu](mailto:rchristi@sou.edu). The deadline for early consideration of proposals is October 25, 2009. Later submissions will be considered.

**Symposia** may be 1/2- or full-day or longer. Individual presentations are usually scheduled with more time than for contributed papers (30 minutes rather than 20 minutes) but the actual scheduling depends on the needs of the symposium and may be longer or shorter, even a mixture. Please contact Dr. Christianson to discuss your specific needs. When preparing your submission, please indicate whether presenters are confirmed or not (see Line 10 below). If you do not yet have a list of presenters, you may submit a list of potential presentation topics. Please keep in mind that we need as much information early as possible in order to adequately publicize the symposium.

**Workshops** generally are 1/2- or full-day and may or may not accompany a symposium. If special facilities and/or equipment are required, be sure to identify what you need as completely as possible in your submission (see Line 10 below). If a cost is incurred, it will be passed along to participants as a workshop fee in addition to the ordinary meeting registration fee.

**Questions?** Contact Dr. Roger Christianson, Executive Director, AAAS Pacific Division, Southern Oregon University, Ashland, OR 97520. Phone: 541-552-6747; e-mail: [rchristi@sou.edu](mailto:rchristi@sou.edu).

**Please format your submission as follows:**

- 1:** Organizer's name.
- 2:** Organizer's full mailing address, including academic/professional affiliation, telephone number and e-mail address.
- 3:** Co-organizer's name(s) (if any).
- 4:** Co-organizer's full mailing address, including academic/professional affiliation, telephone number and e-mail address.
- 5:** Is this a proposal for a Workshop or a Symposium?
- 6:** Number of 1/2-day sessions (each roughly three to four hours, depending on the needs of the program) requested.
- 7:** Title of proposed program.
- 8:** Pacific Division section(s) and/or affiliated society for program sponsorship.
- 9:** Brief description of proposed program (please limit to 250 words).
- 10:** If a symposium, list the names of proposed (confirmed?) speakers, including academic/professional affiliation, telephone number, and e-mail address for each. Presentation titles are optional at this time and will be requested later, along with an abstract for each presentation.  
If a workshop, indicate facilities and/or special equipment required and number of participants that can be accommodated. Also indicate any fees or special expenses for the program. Is advance registration required? If so, by when?

phone: **541-552-6747** • e-mail: **[rchristi@sou.edu](mailto:rchristi@sou.edu)** • internet: **<http://pacific.aaas.org>**



### III. CONTRIBUTED PAPERS

**1100** (time italicized and underlined) indicates a student presentation

\* indicates the speaker from among several authors listed

**63** (bolded number) indicates abstract number

**Monday, 17 August 2009**

#### ***Working on Darwin***

HENSILL HALL 206

Monday

8:10 AM – 11:55 AM

Program organizers: *Michele L. Aldrich* and *Alan E. Leviton* (California Academy of Sciences, San Francisco, CA).

Section Chair: *Michele L. Aldrich*

**8:10 Welcome and Announcements**

**8:15 122** *Darwin and the Gardener's Chronicle, 1841-1877*, **MICHELE L. ALDRICH and ALAN E. LEVITON** (Department of Herpetology, California Academy of Sciences, San Francisco, CA).

**8:40 123** *Darwin's Second Voyage Around the World – This Time by Royal Mail*, **JANET BELL GARBER** (independent scholar, Playa del Rey, CA).

**9:05 124** *The Evolution of Methodological Naturalism in the Origin of Species*, **STEPHEN C. DILLEY** (St Edward's University, Austin, TX).

**9:30 125** *Darwin vs. Wallace Revisited: On Adaptedness and Inheritance*, **JOHN O. REISS** (Department of Biological Sciences, Humboldt State University, Arcata, CA).

**9:55 BREAK**

**10:15 126** *The Humorous Play of Evolution*, **WILLIAM FINLEY FRY** (Nevada City, CA).

**10:40 127** *From Darwin to Dayton: Cartoonists Interpret Evolution, 1860-1925*, **MARK ALDRICH** (Department of Economics, Smith College, Northampton MA).

**11:05 128** *Darwin and the Dragon: Evolution's Influence on John Dewey and China*, **DARRYL E. BROCK** (History Department, Fordham University, Bronx, NY).

**11:30 129** *G.G. Simpson, Paleontology, and the Neo-Darwinian Revolution*, **LÉO F. LAPORTE** (University of California, Santa Cruz, CA).

***Joint Session of the Anthropology and Archaeology; Cell and Molecular Biology; Ecology, Organismal Biology and Environmental Sciences; and Industrial Science and Technology Sections***

HENSILL HALL 201

Monday

8:15 AM – 12:00 PM

Program organized by: *Walter Carl Hartwig* (Division of Basic Medical Sciences, Touro University College of Osteopathic Medicine, Mare Island, CA), *Stephen Frost* (Department of Anthropology, University of Oregon, Eugene, OR), *Kenneth Cornell* (Department of Chemistry and Biochemistry, Boise State University, Boise, ID), *Henry Oman* (Seattle, WA), *Frank Jacobitz* (Department of Engineering, University of San Diego, San Diego, CA), *Richard Van Buskirk* (Environmental Studies, Pacific University, Forest Grove, OR), and *Michael Parker* (Department of Biology, Southern Oregon University, Ashland, OR).

Session Chair: *D. Jeffrey Meldrum* (Idaho State University, Pocatello, ID)

**8:15 Welcome and Announcements**

**8:20 130A** *A Simpler Origin of Life between Mica Sheets?* **HELEN GREENWOOD HANSMA** (Department of Physics, University of California, Santa Barbara, CA).

**8:40 131** *Reconstructing Historical Coral Reef Ecosystem Conditions in the Hawaiian Archipelago*, **JOHN N. KITTINGER<sup>1\*</sup>; JONATHAN H. BLODGETT<sup>2</sup>; JENNIFER K. SCHULTZ<sup>3\*</sup>; LOREN McCLENACHAN<sup>4</sup>; KEPA MALY<sup>5</sup>; TERRY L. HUNT<sup>6</sup>; THOMAS S. DYE<sup>7</sup>; BRUCE A. WILCOX<sup>8\*</sup>; and JOHN M. PANDOLFI<sup>9,10</sup> (<sup>1</sup>Department of Geography, University of Hawai'i at Manoa, Honolulu, HI; <sup>2</sup>The Centre for Marine Studies, The University of Queensland, St. Lucia, Australia; <sup>3</sup>Department of Zoology, University of Hawai'i at Manoa, Honolulu, HI; <sup>4</sup>Scripps Institution of Oceanography, La Jolla, CA; <sup>5</sup>Kumu Pono Associates, LLC, Lanai City, HI; <sup>6</sup>Department of Anthropology, University of Hawai'i at Manoa, Honolulu, HI; <sup>7</sup>T. S. Dye and Colleagues, Archaeologists, Inc., Honolulu, HI; <sup>8</sup>Asia-Pacific Institute for Tropical Medicine and**

## CONTRIBUTED ORAL PAPERS – Monday

Infectious Diseases, Division of Ecology and Health, John A. Burns School of Medicine, University of Hawai‘i, Honolulu, HI; <sup>9</sup>The Centre for Marine Studies and <sup>10</sup>Department of Earth Sciences, ARC Centre of Excellence in Coral Reef Studies, The University of Queensland, Brisbane, AUSTRALIA; \*National Science Foundation, Integrated Graduate Education, Research and Training (IGERT) Program in Ecology, Conservation and Pathogen Biology, University of Hawai‘i at Manoa).

**9:00** **132** *Profiling Microbial Biodiversity and Abundance in Corals Plagued with Yellow Band Disease using 16S rRNA Microarrays*, **COLLIN J. CLOSEK<sup>1\*</sup>**, **SHINICHI SUNAGAWA<sup>1</sup>**, **TODD Z. DESANTIS<sup>2</sup>**, **YVETTE M. PICENO<sup>2</sup>**, **EOIN L. BRODIE<sup>2</sup>**, **CHRISTIAN R. VOOLSTRA<sup>1</sup>**, **GARY L. ANDERSEN<sup>2</sup>** and **MÓNICA MEDINA<sup>1</sup>** (<sup>1</sup>School of Natural Sciences, University of California Merced, Merced, CA; <sup>2</sup>Center for Environmental Biotechnology, Lawrence Berkeley National Laboratory, Berkeley, CA).

**9:20** **133** *An Estuarine Copepod from Asia: Genetic Diversity in Two Recent Introductions*, **ALLEGRA BRIGGS<sup>\*</sup>**, **C. SARAH COHEN** and **WIM KIM-MERER** (Romberg Tiburon Center for Environmental Studies, Department of Biology, San Francisco State University, San Francisco, CA).

**9:40** **134** *Evaluating the Potential for Spread of an Invasive Forb, Limonium ramosissimum, in San Francisco Bay Salt Marshes*, **GAVIN ARCHBALD<sup>\*</sup>** and **KATHARYN BOYER** (Biology Department, San Francisco State University, San Francisco, CA and Romberg Tiburon Center for Environmental Studies, Tiburon, CA).

### 10:00 BREAK

**10:20** **135** *Resistance Risk Assessment for Novel Reduced-Risk Insecticides in Obliquebanded Leafroller, Choristoneura rosaceana (Lepidoptera: Tortricidae)*, **ASHFAQ A. SIAL<sup>\*</sup>**, **JAY F. BRUNNER**, **JOHN E. DUNLEY**, and **MICHAEL D. DOERR** (Department of Entomology, Washington State University, Tree Fruit Research and Extension Center, Wenatchee WA).

**10:40** **136** *Anthropogenic Sounds and Animal Songs: Conservation Biology in a Noisy World*, **M. BETH DAWSON** (Department of Biological Sciences, San José State University, San José, CA).

**11:00** **137** *Simulations of the Microcirculation in Rat Spinothalamus Muscle and Muscle Fascia*, **FRANK**

**JACOBITZ, CASEY WEISS and MATTHEW GABBARD** (Mechanical Engineering Program, University of San Diego, San Diego, CA).

**11:20** **138** *Developmental Canalization of Body Proportions in Sulawesi Booted Macaques: A Possible Connection to Locomotor Ecology*, **ROBERT R. STALLMANN** (Department of Anthropology, University of California, Davis, CA and Anthropology Program, School of Social Sciences, Humanities and Arts, University of California, Merced, CA).

**11:40** **139** *A Survey of Alleged Yeti Tracks: Is the Himalayan Mystery on Firm Footing?* **D. JEFFREY MELDRUM** (Department of Biological Sciences, Idaho State University, Pocatello, ID).

**Sustainability**  
**A Special Theme Joint Session of the**  
**Agriculture and Horticultural Sciences;**  
**Earth Sciences;**  
**Ecology, Organismal Biology and**  
**Environmental Sciences; and**  
**General and Interdisciplinary Sections**  
HENSILL HALL 206  
Monday  
1:30 PM – 5:00 PM

Program organized by: *Michael D. MacNeil* (USDA Agricultural Research Service, Fort Keogh Livestock and Range Research Laboratory, Miles City, MT), *J. Thomas Dutro* (US Geological Survey, National Museum of Natural History, Washington, D.C.), *Richard Van Buskirk* (Environmental Studies, Pacific University, Forest Grove, OR), *Michael Parker* (Department of Biology, Southern Oregon University, Ashland, OR), and *Robert Chianese* (California State University, Northridge, CA).

Program Chair: *Richard Van Buskirk*

**1:10** *Welcome and Announcements*

**1:15** **140** *Unsustainable Water Demand: A Central California Example*, **DAVID CEHRS** (Math and Science Department, Reedley College, Reedley, CA and Kings River Conservation District, Fresno, CA).

**1:35** **141** *Investigating the Effects of Reduced Surface Water Deliveries on the Aquifers of California's Central Valley*, **CHARLES F. BRUSH<sup>1\*</sup>**, **LARRY L. DALE<sup>2</sup>**, **NORMAN L. MILLER<sup>3</sup>**, **SEBASTIAN D. VICUNA<sup>4</sup>**, **EMIN C. DOGRUL<sup>1</sup>**, **TARIQ N. KADIR<sup>1</sup>**, and **FRANCIS I. CHUNG<sup>1</sup>** (<sup>1</sup>Bay-Delta

Office, California Department of Water Resources, Sacramento, CA; <sup>2</sup>Energy Analysis Department, Lawrence Berkeley National Laboratory, Berkeley, CA; <sup>3</sup>Climate Science Department, Lawrence Berkeley National Laboratory, Berkeley, CA and Geography Department, University of California, Berkeley, CA; <sup>4</sup>Civil and Environmental Engineering Department, University of California, Berkeley, CA).

- 1:55 142 Worldwide Impacts of Wastewaters and Wastes from the Cities of the Developing World,** WILLIAM F. GARBER (Assistant Director, Bureau of Sanitation, City of Los Angeles (retired), Los Angeles, CA).

- 2:15 143 New Estimates of Loadings of Suspended Sediments to San Francisco Bay, California,** LESTER J. MCKEE (Watershed Program, San Francisco Estuary Institute, Oakland, CA).

- 2:35 144 Sources, Pathways, and Loadings of Hg, PCBs, and other Pollutants of Concern to San Francisco Bay, California,** LESTER J. MCKEE (Watershed Program, San Francisco Estuary Institute, Oakland, CA).

**2:55 BREAK**

- 3:20 145 An Integrated System for Wastewater Scrubbing and Bioenergy Production,** CATHERINE HARE<sup>1\*</sup>, JOHN KOZLOWSKI<sup>1</sup>, RACHEL McCORMICK<sup>2</sup>, TIM NELSON<sup>3</sup>, LILY CHEN<sup>2</sup> and MICHAEL F. COHEN<sup>1</sup> (<sup>1</sup>Department of Biology, Sonoma State University, Rohnert Park, CA; <sup>2</sup>Department of Biology, San Francisco State University, San Francisco CA; <sup>3</sup>Department of Biology, Seattle Pacific University, Seattle, WA).

- 3:40 146 Investigation of Microbial Population Dynamics During MTBE Biodegradation in Groundwater with Nanoparticle Based DNA Assay,** REEF B. HOLLAND\*, RADOMIR SCMDT, AHJEONG SON and KRASSIMIRA R. HRISTOVA (Department of Land, Air, and Water Resources, University of California Davis, Davis, CA).

- 4:00 147 Sustainability and Ethics of Animal Breeding,** WENDY M. RAUW (Department of Animal Biotechnology, University of Nevada Reno, Reno, NV).

- 4:20 148 Sustainable Building Science: Technology and Building Methods,** SHELLEY LOTZ (Sustainable Living Programs, Ashland, OR).

- 4:40 149 The Gated Membrane: “Getting the Science Right” in Public Decisionmaking,** DEBORAH M. HUSSEY FREELAND (University of San Francisco School of Law, 2130 Fulton Street, San Francisco, CA 94117; dhusseyfreeland@usfca.edu).

**Joint Session of  
Chemistry and Biochemistry; and  
Health Sciences Sections**

HENSILL HALL 201

Monday

1:55 PM – 4:20 PM

Program organized by: Owen McDougal (Department of Chemistry and Biochemistry, Boise State University, Boise, ID) and H. K. Choi, (Department of Biology, California State University Dominguez Hills, Carson, CA).

Program Chair: H. K. Choi

**1:55 Welcome and Announcements**

- 2:00 150 Toward Epigenetic “Voting”: Implications of Darwinian Biology for Health Care in the XXI Century,** FRANCESCO CHIAPPELLI<sup>1\*</sup> and OLUWADAYO OLUWADARA<sup>2</sup> (<sup>1</sup>Division of Oral Biology and Medicine, University of California Los Angeles School of Dentistry, Los Angeles, CA; <sup>2</sup>Department Anatomy, College Medicine, Ibadan University, Nigeria).

- 2:20 151 Effects of Phenyl Propanoids on Murine B16-F10 Melanoma Cells,** HIROKI SATOOKA<sup>1\*</sup> and ISAO KUBO<sup>1,2</sup> (<sup>1</sup>Department of Nutritional Sciences and Toxicology, University of California Berkeley, Berkeley, CA; <sup>2</sup>Department of Environmental Science, Policy and Management, University of California Berkeley, Berkeley, CA).

- 2:40 152 Differential Effects of Mainstream and Side-stream Tobacco Smoke on the Genetic Integrity of Mouse Sperm and Early Embryonic Development,** ARIS POLYZOS<sup>1</sup>, THOMAS ERNST SCHMID<sup>1,2</sup>, BELEM PIÑA-GUZMÁN<sup>3</sup>, BETZABET QUINTANILLA-VEGA<sup>3</sup> and FRANCESCO MARCHETTI<sup>1,4</sup> (<sup>1</sup>Life Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA; <sup>2</sup>Present address: Klinikum rechts der Isar, Technische Universitaet Muenchen, Munich, Germany; <sup>3</sup>Toxicology Section, CINVESTAV-IPN, Mexico City, Mexico).

**3:00 BREAK**

## CONTRIBUTED ORAL PAPERS – Monday

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**3:20 153** *The CDASH-HL7 BRIDG: How Harmonizing Clinical Trial and Healthcare Standards May Impact Data Users*, **CLINTON W. BROWNLEY** (American University, Washington, DC).

**3:40 154** *Chinese Patients' Behaviors and Problems in Eye Medication Adherence*, **AUDREY TAM<sup>1\*</sup> and SHIU Y. KWOK<sup>2,3</sup>** (<sup>1</sup>Department of Molecular and Cell Biology, University of California, Berkeley, CA; <sup>2</sup>Vision Science Medical Group, San Francisco, CA; <sup>3</sup>Department of Ophthalmology, University of California, San Francisco, CA).

**4:00 155** *Solution to the Arrhythmia Problem*, **DAVID BLACKMAN** (retired, University of California Berkeley, Berekeley, CA).

**4:20 156** *Propargyl Methyl Ethers: Novel Precursors to Cobalt-Complexed Propargyl Cations*, **SARINE SHAHMIRIAN<sup>1\*</sup> and GAGIK G. MELIKYAN<sup>2</sup>** (<sup>1</sup>Chaminade College Preparatory High School, West Hills, CA; <sup>2</sup>California State University Northridge, Department of Chemistry and Biochemistry, Northridge, CA).

**Tuesday, 18 August 2009**

***Joint Session of  
Psychology; and Social, Economic,  
and Political Sciences Sections***

HENSILL HALL 439  
*Tuesday*  
*9:00 AM – 12:00 PM*

Program organized by: *J. Kenneth Nishita* (California State University Monterey Bay, Seaside, CA) and *Carl A. Maida* (UCLA Schools of Dentistry and Medicine, University of California, Los Angeles, CA).

Program Chair: *J. Kenneth Nishita*

**9:00 Welcome and Announcements**

**9:05 157 Tariffs and Trusts; Profiteers and Middlemen: Popular Writers and Political Cartoonists Explain Inflation to the American Public, 1897-1920,** **MARK ALDRICH** (Department of Economics, Smith College, Northampton MA).

**9:25 158 The Expanding Role of the States in Science and Technology Policy,** **DEREK KAUNECKIS** (Political Science Department, University of Nevada, Reno, NV).

**9:45 159 Do Those Troublesome Students Have Attention Deficit Disorder and Depression or Are They Just Cognitively Different While Using and/or Abusing Substances?** **J. BARRY GURDIN** (To Love and to Work: An Agency for Change, San Francisco, CA).

**10:05 BREAK**

**10:20 160 Fashion Historiography: A Novel Theoretical Approach,** **DAMAYANTHI ELUWAWALAGE** (State University of New York, Oneonta, NY).

**10:40 161 Effects of Facial Prominence on Predicted Job Performance... A Gender Disparity in Predicted Negative Behavior,** **JUSTIN L. MATTHEWS** (Cognitive Science Program, School of Social Sciences, Humanities, and Arts, University of California Merced, Merced, CA).

**11:00 162 Brown Adipose Tissue in Human Adults: Commodity or Vestige?** **J. KEN NISHITA and ERIKA L. BENT** (Psychology Department, California State University, Monterey Bay, Seaside, CA).

**11:20 163 Psychological Barriers to Global Poverty Involvement,** **STEVEN F. BACON** (Department of Psychology, California State University Bakersfield, Bakersfield, CA).

**11:40 164 Field Theories of Consciousness,** **EDWIN E. KLINGMAN** (Cybernetic Micro Systems, San Gregorio, CA).

***Science and Technology***

***Education Section***

HENSILL HALL 667  
*Tuesday*  
*10:15 AM – 11:40 AM*

Program organized by *William B. N. Berry* (Department of Planetary and Earth Sciences, University of California, Berkeley, CA).

Program Chair: *William B. N. Berry*

**10:15 Welcome and Announcements**

**10:20 165 Environmental Metaphors in Science and Society: Workflow of the Case Study “The Elephant and the Oak Tree,”** **V.G. MINNICH** (University of California Santa Barbara Donald Bren School of Environmental Science and Management, Santa Barbara, CA).

**10:40 166 Analysis of iTunes U Podcast Use by Undergraduate Biology Students Shows a Beneficial Outcome,** **CHRISTOPHER J. SMITH<sup>1,3</sup>, TANIA BELIZ<sup>1</sup>, and JEAN MACH<sup>2</sup>** (<sup>1</sup>Biology Department, <sup>2</sup>English Department, College of San Mateo, San Mateo, CA; <sup>3</sup>Ginger Pharmaceuticals, Inc, San Mateo, CA).

**11:00 167 Design and Implementation of a Software Tool for Managing and Assessing Scientific and Technical Achievements,** **OSCAR L. NAZARIO, MARK A. PISCOTTY, JOSEPH Q. PASCUAL, CHRISTINE M. GOMEZ, RULON K. LINFORD, and KENNETH J. JACKSON** (Lawrence Livermore National Laboratory, Livermore, CA).

**11:20 168 Teaching as a Community College Adjunct Instructor after Retirement,** **ARTHUR ALTSHILLER** (Los Angeles Valley College, Valley Glen, CA and Los Angeles Pierce College, Woodland Hills, CA).

*Joint Session of the  
Computer and Information Sciences; and  
Physics and Material Sciences Sections*

HENSILL HALL 667

Tuesday

1:30 PM – 3:15 PM

Program organized by *Alan E. Leviton* (California Academy of Sciences, San Francisco, CA) and *Panos Photinos* (Southern Oregon University, Ashland, OR).

Session Chair: *Ellen Siem* (Southern Oregon University, Ashland, OR)

**1:30 Welcome and Announcements**

- 1:35 169 Conductivity Measurements in a Semi-Dilute CPyCl/NaSal Micellar System, IAN TAYLOR and PANOS PHOTINOS** (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR).
- 1:55 170 Are the Laws of Physics Laid-down or Built-in? EDWIN E. KLINGMAN** (Cybernetic Micro Systems, San Gregorio, CA).
- 2:15 171 A Rediscovered GEM, EDWIN E. KLINGMAN** (Cybernetic Micro Systems, San Gregorio, CA).
- 2:35 172 Physics 3.0: Why Computer Science Will Lead the Next Physics Revolution, STEVEN BRYANT** (Avitel Corporation, Berkeley, CA).
- 2:55 173 A Novel Memory Organization with Distributed Intelligence, EDWIN E. KLINGMAN** (Cybernetic Micro Systems, San Gregorio, CA).

## IV. CONTRIBUTED POSTERS

**189** poster number is also the abstract number

**193** (number italicized and underlined) identifies a student presentation

\*identifies the presenter from among several authors listed

NOTE TO PRESENTERS: Boards on which to attach poster presentations will be set up in the hallway of the third floor of Hensill Hall. The poster boards have numbers on them that coincide with the numbers assigned to the posters in this program (see number to the left of the title of each presentation). You are expected to use the appropriately numbered display space for your poster.

Posters should be set up at least 15 minutes prior to the start time of your session. You must be present with your poster for at least one hour during the four hours of the poster session in order to discuss your work. Cards will be available to use in posting the time(s) you will be available. *If you are a student in competition for an Award of Excellence, you must be present with your poster from 12:00 p.m. to 2:00 p.m. if presenting on Monday or 11:30 a.m. to 1:30 p.m. if presenting on Tuesday in order to give judges the opportunity to review and discuss your work with you.* Posters should be removed within one-half hour of the end of the session. Presenters assume full responsibility for the security of their poster and other materials.

### *Quick Directory of Sponsoring Sections and Their Posters*

<i>Section</i>	<i>poster numbers</i>
Anthropology and Archaeology .....	187
Cell and Molecular Biology .....	190 – 198
Chemistry and Biochemistry.....	180 – 181
Ecology, Organismal Biology and Environmental Sciences .....	206 – 213
Education .....	174 – 179
Health Sciences.....	199 – 205
Industrial Science and Technology .....	182 – 183
Psychology .....	184 – 186
Social, Economic and Political Sciences .....	188 – 189

**Monday, 17 August 2009**

### **POSTER SESSION I** HENSILL HALL 3<sup>rd</sup> Floor Hallway *Monday* *12:00 PM – 4:00 PM*

#### **EDUCATION**

**174** *Toward the Identification of Value Conflicts in Ecological Restoration, MILTON O. MEUX<sup>1</sup> and BRIAN M. MEUX<sup>2</sup> (Berkeley, CA; <sup>2</sup>Santa Monica Baykeeper, Marina Del Rey, CA).*

**175** *Monitoring African Bushmeat in the Classroom: Global Conservation Education, MEGAN MORIKAWA<sup>1\*</sup> and JAY VAVRA<sup>2</sup> (Duke University, Durham, NC; <sup>2</sup>High Tech High, San Diego, CA).*

**176** *Critical Science Outreach: Implementing an Ecology Education Program into a California Alternative*

*High School, RAYNELLE RINO<sup>1\*</sup>, CYNTHIA WILBER<sup>2</sup>, and RODOLFO DIRZO<sup>1</sup> (<sup>1</sup>Department of Biology, Stanford University, Stanford, CA; <sup>2</sup>Jasper Ridge Biological Preserve, Woodside, CA).*

**177** *CalSmiles: Innovative, Student-driven Education Program Increases Oral Health Knowledge and Awareness, TANNER Y. ZANE<sup>1\*</sup> and PAMELA Z. HAN<sup>2</sup> (<sup>1</sup>University of California San Francisco, School of Dentistry, San Francisco, CA; <sup>2</sup>University of California Berkeley, School of Public Health, Berkeley, CA).*

**178** *Telling a Molecular Story: Mevalonate Kinase – Initiating the Pathway to the Cure for Malaria, LINCOLN SMART TEAM<sup>1\*</sup>, LARS WESTBLADE<sup>2</sup>, KURT GILES<sup>3</sup>, RICHARD GIN<sup>1</sup>, and JULIE REIS<sup>1</sup> (<sup>1</sup>Abraham Lincoln High School, San Francisco, CA; <sup>2</sup>Center for BioMolecular Modeling, Milwaukee School of Engineering, Milwaukee, WI; <sup>3</sup>Institute for Neurodegenerative Diseases, University of California, San Francisco, CA).*

**179** *Building Sustainability at Cal—What the Students Do, IRENE SELIVERSTOV\* and WILLIAM B.N. BERRY (Environmental Sciences, University of California, Berkeley, CA).*

#### **CHEMISTRY and BIOCHEMISTRY**

**180** *Chemical Modification of Proteins to Improve Chemical Stability and Chromatographic Performance as SEC Standards, JERRY L. WILSON (JLW Research, Davis, CA).*

**181** *Biogenic Silica Incorporated Bio Sensors for Ultra Sensitive Protein Detection, GAURAV*

## CONTRIBUTED POSTERS – Monday

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**CHATTERJEE<sup>1\*</sup>, VINDHYA KUNDURU<sup>1</sup>, KAI-CHUN LIN<sup>2</sup>, B. L. RAMAKRISHNA<sup>2</sup>, and SHALINI PRASAD<sup>1</sup>** (<sup>1</sup>Department of Electrical Engineering, Arizona State University, Tempe, AZ; <sup>2</sup>School of Materials, Arizona State University, Tempe, AZ).

### INDUSTRIAL SCIENCE and TECHNOLOGY

- 182** *Conceptual Study of an Algal Bioreactor System for Nutrient and Pollution Mitigation and Supplemental Renewable Biogas Evolution at a Large Municipal Wastewater Treatment Plant*, ERIC LARSEN, LINDA WINTERS, and CAROL WEIR (East Bay Municipal Utility District, Oakland, CA).
- 183** *Nuclear Power for Propulsion and Power Supply for High Altitude Platforms*, BRADLEY S. TICE (Turlock, CA).

### PSYCHOLOGY

- 184** *Alpha/numeric Data-based, Hypothesis-driven Treatment of Complex Psychiatric and Neurological Disorders*, BHAVANA VISHNUBHOTLA (Glen Eden Multimodal Centre, Vancouver, BC, Canada).
- 185** *Independent Component Analysis of EEG Activity in the Mirror Neuron System (MNS) During Visual Perception of Body-Movements*, ANTHONY CARNEVALE BONILLA<sup>1\*</sup>, JENNIFER G. TORRES<sup>2</sup>, MAYRA ESTRADA<sup>2</sup>, CHLOE BOYLE<sup>2</sup>, KRISTINE SARN-LERTSOPHON<sup>3</sup>, SCHUYLER S. ROCKWOOD<sup>4</sup>, and STANLEY E. LUNDE<sup>4</sup> (<sup>1</sup>School of Biological Sciences, University of California Irvine, Irvine, CA; <sup>2</sup>Department of Psychology and Sociology, California State Polytechnic University Pomona, Pomona, CA; <sup>3</sup>Department of Biomedical Engineering, The Johns Hopkins University, Baltimore, MD; <sup>4</sup>University of California Los Angeles, MRRC at Lanterman Developmental Center, Pomona, CA).
- 186** *Computer Simulated Conflicts Assess Room Colors' Effects on Workplace Mood and Behavior*, KRISTEN M. CLARK (Department of Psychology, Washington State University Tri-Cities, Richland, WA).

### ANTHROPOLOGY and ARCHAEOLOGY

- 187** *Preparation as a Mechanism of Hominin Adaptation*, MICHAEL BIFERNO (Biferno and Associates, Arcadia, CA).

### SOCIAL, ECONOMIC, and POLITICAL SCIENCES

- 188** *Domestic Violence Suspects' Use of Illicit Drugs and Alcohol as a Risk Factor for Arrest*, STEPHEN J. MOREWITZ (Research Division, Stephen J. Morewitz, Ph.D., and Associates, IL and CA, Litigation Consultants, San Francisco, CA, and San Jose State University, Department of Sociology, San Jose, CA).
- 189** *Partner Violence as a Risk Factor for Child Physical Abuse*, STEPHEN J. MOREWITZ (Research Division, Stephen J. Morewitz, Ph.D., and Associates, IL and CA, Litigation Consultants, San Francisco, CA, and San Jose State University, Department of Sociology, San Jose, CA).

**Tuesday, 18 August 2009**

**POSTER SESSION II**

HENSILL HALL 3<sup>rd</sup> Floor Hallway

Tuesday

9:30 AM – 1:30 PM

**CELL and  
MOLECULAR BIOLOGY**

- 190** *Fluorescent Marker for Stem Cell Differentiation, ALBERT AVILA, GIPSON LYLES\*, AMIT DESHPANDE, WILLIAM CHENG, and YONG KIM* (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, Los Angeles, CA).
- 191** *Loss of Ectoderm Membrane Rafts Produce Variable Inhibitions of Myogenic Specification in Segmental Plate Mesoderm (SPM)-derived Somites in Chicken Embryos, ROSELLE VISAYA\* and WILFRED F. DENETCLAW* (Department of Biology, San Francisco State University, San Francisco, CA).
- 192** *Ectoderm-derived Sphingomyelin Signals Regulate Somitogenesis and Primary Myotome Formation in Chicken Embryos, TENZIN BHUTIA\* and WILFRED F. DENETCLAW* (Department of Biology, San Francisco State University, San Francisco, CA).
- 193** *CXCL-1 and Rho-Gap 8 PTH Induced Primary Response Genes, EMILIO FRIAS\*, NOEMI ZALDIVAR\*, JEANNE NERVINA, and VETEA MIKLUS* (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, Los Angeles, CA).
- 194** *Effects of Resveratrol and Piceatannol on Cellular Replication of NHEK, MARISOL NUNEZ\*, KAROLYN BLANCAS\*, MO KANG, and ROY KIM* (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, Los Angeles, CA).
- 195** *Myxococcus xanthus: Cell Signaling and Programmed Cell Death, AARON BROWN\*, SHAYLNSMITH\*, ARTURO CALDERON-FLORES, CHRISTOPHER KAPLAN, and WENYAUNRTURO SHI* (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, Los Angeles, CA).
- 196** *Ionizing Irradiation Produces a Delay in Pupation in the Hornworm, *Manduca sexta*, LOUIE RAMOS<sup>1\*</sup>, CLEOPA OMONDI<sup>1\*</sup>, ADRIAN HALME<sup>2</sup>,*

and MEGUMI FUSE<sup>1</sup> (<sup>1</sup>Department of Biology, San Francisco State University, San Francisco, CA; <sup>2</sup>Department of Molecular and Cell Biology, University of California, Berkeley, CA).

- 197** *Determination of the Neurotransmitter that Inhibits the CNS During Ecdysis in the Hornworm, *Manduca sexta*, LAURA MENDOZA\*, ROTH EA\*, ADRIAN CHASE, and MEGUMI FUSE* (San Francisco State University, Department of Biology, San Francisco, CA).

- 198** *Characterizing Ecdysis Behaviors in the Stick Insect, ANDREW CARRIMAN\* and MEGUMI FUSE* (Department of Biology, San Francisco State University, San Francisco, CA).

**HEALTH SCIENCES**

- 199** *The Association of Personal Characteristics and Social Support Resources with the Ability to Afford Needed Dental Care, EDGAR RIVERA\*, DIANE VASQUEZ\*, ELMER BARNES\*, and BENJAMIN A. FREED* (University of California Los Angeles School of Dentistry, Los Angeles, CA).

- 200** *Factors Associated with Severe Periodontal Bone Loss in a National Probability Sample of Diabetics and Non-Diabetics in the United States, THIEN DO\*, KRYSTLE HOLFORD\*, JIE SHEN, and HONGHU LIU* (University of California Los Angeles School of Dentistry, Los Angeles, CA).

- 201** *Vitamin D Deficiency and Bisphosphonate Effects on Bone, BRIELLE McDANIEL<sup>1\*</sup>, MICHAELA SCOTT<sup>1\*</sup>, AKISHIGE HOKUGO<sup>2</sup>, and ICHIRO NISHIMURA<sup>2</sup>* (<sup>1</sup>Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry and <sup>2</sup>The Weintraub Center for Reconstructive Biotechnology, University of California Los Angeles School of Dentistry, Los Angeles, CA).

- 202** *Effect of Altering Apparent Viscosity and Elastic Modulus of Tracheal Mucus and Positioning on Displacement of Mucus during Simulated Cough in Patients with a Wide Range of Respiratory Diseases, ANPALAKI J. RAGAVAN<sup>1\*</sup>, CAHIT A. EVERENSEL<sup>1,2</sup>, and PETER KRUMPE<sup>1,3</sup>* (<sup>1</sup>Graduate Program of Biomedical Engineering, University of Nevada, Reno, NV; <sup>2</sup>Department of Mechanical Engineering, University of Nevada, Reno, NV; <sup>3</sup>School of Medicine, University of Nevada, Reno, NV).

## CONTRIBUTED POSTERS – Tuesday

- 203** *Estrogen Signaling Modulates Cisplatin Resistance in the Treatment of Human Non-Small Cell Lung Cancer Cells*, AMITKUMAR PATEL\*, DIANA C. MARQUEZ-GARBAN, and RICHARD J. PIETRAS (University of California Los Angeles Department of Medicine, Division of Hematology-Oncology, Los Angeles, CA).
- 204** *The Relationship of Calcium Concentration on *Blastomyces dermatitidis* Yeast Cell Growth and Antibody Detection with Cell Lysate Antigens*, JAMES B. SMITH, ROSS DECHANT, and GENE M. SCLARONE (Department of Biological Sciences, Idaho State University, Pocatello, ID).
- 205** *Comparative Studies on  $\alpha$ -(1,3)- glucan in *Blastomyces dermatitidis* Yeast Lysate Antigens and the Use of the Lysates for the Detection of Antibodies*, MANDIRA MANANDHAR and GENE M. SCLARONE (Department of Biological Sciences, Idaho State University, Pocatello, ID).
- 210** *The Presidio Bee Biodiversity Survey*, CHRISTOPHER QUOCK\* and JESSICA VAN DEN BERG (Department of Biology, San Francisco State University, San Francisco, CA).
- 211** *Altered Host Nutrient Consumption and Utilization Determines Parasite Success*, S.N. THOMPSON and R.A. REDAK (Department of Entomology, University of California, Riverside, CA).
- 212** *Diversity on the California Academy of Sciences' Green Roof*, JESSICA VAN DEN BERG (Department of Biology, San Francisco State University, Entomology Lab, San Francisco, CA).
- 213** *Phylogenetic Analysis of Relationships within *Phacelia* (Boraginaceae) Inferred from Chloroplast Sequence Data*, GENEVIEVE K. WALDEN\* and ROBERT PATTERSON (San Francisco State University, Department of Biology, San Francisco, CA).
- ECOLOGY, ORGANISMAL BIOLOGY and ENVIRONMENTAL SCIENCES**
- 206** *A Study of the Changes in Composition of Native vs. Non-native Plant Density in Oregon Coastal Clatsup Prairie under Species Specific Management Conditions*, DEREK NAEGELI\* and MEGHANN CARTER\* (Environmental Science, Pacific University, Forest Grove, OR).
- 207** *Effect of Host on *Symbiodinium* Gene Expression*, ERIKA DIAZ-ALMEYDA\*, SHINICHI SUNAGAWA, CHRISTIAN VOOLSTRA, COLLIN CLOSEK, and MONICA MEDINA (School of Natural Sciences, University of California, Merced, CA).
- 208** *Pattern of Symbiont Distribution in Two Intertidal Isopods (*Ligia pallasii* and *L. occidentalis*) along the Eastern Pacific*, RENATE EBERL\*, MATTHEW COHN, and DONALD R. STRONG (University of California Davis, Department of Evolution and Ecology, Davis, CA).
- 209** *Modeling the Impacts of Climate Change on San Francisco Bay-Delta Wetlands and Links to Pelagic Food Webs*, V.T. PARKER<sup>1</sup>, J.C. CALLAWAY<sup>2</sup>, E.R. HERBERT<sup>1</sup>, L.M. SCHILE<sup>3</sup>, V.T. VREDENBURG<sup>1</sup>, M.C. VASEY<sup>1,4</sup>, E.L. BORGNISS<sup>2</sup>, N.M. KELLY<sup>3</sup>, and D.M. TALLEY<sup>5</sup> (<sup>1</sup>Department of Biology, San Francisco State University, San Francisco, CA; <sup>2</sup>Department of Environmental Science, University of San Francisco, San Francisco, CA;
- <sup>3</sup>Department of Environmental Science and Policy Management, University of California Berkeley, Berkeley, CA; <sup>4</sup>Department of Environmental Studies, University of California Santa Cruz, Santa Cruz, CA; <sup>5</sup>Department of Marine Science and Environmental Studies, University of San Diego, San Diego, CA).

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# ABSTRACTS

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Abstracts are grouped by program.  
Not all presenters submitted an abstract.

## PUBLIC LECTURES

### Sunday Evening Plenary Lecture 7:00 p.m. in Science 201

**1 Ecological Awareness in American Landscape Art: Depicting and Repairing the American Wasteland,** ROBERT L. CHIANESE (Department of English (retired), California State University, 18111 Nordhoff Street, Northridge, CA 93130-8243; robert.chianese@csun.edu).

Some nineteenth-century American landscape artists developed “pre-ecological consciousness” and depicted the destruction of American wilderness. They rejected the “New Eden” and “Manifest Destiny” ideologies of their times and evolved a countervailing ideology of the American Wasteland. For them, leveling the forest for settlement and even for a commercially productive Garden produced eco-catastrophe.

These contrary energies in the beginnings of the American landscape tradition—for development or for preservation—fuel a contemporary movement in landscape art today of revising or “reconstructing” many older, classic landscape works of art that extol development. Such modern reconstructions deliberately reconfigure the imagery and values implicit in earlier works, both deconstructing and reconstructing earlier American painting, shifting attention from mythic assumptions to environmental actualities.

At the same time, postmodern landscape artists make their reconstructions of earlier landscape art a way of problematizing landscape art itself. They call into question the very construction of “nature” by human culture and let this serve as a form of environmental consciousness-raising.

Finally, other contemporary artists actually work to reclaim degraded land and make art that literally restores wilderness and creates eco-preserves out of wastelands. These “eco-artists” frame a new kind of environmental beauty in art and once again revamp the tradition of American landscape art as they draw inspiration from it.

This paper includes a slide presentation of illustrative examples of each of the periods, movements, and artists in American Landscape art that depict and repair the American Wasteland.

### Monday Noon Public Lecture 12:15 p.m. in SCIENCE 201

**2 Millennial Biology: The National Science Foundation and the Life Sciences, 1975 to 2005,** DONALD J. McGRAW (P.O. Box 515, Ephraim, UT 84627; donaldmcgraw@mac.com).

The history of the ‘life sciences,’ including both biological and sociological, has been examined by Toby Appel in her book *Shaping Biology...* in which she dissects and presents the early role of the National Science Foundation from before (1945) its establishment (1950) to 1975 in supporting the growth of these fields. Focusing on both the biological, and to some extent the sociological sciences, she discusses the role of the NSF in ‘shaping’ biology

especially over a three-decade time period. The present study undertakes the next 30 years, the first half of which includes sociology, behavioral science, neurosciences and related areas, as well as biology. The second half probes the role of NSF in the growth of biology exclusively in the U.S. during the period from about 1991 to 2005. The book to eventuate from this three-year contract is now in its early research stages. A status report is the topic of this oral presentation and describes a work that will be agency/organizational/institutional history, as well as a contribution to the history of science. Three research trips from the author’s western base to NSF in Arlington, VA have been completed. Thousands of sheets of data (original memos, award information, project histories, published articles, committee meeting minutes, and many other forms of documents) have been gathered and about a score of interviews conducted in order to detail this large and complex story. The author invites you to share in his excitement in understanding how the reciprocal dynamics of NSF and the biological (and sociological) communities both profited by this synergistic relationship over three of the most scientifically productive decades in the history of science.

### Monday Evening Plenary Lecture 7:00 p.m. in SCIENCE 201

**3 Shipwrecks as Fossils,** CATHRYN R. NEWTON (Dean Emerita and Professor of Interdisciplinary Sciences, The College of Arts and Sciences, 110 Life Sciences Complex, Syracuse University, Syracuse, NY 13244).

Millions of shipwrecks populate the substrates of the world’s oceans, and they vary tremendously in ship type, antiquity, historical significance, and impact on the marine environment. Some continental margins are essentially “shipwreck graveyards”—with high population densities of wrecks and associated cultural artifacts.

One of these, the continental margin of North Carolina, has been termed the “Graveyard of the Atlantic” by mariners. Shipwrecks in this region include World War II U-boats; Civil War vessels, both Federal and Confederate; slave ships; rum runners; and many other types. Presented here for the first time are initial results from a new and fully searchable database of 2038 shipwrecks from this region.

Considering shipwrecks as fossils and using a larger database than any previously compiled for this part of the ocean, we can pose new questions that are primarily populational: questions about when and where wrecks occur, the degree to which they are linked causally with hurricanes, and even cultural questions regarding cargoes, voyages, and circumstances of sinking. These queries yield some surprising results in shipwreck patterns and trends.

The presentation will also highlight oceanographic research on shipwrecks such as the Civil War ironclad USS MONITOR, including a first-hand account of its discovery; WWII German U-boats and 100 ships that were their victims; and sailing ships built for speed.

## ABSTRACTS - Public Lectures/Symposia

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### Tuesday Noon Public Lecture

12:15 p.m. in SCIENCE 201

- 4 Specific Events Delaying Recognition of Franklin's Contribution to DNA Structure,** LYNNE OSMAN ELKIN (retired, Department of Biological Sciences, California State University East Bay, Hayward, CA; current address: 2690 Mountaingate Way, Oakland, CA 94611; [lynne\\_elkin@yahoo.com](mailto:lynne_elkin@yahoo.com)).

During 1950-1953, and even until the 1968 publication of *The Double Helix*, every major DNA participant, including Franklin, contributed in some way to the Cambridge DNA triumph over King's College, London. Many of their actions obscured Franklin's contribution. A careful reconstruction of the DNA timeline, based upon my own extensive interviews, older and newly released archival papers and all relevant books revealed several pivotal events which have not yet been fully analyzed. Franklin's personality, which clashed with that of her colleague Maurice Wilkins, was part of a perfect storm that caused her to refuse a valuable opportunity in 1952 that probably would have hastened a King's solution. This storm also involved Wilkins having discussed his pessimistic views of Franklin and her work with MRC (Medical Research Council) Director John Randall. Randall then reacted in ways that proved both astute and disruptive. Wilkins had formulated his views while he was under the influence of Watson and Crick's dismissive attitudes, yet none of them had had the benefit of access to her data. To further complicate matters, after using her data, Watson and Crick systematically avoided clear acknowledgment of Franklin and others, thereby missing several opportunities to embark on a more inclusive path. The key event involved Franklin's inexperience in classical crystallography of organic substances which caused her to have missed the anti-parallel significance of her calculated DNA space group. The more "crystallographically" experienced Crick recognized this immediately upon reading her King's MRC report.

Darwin's Finches, and more particularly in the evolution of species-specific bird song. Bowman had an uncanny ability to emulate the chirping of his beloved finches and he was able to communicate with them, thus the focus of his research. In addition, Robert played a lead role in encouraging the Ecuadorian government to set aside more than 1.7 million acres, the Galapagos Archipelago, as the Galapagos National Park, and in the establishment of both the Darwin Research Station, located on Isla Santa Cruz, and the Charles Darwin Foundation. It is to Robert I. Bowman that we dedicate this Galapagos Island Symposium.

- 7 Charles Darwin: Besides Galapagos,** JERE H. LIPPS (Department of Integrative Biology and Museum of Paleontology, University of California, Berkeley, CA 94720; [jlipps@berkeley.edu](mailto:jlipps@berkeley.edu)).

Focused by Adam Sedgwick's field instruction and Charles Lyell's *Principles of Geology*, Darwin concentrated on geology during much of the voyage of the *Beagle*. Indeed, he wrote 1383 pages of notes on geology and only 368 on biology. Most of his first books were on geology and not for many years did he begin to assemble his observations on biology into his most famous books.

Of the 1,741 days of the voyage, 35 were in the Galapagos and Darwin was ashore for only 19 of them although he cruised near eight other islands. During the other 1706 days, Darwin examined the geology and living corals of Atlantic islands, learned about slavery first-hand, explored the Pampas and collected fossils, geologized at the Falklands, viewed active volcanoes and earthquakes in the Andes, called Isla Chiloé "a fine island", determined how reefs formed, and commented on the natives everywhere. Leaving South America for Galapagos, the crew longed for home and stops were few and quick. Tahiti finalized his ideas about coral reef formation, and he even began a manuscript on them on the crossing of the Pacific. He seemed to have forgotten the Galapagos, and came away from them with plenty of good observations but no particularly noteworthy insights—these developed later.

Darwin's scientific contributions came from a vast experience with 40+ islands and two continents, honing his comparative research style. Overall, he absorbed both geology and biology, recognizing that history matters, and integrated them into his thinking.

- 8 Recreating Darwin's Experiences as a Geologist Using Texts, Sites, and Specimens,** SANDRA HERBERT (Department of History, University of Maryland Baltimore County, 1000 Hilltop Circle, Baltimore, MD 21250; [herbert@umbc.edu](mailto:herbert@umbc.edu)).

When Charles Darwin's life and works were celebrated in 1959 on the occasion of the 100<sup>th</sup> anniversary of publication of the *Origin of Species*, it was possible to present only a limited picture of his early career because his manuscripts from the voyage of the *Beagle* had yet to become fully available to scholars. The largest collection of Darwin manuscripts came to Cambridge University Library gradually over a period of years beginning in the late 1940s. Publication of a *Handlist* in 1960 marked the moment when scholars could make practical use of the collection. Meanwhile the bulk of Darwin's geologist specimens were housed, not far away, at the Sedgwick Museum. Over time, as scholars have become more familiar with Darwin's manuscripts, it has become possible to integrate the insights they allow with evidence provided by re-examination of physical specimens and of sites. After surveying several instances where scholars have pursued this agenda, I will focus on one recent example taken from the Galápagos archipelago where examination of manuscripts and specimens in conjunction with a

## SYMPOSIA

### Darwin and the Galapagos, Part I

Friday, 9:00 a.m. in the Forum at the  
California Academy of Sciences

- 6 Robert Irwin Bowman (1925-2006) Remembered,** ALAN E. LEVITON and MICHELE L. ALDRICH (California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118; [aleviton@calacademy.org](mailto:aleviton@calacademy.org); [maldrich@smith.edu](mailto:maldrich@smith.edu)).

In addition to celebrating the 200<sup>th</sup> anniversary of the birth of Charles Darwin and the 150<sup>th</sup> anniversary of the publication of the *Origin of Species*, we are also commemorating the life of Robert Irwin Bowman to recognize the extraordinary contributions he made to the study of the Galapagos fauna and flora and to the long-term conservation and preservation of both for future generations. Robert Bowman died in his 80<sup>th</sup> year in 2006. He served for nearly 35 years on the biology faculty of San Francisco State University, an indefatigable leader, teacher, and researcher. Furthermore, he was associated with the California Academy of Sciences for those years as a Research Associate, Trustee, and most importantly, friend, and with the AAAS Pacific Division as a member of the Division's Executive Committee and in 1982 as President. Robert was especially interested in the geospizid finches, better known as

site have provided grounds for renewed appreciation of Darwin's reliability as a field researcher. The site is James Island (Isla Santiago), the texts are Darwin's notes from the voyage and his book on *Volcanic Islands* (1844), and the specimens are those collected by Darwin at the site and held by the Sedgwick Museum of Earth Sciences. I will describe the interpretive problems associated with this site. I will also suggest how Darwin's scheme of geological work on James Island integrated with his work in zoology and botany. Dr. Sally Gibson will follow with the detailed results of historical and scientific expeditions to the site in 2007 and 2008.

**9 Tracing Darwin's Geological Footsteps on Isla Santiago (James Island), SALLY A. GIBSON** (Department of Earth Sciences, University of Cambridge, UK. CB2 3EQ; sally@esc.cam.ac.uk).

During the *Beagle* voyage (1831–1836) Charles Darwin was especially interested in ocean islands and one of his most important contributions to geology was his theory concerned with their formation. In *Volcanic Islands* (1844), Darwin described the importance of crystal density in controlling the range of compositions of lavas erupted from a single volcano. His idea was especially focused on the evolutionary link between basalts and trachytes and of particular significance to this were his observations in Galápagos.

Trachyte is a rare magma type in Galápagos, only occurring in NW Santiago (and a small adjacent island), and it appears fortuitous that this is where Darwin spent the most time whilst in the archipelago. His rock samples from Santiago are highly varied in composition and reveal his remarkably keen collectors 'eye'. We have used information from these and also Darwin's field notes -- together with our findings from expeditions in 2007 and 2008 -- to retrace his footsteps on Santiago. The geochemistry of lava flows erupted in Santiago is distinctive and highly varied. Trachytes, for example, only occur at the summit of the island. Geochemical 'sequencing' of Darwin's original rock specimens and those from our recent expeditions has permitted us to characterise and accurately locate his collection sites. Using this information we have been able to pinpoint Darwin's route on Santiago and gain a greater insight into where he may have gained inspiration on magmatic evolution and made zoological and botanical observations that were to be important in his later work on the *Origin of Species*.

**10 Darwin, the Galapagos and His Changing Thoughts about Species Origins: 1835-37, JONATHAN HODGE** (History and Philosophy of Science, Department of Philosophy, University of Leeds, LS2 9JT, UK; m.j.s.hodge@leeds.ac.uk).

From 1834, Darwin accepted Lyell's view of species origins. Species are fixed in character, created each at a single place determined solely by providential, adaptational considerations, so similar species originate in similar conditions. Nothing Darwin saw at the Galapagos (Sept 15 – Oct 20, 1835) changed his mind. Around nine months later, however, he was favoring species transmutation. The mid-1836 entry, in his *Ornithological Notes*, about interisland, intervarietal, intraspecific divergences in Galapagos tortoises and mocking birds and in Falklands foxes, shows that Darwin was now favoring transmutation, and that this favoring was not due to reflecting on these facts. As cases of intervarietal not interspecies divergence, they did not require transmutation as their explanation. They could only suggest that isolation on migration to new locations could initiate varietal, and so (*but only for a transmutationist*) specific divergences. (Note: at this time, if he had judged, e.g., the mocking birds to be *distinct species* on different islands, he would

probably have thought them so many migrant species from the nearest, older mainland, which he had not visited, and hence irrelevant to the species stability issue). So: what other reflections on other facts had already led Darwin to first favor transmutation? Most likely, I conjecture, reflections, shortly before (see *ON*), about the distribution on the southern South American mainland of Ant-bird and Oven-bird species. Here very similar congeneric species had evidently originated in one region, but in sublocations with very different conditions. Their similarities discredited Lyellian adaptationist special creationism but were explicable as due to common descent. Such *interspecific similarities* were, I conjecture, Darwin's primary rationale for transmutationism. Interisland, intervarietal, intraspecific divergences were a secondary supporting rationale. In early 1837, with Darwin back in London, Gould's reinterpretations of Darwin's Galapagos birds transformed them evidentially. Many species, of several genera and families, Darwin now learned, were both *peculiar to* the Galapagos land, and *very similar* to distinct species on the nearest mainland. (Note: the Galapagos land being so many islands is irrelevant here). So, they now presented a new, unexpected jackpot bonanza of very similar species originating in very dissimilar conditions (eg Galapagos arid, mainland not): the primary rationale. And, moreover, Gould's judging the mocking birds specifically not just varietally distinct on different islands made them an unexpected, enhanced bonus case of the secondary rationale. Darwin soon decided to side with Lamarck against Lyell in a completely general way. By July he was opening *Notebook B* by sketching, in two dozen pages, a comprehensive zoonomical system emulating the structure of Lamarck's 'system' as outlined by Lyell.

**11 Going Public on the Galapagos: Reading Darwin between the Lines, MICHAEL T. GHISELIN** (Department of Invertebrate Zoology, California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118; mghiselin@calacademy.org).

Darwin was not an evolutionist until after he returned from the *Beagle* voyage. He presented material relevant to evolution in his earlier publications the significance of which only became explicit in his later ones. Good examples are to be found in his *Journal of Researches*, and in his barnacle monograph, which was his first book on evolution. He enlisted the aid of specialists to work up his specimens, but keeping his ideas largely to himself hampered his efforts to get the kind of information that he needed. Acting as editor (and to some extent a co-author) of the *Zoology* of the voyage made the task somewhat easier. He went so far as to explain his theory to his confidants Joseph Dalton Hooker and Asa Gray. Alfred Russel Wallace, who was actively seeking for evidence of evolution, was able to understand enough of the cryptically evolutionary passages (such as those on the Galapagos) well enough to get credit for what purports to be an independent discovery.

**12 Darwin: The Botanist on the Beagle, DUNCAN M. PORTER** (Department of Biological Sciences, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061; duporter@vt.edu).

Contrary to popular belief, Charles Darwin was not hired to be the naturalist for HMS *Beagle*, nor was he deficient in training in zoology, botany, or geology. Most of this training was in botany under the tutelage of Professor John Stevens Henslow, while Darwin was a student at the University of Cambridge. This training continued during the voyage via advice sent in Henslow's letters to Darwin. As a result, Darwin collected plants, algae, lichens, and fungi and made observations on vegetation almost everywhere he

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went on the voyage. By the time he reached the Galapagos Islands, four years into the voyage, Darwin had collected plants from the Cape Verde Islands to Brazil and some of its Atlantic islands, Uruguay, Argentina, Patagonia, Tierra del Fuego, the Falkland Islands, and Chile. After leaving the Galapagos he apparently collected plants only on the Indian Ocean's Cocos (Keeling) Islands. The importance of these collections and observations to Darwin and the floristic botanists who followed him, especially William Jackson Hooker and his son Joseph Dalton Hooker, is emphasized, particularly those made in the Galapagos.

### Darwin and the Galapagos, Part II

Saturday, 9 a.m. in the Forum at the  
California Academy of Sciences

**13 A Damned Creation: The Galapagos Before Darwin,** EDWARD J. LARSON (Humanities Division, Pepperdine University, SOL, Malibu, CA 90265; elarson@pepperdine.edu).

The Galapagos Islands gained a niche within European natural history even before Charles Darwin's 1832-36 voyage aboard the British survey ship *Beagle* transformed them into a fabled laboratory of evolution. The Spanish bishop Tomàs de Berlanger discovered the uninhabited archipelago in 1532, when his ship became becalmed there on an official voyage from Panama to Peru. He brought back tales of strangely desolate islands with gigantic land tortoises and fearless birds. Gaining favor as a resort for British and Dutch privateers preying on Spanish ships carrying gold and precious metals north from Peru, reports continued to reach Europe about the archipelago's distinctive reptiles and birds. A late 18<sup>th</sup> Century British expedition led by James Colnett depicted the region as a breeding ground from whales, leading to a rush of whalers to the islands. Small settlements sprung up and the waters became sight of skirmishes during the 1812-14 war between the United States and Britain, both of which boasted large whaling fleets. Growing interest in distinctive Galapagos plants and animals also led to stops there before Darwin by Vancouver's *Discovery* expedition, British botanical collector David Douglas, and Lord Byron on his voyage to Hawaii. Although these explorers and travelers found the native flora and fauna interesting, no one succeeding in explaining it until Darwin offered his evolutionary account. Rather than an exhilarating place for evolving new species, the Galapagos struck previous visitors as a damned creation.

**14 Collecting Evolution: The Untold Story of the Vindication of Charles Darwin by the 1905-06 Galapagos Expedition of the California Academy of Sciences,** MATTHEW J. JAMES (Department of Geology, Sonoma State University, Rohnert Park, CA 94928; james@sonoma.edu).

The yearlong 1905-06 scientific collecting expedition to the volcanic Galápagos archipelago unintentionally vindicated Charles Darwin's theory of evolution and made the Galápagos Islands the world-class ecotourism destination they are today. By showcasing the islands in his landmark 1859 book *On the Origin of Species*, Darwin made the Galápagos Islands more than just a museum or showcase of evolution, as they are often described today. The vigorous intellectual debate that followed publication of *The Origin of Species* only strengthened the allure of the Galápagos. One could read the book and vicariously partake in the controversy, or one could go visit the Galápagos and participate in the controversy first

hand. In the early summer of 1905, the senior curators at the California Academy of Sciences decided to both read and visit: they would send young collectors to the Galápagos while they themselves stayed home in San Francisco, with the ultimate goal of publishing taxonomic papers on the results of the expedition. The 17-month 1905-06 scientific collecting expedition was the brainchild of Academy Director and ornithologist Leverett Mills Loomis, who wanted his expedition to be longer in duration and conduct more thorough collecting activity than any previous expedition sent to these islands made famous by Darwin. Loomis was motivated twofold by Darwin, but not in the usual ways. On the one hand, Loomis was acting on the well-founded fear that species in the Galápagos, especially the archipelago's namesake giant tortoises, were fast disappearing due to human depredation. On the other hand, Loomis was not a vocal advocate of Darwin. After delaying the expedition for eight months for lack of a suitable vessel, Loomis finally assembled a hardy group of "eight young men" to work as sailor-scientists to proceed south on the 89-foot schooner *Academy* to spend a full year in the islands, not necessarily supporting or refuting evolution, but collecting evolution in the archipelago.

**15 Darwin, Barnacles and the Galapagos: A View through a 21<sup>st</sup> Century Lens,** ROBERT VAN SYOC (Department of Invertebrate Zoology and Geology, California Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118; bvansyoc@calacademy.org).

Darwin's visit to the Galapagos in 1835 pre-dated his studies on barnacle evolution by over a decade. Therefore, he paid little attention to them on the Galapagos. He did collect some barnacles in the Galapagos, but these specimens were apparently lost, therefore he had to ask other scientists to collect material for him when he began his Cirripedia work in 1846. He also studied the collections at the British Museum of Natural History and borrowed material from the Museum National d'Histoire Naturelle in Paris.

Darwin's four landmark monographs of Cirripedia, published from 1851-1854, forged the first major modern comparative morphological study of that group. These works are still in use today, though mostly as a reference to early recognition of various morphological characters and name usage.

As in Darwin's time, barnacles continue to be an excellent taxon for the study of evolution: with an extensive fossil record, adaptations to extreme physical environments and host-specific symbioses with many types of organisms.

Current tools and techniques such as phylogenetics, scanning electron microscopy and molecular-level comparisons have allowed present day cirripedologists to delve more deeply into the taxonomy and systematics of the group. We now realize that although Darwin recognized many of the genus and subgenus level clades, he could not prove the stability of some morphological characters and he failed to determine many closely related and cryptic species, which we are still in the process of discovering.

Examples from the Galapagos include the recognition of morphologically cryptic, but genetically distinct, new species in the genera *Oxynaspis* and *Conopea*. Conversely, morphological variability, with molecular-level similarity, in a widespread eastern tropical Pacific species of *Megabalanus* more closely fits Darwin's view of morphological variation within barnacle species.

**16 The Fishes of the Galápagos Archipelago,** JOHN E. MCCO-SKER<sup>1</sup> and RICHARD H. ROSENBLATT<sup>2</sup> (<sup>1</sup>California

Academy of Sciences, 55 Music Concourse Drive, San Francisco, CA 94118; jmccosker@calacademy.org; <sup>2</sup>Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA 92037; rosenblatt@ucsd.edu).

The terrestrial flora and fauna of the Galápagos have provided evolutionary biologists an opportunity to examine insular endemism in light of life history traits, habitat requirements, ecosystem composition, and differences in vagility. Whereas most biologists associate Charles Darwin's 1835 visit aboard the *Beagle* with his observations of plants, birds, and tortoises, few appreciate that he accomplished the first Galápagos ichthyological survey as well. He returned with 15 Galápagos fish specimens, all of which were subsequently described by the Reverend Leonard Jenyns as new species. The 1000 km deep water gap separating the archipelago from the mainland as well as the variety of currents bathing the Galápagos have allowed similar opportunities for the Galápagos ichthyofauna to have achieved a significant level of uniqueness. Previous estimates of Galápagos fish endemism have ranged from 9–18%; new estimates based on recent collections using submersibles to 1000 m have resulted in many new records and new taxa, such that we now recognize 552 species (excluding mesopelagic fishes) and endemism to be as high as 13%. Endemism increases to as high as 19% if one includes species unique to Galápagos, Cocos and Malpelo islands. The faunal composition, its origin and affinities, and its means of arrival will be discussed.

**17 Collecting Galapagos and the Pacific: How Rollo Howard Beck Shaped Our Understanding of Evolution, JOHN P. DUMBACHER** (Department of Ornithology and Mammalogy, California Academy of Sciences, San Francisco, CA 94118; jdumbacher@calacademy.org).

The largest scientific collection of the Galapagos animals was gathered by Rollo Howard Beck, working on behalf of the California Academy of Sciences. Beck had been to the Galapagos on two previous scientific expeditions, and during these trips he collected a fine series of birds that later provided the core data for works such as David Lack's seminal book, *Darwin's Finches*. The Galapagos was not only a proving grounds for concepts of evolution, but also for Rollo Beck himself, who later collected birds throughout the Pacific Ocean from Alaska to Argentina, and California to New Guinea. His collections in California challenged UC Berkeley's Joseph Grinnell, and his work in the Pacific provided important data for Robert Cushman Murphy's work on oceanic birds and Ernst Mayr's work on western Pacific birds. Throughout his life, Beck collected over 62,500 bird specimens, and thousands more of mammals, herps, plants, and even anthropological artifacts. This talk discusses the importance of these scientific collections in our understanding of the Galapagos and evolution as well as celebrating one of the most productive collectors of all times.

**18 The Evolution of Darwin's Finches, PETER R. GRANT and B. ROSEMARY GRANT** (Department of Zoology, Princeton University, Princeton, N.J.; rgrant@princeton.edu).

This year is the 150<sup>th</sup> anniversary of Darwin's book the "Origin of Species" in which he established the scientific basis for understanding how evolution occurs by means of natural selection. Darwin was less clear about the actual process of species formation. Nevertheless he envisioned a three-step process: colonization, involving the expansion of a population into a new environment; divergence, when populations become adapted to novel

environmental conditions through natural selection; and finally, the formation of a barrier to interbreeding between divergent lineages. He showed characteristic perception by suggesting that investigations of what we now call, "very young adaptive radiations" might provide windows through which we can view the processes involved.

Since Darwin's time insights from the fields of genetics, behavior and ecology have continued to illuminate how and why species evolve. In this talk we will discuss the progress that has been made in our understanding of speciation with special reference to the young radiation of Darwin's Finches.

**19 Darwin and the Galápagos: What Darwin Would Like to Have Known, FRANK J. SULLOWAY** (Institute of Personality and Social Research, University of California, 4125 Tolman Hall, Berkeley, CA 94720; sulloway@berkeley.edu).

Modern research involving the Galápagos Islands has shed abundant light on several key theories and arguments that Charles Darwin set forth in his *Origin of Species* (1859). Four of these arguments, which each played an important role in Darwin's *Origin*, will be discussed in this lecture and related to recent research: (1) The vulnerability of island ecosystems to invasion by exotic species, including the threat currently posed to endemic land birds by the introduced ecotoparasite *Phlornis downsi*; (2) Darwin's "principle of divergence," which he ranked along with natural selection as the "keystone" to the *Origin of Species*; (3) Darwin's "naturalization hypothesis," as illuminated by research on introduced Galápagos plants; and (4) the role of geographic isolation in the origin of new species. "The Galapagos," Darwin declared to botanist Joseph Hooker in 1846, "seems a perennial source of new things." Consistent with Darwin's dictum, these islands continue to provide novel evidence that has supported and refined some of Darwin's most fundamental scientific insights.

### San Francisco Bay: Tracking and Understanding a Changing Estuary Monday, 8:25 a.m. in SCIENCE 101

**20 Climate Change From Both Ends: Projected Sea Level Rise and Inflow Changes in San Francisco Bay, NOAH KNOWLES** (U.S. Geological Survey, Menlo Park, CA; nknowles@usgs.gov).

Variability in the San Francisco Bay Estuary is driven by forcings from both the upstream and downstream ends. Water levels at the Golden Gate and freshwater inflows from the watershed control water heights and water quality throughout the Bay. Climate change influences both of these factors, leading to increasing sea level at the Golden Gate and shifts in the timing and amount of annual runoff from the watershed. Key impacts are increased risk of inundation around the Bay, and increased salinities within the Bay.

Projections of changing sea level extremes are used to map the resulting influence on flooding potential for areas adjacent to the Bay. In the North Bay, wetland survival and developed fill areas are at risk. In Central and South bays, a key feature is the bay-ward periphery of developed areas that would be newly vulnerable to inundation. Nearly all municipalities adjacent to South Bay face this risk to some degree. For the Bay as a whole, as early as 2050, the one-year peak high-water event nearly equals the 100-year peak event in 2000.

At the upstream end, diminished snowpack in the Sierra

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Nevada mountains under a warmer climate will result in earlier runoff and increased downstream flooding potential. Combined with sea level rise, this results in a higher risk of levee failure in the estuary's northern reach and upstream Delta. Such failures would increase tidal prism and raise salinities in these areas, potentially impacting ecosystem health and threatening freshwater supplies drawn from the Delta. Additionally, drying trends in most climate models raise the possibility of reduced upstream freshwater supply, exacerbating Bay/Delta water quality and supply issues.

**21 Morphological Change of the San Francisco Estuary,** BRUCE JAFFE<sup>1</sup>, THERESA FREGOSO<sup>1</sup>, AMY FOXGROVER<sup>2</sup>, MICK VAN DER WEGEN<sup>3</sup>, DANO ROELVINK<sup>3</sup>, NEIL GANJU<sup>4</sup>, KATE DALLAS<sup>5</sup>, PATRICK BARNARD<sup>1</sup>, DAN HANES<sup>1</sup>, JOHN CHIN<sup>6</sup>, DON WOODROW<sup>6</sup>, MARY McGANN<sup>6</sup>, LYNN INGRAM<sup>7</sup>, SHAWN HIGGINS<sup>8</sup>, MARK MARVIN-DiPASQUALE<sup>6</sup> and ELENA NIELSEN<sup>9</sup> (<sup>1</sup>United States Geological Survey, Pacific Science Center, 400 Natural Bridges Drive, Santa Cruz, CA 95060; <sup>2</sup>Virginia Institute of Marine Science, Gloucester Point, VA 23062; <sup>3</sup>UNESCO-IHE, PO Box 3015, 2601 DA Delft, The Netherlands; <sup>4</sup>United States Geological Survey, Woods Hole Science Center, 384 Woods Hole, Woods Hole, MA 02543; <sup>5</sup>University of California, Santa Cruz, 1156 High Street, Santa Cruz, CA 95064; <sup>6</sup>United States Geological Survey, 345 Middlefield Road, Menlo Park, CA 94025; <sup>7</sup>University of California, Berkeley, 13 McCone Hall, Berkeley, CA 94720; <sup>8</sup>Kamman Hydrology and Engineering, Inc., 7 Mount Lassen Drive, Suite B250, San Rafael, CA 94903; <sup>9</sup>United States Geological Survey, 2130 SW 5<sup>th</sup> Avenue, Portland, OR 97201; bjaffe@usgs.gov).

The morphology of the San Francisco Estuary has undergone dramatic changes since the Gold Rush as both natural forces and human activities have added, rearranged, and removed massive quantities of sediment. The patterns and quantities of historical bathymetric change indicate that sediment delivery is the single most important forcing for long-term and large-scale geomorphic change. Hydraulic gold mining in the Sierra Nevada foothills in the mid- to late 1800s resulted in an order of magnitude increase in sediment inflow (from ~2 Mcm/yr pre-mining to 14.1 Mcm/yr during mining) to the San Francisco Estuary. This unnaturally high inflow of sediment filled bays in the northern estuary by as much as 1 m during a 30-year period, altered channel courses, created new intertidal mudflats, and built out the ebb tide delta. In contrast, a decrease in sediment inflow to the estuary in the past half-century, in large part caused by damming of rivers and altered land use, has resulted in net erosion in the system. As the morphology of the estuary changed so did its physical environment including the hydrodynamics, sediment transport, and salinity. Sediments record the environmental change in grain size, microfossils, and geochemistry. Altered sediment transport has also resulted in a complicated distribution of legacy contaminants such as mercury and hydrocarbon that are either buried or exposed near the surface. A formidable challenge is to improve our ability to predict the morphologic and environmental change as global warming accelerates sea level rise and alters weather patterns that shape the estuary.

**22 A New Regime of Decreased Sediment and Carbon Supply in the San Francisco Estuary,** DAVID H. SCHOELLHAMER<sup>1</sup>, SCOTT A. WRIGHT<sup>1</sup>, ELIZABETH A. CANUEL<sup>2</sup>, JUDITH Z. DREXLER<sup>1</sup>, and LESTER J. MCKEE<sup>3</sup> (<sup>1</sup>U.S. Geological Survey, 6000 J Street, Placer Hall, Sacramento, CA 95819; <sup>2</sup>Virginia

Institute of Marine Science, P.O. Box 1346, Gloucester Point, VA 23062; <sup>3</sup>San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621; dschoell@usgs.gov).

In the late 1800s hydraulic gold mining in the Sierra Nevada created a massive sediment pulse that passed through the Sacramento Valley and Delta and entered San Francisco Bay. In the 1900s cessation of hydraulic mining and development of California's modern water infrastructure including dams and bank protection decreased the supply of sediment from the Central Valley to the Bay. Lower Sacramento Valley rivers and San Francisco Bay generally eroded during the 1900s, which at least partially countered the loss of sediment from upstream. Other studies have found that stable river channels that lose upstream sediment supply tend to erode until a new stable regime is established. This regime change and related ecosystem response propagate downstream with time. Now the effects of decreased sediment supply appear to have reached San Francisco Bay and are waning in the watershed, resulting in a new regime of decreased sediment and carbon supply to the estuary. Recent findings supporting this hypothesis include decreased river channel erosion, decreased sediment supply from the Central Valley, decreased turbidity in the Delta, decreased sediment and carbon deposition in the Delta, and decreased suspended-sediment concentration in San Francisco Bay. A decreased sediment and carbon-supply regime may have contributed to an increase of phytoplankton in the Bay and the decline of estuarine pelagic organisms in the 2000s. Decreased sediment supply may hinder wetland sustainability and restoration in the estuary. A fundamental question affecting ecological management and adaptation to sea-level rise that we cannot answer at this time is whether the system will continue to change or whether it is now stable.

**23 Historical Landscapes of the San Francisco Bay Area: New Perspectives on the Past and the Future,** ROBIN GROSSINGER<sup>1</sup>, JOSH COLLINS<sup>1</sup>, LESTER MCKEE<sup>1</sup>, PETER BAYE<sup>2</sup>, LAUREL COLLINS<sup>3</sup>, ROBERT LEIDY<sup>4</sup>, and JANET SOWERS<sup>5</sup> (<sup>1</sup>San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621; <sup>2</sup>P.O. Box 65, Annapolis, CA 95412; <sup>3</sup>Watershed Sciences, 1128 Fresno Avenue, Berkeley, CA 94707; <sup>4</sup>Wetlands Regulatory Office, U.S. Environmental Protection Agency, 75 Hawthorne Street, San Francisco, CA 94105; <sup>5</sup>William Letts and Associates, 1777 Bothelho Drive, Walnut Creek, CA 94596; robin@sfei.org).

Driven by the need for information to guide environmental management, recent studies of historical landscapes have developed new understandings about the natural functions and ecological diversity of San Francisco Bay. Historical research is reestablishing a broad ecological "palette" for local management, as seen by restoration projects incorporating formerly forgotten habitats such as tidal marsh pannes, marsh-upland ecotones, sandy beaches, and, potentially, alluvial fans.

Historical analyses have shown that San Francisco Bay is comprised of many small estuaries associated with local watersheds, and that watershed form and function varied significantly in response to local differences in rainfall, topography, and geology. Streams discharged water and sediment to the Bay margin in a variety of ways, in some cases spreading into lowland wetlands, and in others maintaining lush perennial or xeric intermittent connections. Each style supported unique habitats and species assemblages; they also vary widely in the rates of natural geomorphic processes and response to land use impacts. At the local scale, these findings help develop management initiatives such as restoration

designs, alternative water management approaches, and natural flood protection strategies. At the Bay scale, historical landscape analysis helps formulate hypotheses about the importance of local watershed sediment supply in the evolving bathymetric patterns of the Bay, providing independent data to support policymakers in the implementation of TMDLs, wetland restoration, and endangered species management.

The challenge over the next decade is to synthesize this emerging information into strategies that link climate, topography, supply and storage of water and sediment, and land use to desired watershed and wetland functions in relation to changing shoreline position and infrastructure, as the landscape and people adjust to climate change.

**24 Central San Francisco Bay: The Crossroads of San Francisco Bay**, MARK STACEY<sup>1</sup>, JOHN LARGIER<sup>2</sup>, TOBY GARDFIELD<sup>3</sup>, STEPHEN MONISMITH<sup>4</sup>, THOMAS POWELL<sup>1</sup>, JONATHAN FRAM<sup>5</sup>, and EDWARD GROSS<sup>4,6</sup> (<sup>1</sup>University of California Berkeley; <sup>2</sup>University of California Davis (Bodega Marine Lab); <sup>3</sup>Romberg Tiburon Center, San Francisco State University; <sup>4</sup>Stanford University; <sup>5</sup>University of California Santa Barbara; <sup>6</sup>Bay Modeling; mstacey@berkeley.edu).

San Francisco Bay is easily separated into 3 distinct regions: South San Francisco Bay (South Bay), which lies south of the Bay Bridge; Northern San Francisco Bay (North Bay), which extends from the Richmond-San Rafael Bridge to the Sacramento-San Joaquin Delta (the Delta), and Central Bay, which is the region of intersection between North Bay, South Bay and Pacific Ocean waters. The North Bay is a traditional estuary, with freshwater flow provided by the Sacramento and San Joaquin Rivers entering through the Delta. South Bay, in contrast, has limited freshwater inflow and, at times, resembles a large tidal lagoon. In fact, South Bay salinities are as strongly influenced by North Bay freshwater flows as by local inflows. Central Bay is the mixing basin that connects these other components of the estuary to the Pacific Ocean, and is characterized by complex topography that separates the basin into a number of channels that connect from east to west (from the Pacific Ocean to the Bay) and north to south (between North and South Bays). The interaction of highly energetic tidal flows with this complex topography makes the basin highly dispersive. The mixing in the basin, however, defines the salinity boundary condition for North Bay, produces fluxes of freshwater into South Bay, and establishes the exchange between the estuary and the ocean.

Recent studies in Central Bay have begun to illuminate the roles of tides, density forcing and topography in establishing transport and mixing. The topography of Central Bay provides separate conduits for North Bay and South Bay waters through the basin. North Bay waters preferentially move through Raccoon Strait, where they interact with a partial sill and two deep holes to define the net flux of North Bay waters into the region of the Bay mouth. South Bay waters, on the other hand, preferentially move along the southern edge of the basin. The result is that at the mouth of the Bay, during the ebbing tide, the signatures of North Bay and South Bay waters, including distinct densities, are evident along opposite sides of the Golden Gate channel. As the tide slacks at the end of the ebb tide, this lateral density gradient relaxes, producing vertical stratification and a phase shift in the tidal velocities that leads to net exchange between the ocean and the estuary.

**25 Historical and Present-Day Bathymetric Changes and Sediment Transport Patterns in and around the Golden Gate**, PATRICK L. BARNARD<sup>1</sup>, DAN M. HANES<sup>1</sup>, LI H. ERIKSON<sup>1</sup>, BRUCE JAFFE<sup>1</sup> and KATE DALLAS<sup>2</sup> (<sup>1</sup>United States Geological Survey, Pacific Science Center, 400 Natural Bridges Drive, Santa Cruz, CA 95060; <sup>2</sup>University of California Santa Cruz, Department of Earth and Planetary Sciences, 1156 High St., Santa Cruz, CA 95064; pbarnard@usgs.gov).

Historical bathymetric changes highlight major anthropogenic influences since the 19<sup>th</sup> century to the Golden Gate region, the core of San Francisco Bay Coastal System. Hydraulic mining during the Gold Rush introduced enormous volumes of sand and gravel into the bay that continued well into the 20<sup>th</sup> century. During this same period, bay development significantly reduced the tidal prism, and from the 1920's to the present, dredging (borrow pits and channel) and aggregate mining removed at least 130 million m<sup>3</sup> of mostly sand and gravel from the system. Bathymetric change analysis of North Bay, Central Bay, South Bay and the San Francisco Bar demonstrates that ~250 million m<sup>3</sup> of sediment has been lost from the system over the last 50 years, the majority of which is sand-sized material from the Golden Gate region. This persistent trend of recent sediment loss in the San Francisco Bay Coastal System combined with accelerating sea level rise suggest that sedimentation rates required to maintain tidal flats and marshes may not be sufficient, and that sediment supply to adjacent open-ocean beaches may be further depleted, where decadal-scale patterns of erosion are already observed. This erosional trend will present major challenges for managers and emergency planners as we move further into the 21<sup>st</sup> century. To aid in the understanding of present-day sediment transport patterns in the Golden Gate, located between the mouth of San Francisco Bay and Central Bay, we performed detailed bedform analysis of high resolution multibeam bathymetry, 3-D process-based numerical modeling, and mineral provenance. These studies have identified key sediment transport pathways that can assist the sediment management community to more efficiently manage precious sand and gravel resources in this region and mitigate negative impacts.

**26 Primary Production in the Northern San Francisco Estuary: Recent Insights From Carbon and Nitrogen Productivity Studies**, ALEXANDER E. PARKER, RICHARD C. DUGDALE, FRANCES P. WILKERSON and AL MARCHI (San Francisco State University, 3152 Paradise Drive, Tiburon, CA 94920; aeparker@sfsu.edu).

The annual primary productivity cycle is a function of interactions between physics, nutrients and biological communities and thus an integrator of long term change in urbanized estuaries. Perturbations in the productivity cycle in the San Francisco Estuary (SFE) have been documented over the past several decades which can be tied to relationships between natural and anthropogenic change and ecosystem drivers. Increasingly sophisticated models of SFE productivity have been proposed to explain these relationships. During the 1970's and 1980's primary production was suggested to be impacted by freshwater flow and suspended sediments with light-limitation maintaining low productivity rates, among the lowest of any estuary worldwide. During the mid 1980's the appearance of an invasive benthic grazer acting as a strong top-down control on primary production coincided with the disappearance of high phytoplankton biomass in northern SFE. During the most recent decade phytoplankton studies in the SFE have focused on phytoplankton

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nitrogen (N) and carbon (C) productivity and suggest additional modulating factors. Nutrients, which were previously considered unimportant in the dynamics of primary production, may in fact play a significant role through complex interactions between nitrate and ammonium availability, phytoplankton N physiology, and potentially, phytoplankton community structure. Additionally, work using carbon tracers, indicates that while light limitation is still critical to estuarine productivity, photosynthetic efficiency may have declined since the 1980's resulting in lower primary production. The synergistic effects of these disruptions on the primary production cycle are likely linked to downward trends observed for higher trophic levels within the SFE ecosystem.

**27 Contaminants in San Francisco Bay: Current Status and Advances in Science and Management Over the Past 15 Years,** JAY A. DAVIS<sup>1</sup>, LESTER J. MCKEE<sup>1</sup>, MARGARET D. SED-LAK<sup>1</sup>, SAM N. LUOMA<sup>2</sup>, A. RUSSEL FLEGAL<sup>3</sup>, CYNTHIA L. BROWN<sup>4</sup>, THOMAS MUMLEY<sup>5</sup>, KAREN TABERSKI<sup>5</sup> and INGE WERNER<sup>6</sup> (<sup>1</sup>San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621; <sup>2</sup>John Muir Institute of the Environment, University of California Davis, Davis, CA 95616; <sup>3</sup>University of California Santa Cruz, Santa Cruz, CA 95064; <sup>4</sup>US Geological Survey, 345 Middlefield Rd, Menlo Park, CA 94025; <sup>5</sup>San Francisco Bay Regional Water Quality Control Board, 1515 Clay St, Suite 1400, Oakland, CA 94612; <sup>6</sup>University of California Davis, Davis, CA; jay@sfei.org).

San Francisco Bay has gone from being among the last of the world's great estuarine systems to be critically studied (Hedgpeth 1979), to being perhaps the most thoroughly studied with regard to water quality.

Scientific understanding of contaminants in the Bay has advanced considerably in the past 15 years, in large part due to the Regional Monitoring Program for Water Quality in the San Francisco Estuary (RMP), which began in 1993, and more recent monitoring efforts by the Interagency Ecological Program in the North Bay.

Management approaches and priorities have changed substantially over this period, in step with the growing body of information. Methylmercury, PCBs, dioxins, and exotic species are the currently regulated contaminants that pose the most severe problems in the Bay. Recovery in a 20-year timeframe is possible for methylmercury (though further deterioration is also possible), slight recovery is anticipated for PCBs, and recovery for dioxins and exotic species is not expected in this timeframe. Significant concerns also exist for selenium, PAHs, and legacy and current-use pesticides, though the degree of present impairment is unclear. Nickel, copper, and nutrients are below thresholds, but merit continued tracking. Emerging concerns that are currently not regulated but appear to pose significant risks include PBDEs, pyrethroids, and sediment toxicity. The combined effect of contaminant mixtures is a continuing concern. Urban runoff is an important pathway for many of the contaminants of concern and is a focus of cleanup strategies. River inflow, remobilization from sediment, and wastewater discharges are also important for multiple contaminants. The Lower South Bay is particularly impacted by many contaminants. Important information gaps include sources of methylmercury, selenium fate and transport, effects of pesticides, the role of contaminants in fish population declines, and sources of sediment toxicity.

**28 Temporal and Spatial Distributions of Benthic and Pelagic Grazers: How Do They Affect Phytoplankton Dynamics in San Francisco Bay? JAN THOMPSON<sup>1</sup>, LISA LUCAS<sup>1</sup> and WIM KIMMERER<sup>2</sup>** (<sup>1</sup>United States Geological Survey, 345 Middlefield Rd., MS 496 Menlo Park, CA; <sup>2</sup>Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon, CA 94920; jthompson@usgs.gov).

Seasonal light availability, vertical and horizontal transport, and pelagic and benthic grazing combine to limit phytoplankton blooms to distinct seasons in most of San Francisco Bay. While it has been shown that bivalve filter feeding is an important control on phytoplankton biomass in the shallow reaches of San Francisco Bay we know considerably less about the effect of zooplankton grazing on phytoplankton dynamics. Because the zooplankton may have a different seasonal pattern, feed in the water column rather than the bottom, and may themselves be consumed by bivalves, it is important to consider these grazers together. Annual minimum biomass in bivalves and zooplankton in the freshest bay (Suisun Bay) coincides with freshwater flow maximums in winter. Thus the timing of the short, small magnitude phytoplankton bloom in this system can be related to the interannual variability in freshwater flow. In contrast, the seasonally predictable minimum in shallow water bivalve biomass in the two meso/polyhaline bays (San Pablo and South Bays) appears to be due to predation by migratory birds and fish. Phytoplankton blooms in these systems are larger in magnitude and duration than those in the northern bay and coincide with the periods when the bivalves are absent. The limited zooplankton data available for these systems shows that zooplankton and bivalve grazing patterns may be seasonally similar. Interannual variability in filter-feeding bivalve biomass, likely related to increases in demersal fish and invertebrate predators, underscores our need for a more thorough understanding of zooplankton dynamics in all systems.

**29 Climate Shift, Crabs, Shrimp, Fish and Phytoplankton in San Francisco Bay, JAMES CLOERN** (USGS, Menlo Park, CA; jcloern@usgs.gov).

The California Department of Fish and Game Bay Studies Program documented record high abundances of demersal marine species (e.g. juvenile English sole, speckled sandab, Dungeness crab) and shrimp beginning in 1999 and continuing through 2005. The timing and persistence of this biological shift inside San Francisco Bay coincided with a climate-driven regime shift that occurred in 1999 when the North Pacific Gyre Oscillation (NPGO) flipped from its negative to positive phase, signaling a strengthening of the California Current and intensification of coastal upwelling. Concurrent sampling by the U.S. Geological Survey documented a trend of increasing phytoplankton biomass in San Francisco Bay that also began in 1999 and persisted during the positive phase of the NPGO. Strong coherence of these shifts suggests that multi-decadal oscillations of atmospheric forcing across ocean basins can generate large changes in biological communities of estuaries, but the mechanisms of this linkage are not yet understood. Sustained observations are required to capture processes that fluctuate over periods longer than a decade. Our discovery of synchronous physical-biological changes after 1998 motivates a new research agenda to understand the processes through which atmosphere-ocean regime shifts propagate into San Francisco Bay to modify its biological communities.

**30 Restoration of Eelgrass (*Zostera marina*) Habitats in San Francisco Bay: A Rapidly Evolving Understanding of Limitations and Opportunities, KATHARYN E. BOYER<sup>1</sup>, SANDY WYLLIE-ECHEVERRIA<sup>2</sup>, SARAH COHEN<sup>1</sup>, KEITH MERKEL<sup>3</sup>, NATALIE COSENTINO-MANNING<sup>4</sup>, and MARK FONSECA<sup>5</sup>** ('Romberg Tiburon Center, San Francisco State University, 3152 Paradise Drive, Tiburon, CA 94920; <sup>2</sup>Friday Harbor Laboratories, University of Washington, 620 University Road, Friday Harbor, WA 98250; <sup>3</sup>Merkel and Associates, 5434 Ruffin Road, San Diego, CA 92123; <sup>4</sup>NOAA Fisheries Restoration Center, 777 Sonoma Avenue, Santa Rosa, CA 95404; <sup>5</sup>National Ocean Service/NOAA, 101 Pivers Island Road, Beaufort, NC 28516; katboyer@sfsu.edu).

Losses of seagrasses worldwide have resulted in intensive efforts to protect and restore these plants and the important habitat and water quality functions they provide. Following a long history of very limited study of eelgrass (*Zostera marina*) habitats in San Francisco Bay, a flurry of recent work has led to advances in our understanding of eelgrass restoration potential and constraints. A convergence of several factors has contributed to these advances: 1) incentive—the need to mitigate damages resulting from the Oakland-San Francisco Bay Bridge earthquake retrofit; 2) leadership—the foresight of key resource agency staff to recognize the need for better understanding of eelgrass resources before launching wholesale into restoration; and 3) collaborations in science—mapping and modeling of extant eelgrass distribution, a series of field and mesocosm experiments to inform restoration site selection, donor choice, and restorative techniques, and early and continued inclusion of genetic measures to inform restoration choices. We detail results of these recent studies and discuss how they are influencing plans for scaling up eelgrass restoration in San Francisco Bay. Results of these studies continue to promote collaboration among scientists and resource managers tasked with setting goals for restoration and conservation of subtidal habitats in the San Francisco Bay. In view of altered conditions predicted by regional climate change models, it is expected that this collaboration will contribute to ongoing public policy discussions related to sea level rise and watershed management.

**31 New Perspectives on the Wetlands of San Francisco Bay: Their Past, Present, and Future Relationships to the Bay and Its Watersheds, JOSH N. COLLINS<sup>1</sup>, LETITIA GRENIER<sup>1</sup>, ROBIN M. GROSSINGER<sup>1</sup>, LESTER J. MCKEE<sup>1</sup>, JOHN CALLAWAY<sup>2</sup>, FRANCES MALAMUD-ROAM<sup>3</sup>, and ELIZABETH B. WATSON<sup>4</sup>** ('San Francisco Estuary Institute, 7770 Pardee Lane, Oakland, CA 94621; <sup>2</sup>University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117; <sup>3</sup>California Department of Transportation, 111 Grand Ave P.O. Box 23660, Oakland, CA 94623-0660; <sup>4</sup>El Centro de Investigación Científica y de Educación Superior, Km. 107 Carretera Tijuana-Ensenada Código Postal 22860 Apdo. Postal 2732 Ensenada, B.C. México; josh@sfei.org).

Landmark studies of Bay wetlands published decades ago gave rise to multiple lines of research that have substantially increased understanding of tidal wetland evolution, form, and function. Wetlands have been revealed as manifestations of dynamic equilibria between sedimentation and erosion that vary with sediment supply and tidal prism, as controlled by land use and climate. The importance of allochthonous inorganic sediment decreases and that of autochthonous organic sediment increases as wetlands mature. Inorganic sediments were mostly confined to tidal channels and levees in ancient marshes. Increased watershed erosion due to

modern land use is evident as increased inorganic sedimentation on marsh plains. Equilibrium channel form is correlated to aqueous salinity regime. Studies of wetland restoration indicate that land use history and initial site conditions affect long-term project performance. Initial elevation and substrate quality affect channel development and plant community structure. Regional surveys indicate that most projects do not compare well to ambient conditions, even after years of wetland evolution. New understanding about wetland developmental processes is influencing project design. Bay wetlands are increasingly regarded as extensions of local watersheds. Their development and bio-diversity depend on local supplies of sediment and freshwater. As sea level rises, wetlands will continue to move into local watersheds. From the wetland perspective, the Bay is a complex arrangement of many subordinate estuaries, one per local watershed, each with a particular ecology related to estuarine gradients that vary in length and steepness depending on watershed physiography, land use, and position around the Bay.

**32 Trends of Waterbird Populations in San Francisco Bay: Top-Down Assessment of Ecosystem Health, JOHN Y. TAKEKAWA<sup>1</sup>, SUSAN DE LA CRUZ<sup>1</sup>, NICOLE ATHEARN<sup>1</sup>, MICHAEL CASAZZA<sup>1</sup>, JOSH ACKERMAN<sup>1</sup>, JILL DEMERS<sup>2</sup>, JOHN KELLY<sup>3</sup>, NADAV NUR<sup>4</sup>, NILS WARNOCK<sup>5</sup>, MICHAEL PERLMUTTER<sup>6</sup>, and ROBIN GROSSINGER<sup>7</sup>** ('USGS Western Ecological Research Center, Sacramento, CA 95819; <sup>2</sup>San Francisco Bay Bird Observatory, 524 Valley Way, Milpitas, CA 95035; <sup>3</sup>Audubon Canyon Ranch, Box 808, Marshall, CA 94940; <sup>4</sup>PRBO Conservation Science, 3820 Cypress Drive #11, Petaluma, CA 94954; <sup>5</sup>Univ. Calif. Wildlife Health Center, Davis, CA 95616; <sup>6</sup>Audubon Society; <sup>7</sup>San Francisco Estuary Institute; john\_takekawa@usgs.gov).

Aquatic bird populations are ubiquitous fauna of the open water and marsh habitats in the San Francisco Bay (SFB) estuary. By relating their abundance to the quantity and quality of resources in these habitats, changes in their populations may be used as indicators of ecosystem health. This top-down approach allows us to assess large-scale changes in the estuary through comprehensive periodic surveys of bird communities. In this review, we discuss the open water and marsh species for which we have this type of ambient data in the SFB estuary, and we discuss the limitations of these datasets for analyzing trends including their spatial extent, continuity, and accuracy. Our analysis includes a summary of ecological characteristics of guilds that are related to their use of habitats such as preferred prey items in their diet, and we discuss the information needed to improve our understanding of these relationships. We present our findings in light of the threats to their habitats, especially invasive species and the effects of climate change, including predicted sea

**33 Cascading Threats, Constrained Management and the Future of Invasive Species in San Francisco Bay, EDWIN GROSHOLZ<sup>1</sup>, CHELA ZABIN<sup>1</sup>, ANDY CHANG<sup>1</sup>, BILL BENNETT<sup>2</sup> and BRENDAGREWELL<sup>3</sup>** ('Dept. of Environmental Science and Policy, University of California, Davis, CA 95616; <sup>2</sup>Center for Watershed Sciences, University of California, Davis, CA 95616; <sup>3</sup>USDA Agricultural Research Service, Davis, CA 95616; tedgrosholz@ucdavis.edu).

Invasive non-native species continue to pose a significant, ongoing threat to many aspects of the San Francisco Bay ecosystem including the maintenance ecosystem function, restoration of

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native species and habitats and the support of recreation and commerce. Predicted changes in climate, commerce and management suggest that the number of invasive species, their sources of origin and their points of entry as well as the scale of their impacts are likely to change in the future. Preventing the introduction of invasive species, quantifying their threats, and mitigating their impacts will also necessarily change with the physical alterations associated with climate change and the changing human landscape. Our results capture the most important future drivers that are expected to affect the occurrence and consequences of biological invasions in SF Bay. Among those considered are predicted changes in climate including increasing CO<sub>2</sub> in air and water, rising sea levels, higher temperatures, etc., changes in commerce including trade with live organisms, shipping, etc. and newer approaches to invasive species management.

**34 Screening of the 1974 PBS NOVA Film, "Inside the Golden Gate," with Introduction and Follow-up Discussion, FREDERIC H. NICHOLS** (U. S. Geological Survey, Menlo Park, CA, retired).

The 1974 PBS NOVA film, "Inside the Golden Gate", describes the challenges facing the San Francisco Estuary in the early 1970s with respect to such issues as the effects of river inflow and water pollution on the estuary's fish and wildlife resources. Emphasis in the film is on the role of scientists trying to understand the important processes relevant to the critical issues.

### Materials Science and Materials Science Education Monday, 8:55 a.m. in HENSILL HALL 439

**35 Nanomonitors: Electrical Immunoassays for Protein Biomarker Profiling, SHALINI PRASAD<sup>1,2</sup>, MANISH BOTHARA<sup>1</sup>, THOMAS BARRETT<sup>3</sup> and JOHN CARRUTHERS<sup>4</sup>** (<sup>1</sup>Department of Electrical and computer Engineering, Portland State University, Portland, OR 97201; <sup>2</sup> Department Electrical Engineering, Arizona State University, Tempe, AZ 85287; <sup>3</sup>Department of Medicine, Oregon Health Sciences University, Portland, OR; <sup>4</sup>Department of Physics, Portland State University, Portland, OR 97201; prasad@pdx.edu).

Robust diagnosis of a disease can be accomplished by reliable detection of multiple protein biomarkers. Traditional assay methods for protein detection such as enzyme-linked immunosorbent assay (ELISA) have several limitations. This presentation discusses the development of nanomonitors, which are electrical immunoassays for label-free, sensitive, fast, reliable and cost effective detection of multiple protein biomarkers.

The nanomonitors are platform-based devices comprising of base silicon substrate with metallic measurement sites overlayed with nanoporous alumina membranes. These nanoporous membranes confine proteins into narrow spaces on to the Si-based microdevice preventing the denaturing of proteins. This in-turn preserves their functionality and increases the sensitivity of the device. The effect of the size of nanopores on the electrical signal has been studied here by investigating two pore sizes, 200 nm and 20 nm. It was observed that the 20 nm pores show improved signal strength due to a higher confinement of the proteins.

The device performance has been demonstrated for two inflammatory markers - C-reactive protein (CRP) and Myeloperoxidase (MPO) from complex fluids samples/ human serum. The

performance parameters of nanomonitors are compared with traditional assay methods. Apart from being a label-free technique, the nanomonitors can provide several improvements like increased speed of detection on the order of minutes as compared to hours for ELISA, significant reduction in volume of reagents to a few µl, large reduction in cost per assay and the reduction in the size of assay thus making it a candidate for a clinical diagnostic "lab-on-a-chip" device.

**36 Nanomonitor Technology for Glycosylation Analysis, GAURAV CHATTERJEE<sup>1</sup>, VINAY J. NAGRAJ<sup>2</sup>, PETER WIKTOR<sup>2</sup>, SERON EATON<sup>2</sup> and SHALINI PRASAD<sup>1</sup>** (<sup>1</sup>Department of Electrical Engineering, Arizona State University, P.O. Box 875706, Tempe, AZ 85287-5706; <sup>2</sup>Center for Bioelectronics and Biosensors, The Biodesign Institute at Arizona State University, Tempe, AZ 85287-5706; Gaurav.Chatterjee@asu.edu).

Changes in protein glycosylation have great potential as markers for the early diagnosis of cancer and other diseases. The current analytical tools for the analysis of glycan structures need expensive instrumentation, advanced expertise, is time consuming and therefore not practical for routine screening of glycan biomarkers from human samples in a clinical setting.

We are developing a novel ultrasensitive diagnostic platform called 'NanoMonitor' to enable rapid label-free glycosylation analysis. The technology is based on electrochemical impedance spectroscopy where capacitance changes are measured at the electrical double layer interface as a result of interaction of two molecules.

The NanoMonitor platform consists of a printed circuit board with array of electrodes forming multiple sensor spots. Each sensor spot is overlaid with a nanoporous alumina membrane that forms a high density of nanowell. Lectins, proteins that bind to and recognize specific glycan structures, are conjugated to the surface of nanowell. When specific glycoproteins from a test sample bind to lectins in the nanowell, it produces a perturbation to the electrical double layer at the solid/liquid interface at the base of each nanowell. This perturbation results in a change in the impedance of the double layer which is dominated by the capacitance changes within the electrical double layer.

Using a panel of lectins, we were able to detect subtle changes in the glycosylation of fetuin protein as well as differentiate glycoproteins from normal versus cancerous cells. Our results indicate that NanoMonitor can be used as a cost-effective miniature electronic biosensor for the detection of glycan biomarkers.

**37 Low Dimensional Boundary States, JEREMY S. QUALLS and BRAD YEARWOOD** (Department of Physics and Astronomy, Sonoma State University, 1801 East Cotati Avenue, Rohnert Park, CA 94928-3609; jeremy.qualls@sonoma.edu).

For many years researchers have tried to understand and control the electrical capabilities of organic conductors. Although great advances have been made the materials remain very esoteric. In the seventies and eighties a great deal of effort went into trying to synthesize organic superconductors. Today organic conductors are heavily studied for their novel ground states as well as their potential for device fabrication. In this talk I will address the highly conductive layer that forms at the interface between two different insulating organic conductors. This work started as a capstone project for SSU student Brad Yearwood. It has developed into an in depth investigating probing the nature of this state including the dependence of this state on temperature, magnetic field, and field orientation.

**38 Thickness Dependence of Thin Film Samaria Doped Ceria Oxygen Sensor**, RAHUL SANGHAVI<sup>1</sup>, M. NANDASIRI<sup>2,3</sup>, S. KUCHIBHATLA<sup>2</sup>, P. NACHIMUTHU<sup>2</sup>, M.H. ENGELHARD<sup>2</sup>, V. SHUTTHANANDAN<sup>2</sup>, W. JIANG<sup>2</sup>, S. THEVUTHASAN<sup>2</sup>, ASGHAR KAYANI<sup>3</sup>, and S. PRASAD<sup>1</sup> (<sup>1</sup>Department of Electrical Engineering, P.O. Box 875706, Arizona State University, Tempe, AZ 85287-5706; <sup>2</sup>EMSL, Pacific Northwest National Laboratory, Richland, WA 99354, USA; <sup>3</sup>Physics Department, Western Michigan University, Kalamazoo, MI 49008, USA; Rahul.Sanghavi@asu.edu).

There is an ongoing need to design and develop ultrasensitive oxygen sensors that can operate under high temperatures to quantify the concentration of oxygen with the ability to respond rapidly to the changes in oxygen content. Our goal is to identify and optimize the material system that would potentially function as the active sensing material for such an oxygen sensor.

We have used thin film samaria doped ceria as the sensing material for the sensor operation, exploiting the fact that at high temperatures, oxygen vacancies act as conducting medium, in which due to electroadsorptive effect, oxygen ions hop causing conduction and corresponding electrical signal is generated. The principle of operation is based on the change in the chemi-impedance of the sensor, defined by a relationship between the oxygen exposure to the active sensing material and the overall conductivity of the sensor at high temperatures.

We have recently established that 6 atom % Sm doping in ceria films has optimum conductivity. Based on this observation, we have studied the variation in the overall conductivity of the thin films as a function of thickness in the range of 50 nm to 300 nm at a fixed bias voltage of 2 volts. We observed saturation in the conductivity above 200 nm up to 300 nm film thickness. We also examined the dynamic response of the sensor with the variation in oxygen pressure for reckoning the sensor's hysteresis performance at different film thicknesses.

**39 Phase Transitions and Ferroelectricity in  $\text{NaSb}_3\text{F}_{10}$** , R. J. CHRISTIE, P. WU, P. PHOTINOS and S. C. ABRAHAMS (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR 97520; Photinos@sou.edu).

Atomic coordinate analysis allows materials with appropriate but previously unrecognized dielectric properties to be predicted as new ferroelectrics if their crystal structure is known. An earlier such prediction that  $\text{NaSb}_3\text{F}_{10}$  is ferroelectric is confirmed herein without ambiguity. Its spontaneous polarization  $P_s$  is found to exhibit reproducible dielectric hysteresis at room temperature, with  $P_s \approx 60 \text{ mC m}^{-2}$  under the application of a field of  $0.3 \text{ MV m}^{-1}$  or greater.

The pyroelectric coefficient of  $\text{NaSb}_3\text{F}_{10}$  is  $\langle p \rangle = 17(5) \text{ mC m}^{-2} \text{ K}^{-1}$  at 298 K.

$\text{NaSb}_3\text{F}_{10}$  undergoes a phase transition at  $T_c \approx 461 \text{ K}$ , on correction for thermal hysteresis, with entropy change  $\Delta S = 5.7(3) \text{ J mol}^{-1} \text{ K}^{-1}$ . The colorless crystals melt at  $T_m \approx 515 \text{ K}$  and decompose above  $\sim 600 \text{ K}$ . The thermal hysteresis of  $\sim 35 \text{ K}$  in  $T_c$ , on heating and cooling at  $5\text{--}25 \text{ K min}^{-1}$ , is typical of first-order phase transitions.

The dielectric permittivity  $\epsilon'$  at 1 kHz increases over an order of magnitude between 300 K and a major inflection at  $T_c$ , continuing to increase steadily thereafter to  $T_m$ .

**40 Introducing Nanophysics and Nanotechnology at the Undergraduate Level: Physics Majors and Non-Science Majors**, ELLEN SIEM (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR 97520; Sieme@sou.edu).

There is a current need and push by both the government and industry to develop tools for teaching nanotechnology to K-16 students. Nanoscale science and technology is an area with rapidly growing opportunities for new research and development. The National Science Foundation (NSF) has estimated that by 2015 nanotechnology-based products will contribute \$1 trillion to the world economy.

This presentation will focus on courses developed to encourage physics majors to apply concepts in advanced physics and a basic understanding of interesting nanoscale behaviors to explore unique properties of nanoscale structures and to introduce concepts and the current and potential applications of nanophysics and nanotechnology to a broad (non-science) audience. Examples of student work and student assessment will be presented.

**41 Conceptual Approach to Teaching Nanoscience to Undergraduates**, PRASHANT SHARMA (Department of Physics, Suffolk University, 41 Temple Street, Boston, MA 02114; psharma@suf-folk.edu).

Teaching Nanoscience and Nanotechnology poses a variety of challenges arising mainly from the interdisciplinary nature of the subject. The nano-regime presents us with a bewildering array of phenomenology that requires a multi-disciplinary approach to develop conceptual, or phenomenological, understanding. At the same time, however, nanoscience education presents a unique opportunity to convey to students the limitations in our current understanding of materials science. I will talk about an approach that I have adopted in teaching an introductory course in nanoscience that emphasizes our conceptual understanding of the physics of materials at the macroscopic scale, as well as physics at the atomic and molecular scale. This approach allows the instructor to introduce students to the difficulties encountered in extrapolating these concepts to the nanoscale. It creates a natural issues based setting for topics in nanoscience and creates a “need to know” situation for teaching that topic. It also encourages students to get involved in nanoscience research as part of their undergraduate education.

**42 The First Undergraduate Materials Science Degree in Oregon**, GEORGE QUAINOO and ELLEN SIEM (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR 97520; QuainooG@sou.edu).

Materials science focuses on the physics, chemistry, and engineering of condensed matter and has extensive applications in research and industry. Southern Oregon University is the first educational institution in Oregon to offer an undergraduate degree in materials science. It is offered in conjunction with the Materials Science Institute at the University of Oregon.

The curriculum emphasizes the materials aspects of physical science by exploring the structure-property relationships for materials. Students are exposed to core classes in introductory materials science, thermodynamics, kinetics, materials processing, and nanotechnology. In addition, students apply theory through experimentation in the new Materials Science Laboratory.

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### Conservation in an Urban National Park

Monday, 9:00 a.m. in HENSILL HALL 543

**43 The Evolving People and Landscapes of the West, EMILYN SHEFFIELD** (Department of Recreation and Parks Management, California State University, Chico, DRPM 560, Chico, CA 95929-0560; esheffield@csuchico.edu).

From local parks to national icons our rich public land heritage forms the backdrop for thriving communities and future prosperity throughout the western United States. How will the western United States change during the next ten years? By mid-century? How can natural resource professionals and their partners connect with a larger, older, increasingly diverse, and urban nation?

This portion of the symposium describes three demographic drivers that are changing the face of the west and three lifestyle trends that are transforming the timeless relationship between people and nature. Field-tested strategies to connect with diverse and urban residents will enable participants to start planning for tomorrow today. Working together we can embrace the immense opportunity to use our unique professional strengths to connect people to nature and to enrich, engage, and inspire Americans to protect and preserve natural resources now and into the future.

**44 Ecological Restoration in National Parks: Case Examples from Golden Gate National Recreation Area, SUSAN L. FRITZKE** (National Park Service, Golden Gate National Recreation Area, Natural Resources and Science, Fort Mason, Building 201, San Francisco, CA 94123; Sue\_Fritzke@nps.gov).

Ecological Restoration in the National Park Service has evolved from simply removing invasive plants and filling ditches to full-scale restoration of hydrology, soils, topography, vegetation, wildlife, and endangered species. These efforts have been ongoing at Golden Gate National Recreation Area, where a consistent approach to ecological integrity in the face of immense pressures from invasive species, past and current land uses and patterns, and future changes with climate change are all apparent. I will present a number of examples from Golden Gate National Recreation Area to illustrate the issues natural resource managers face, how we resolve and improve project outcomes through integration of all resources, and the results of some of those restoration projects in terms of ecosystem function and value.

**45 Restoration of Remediation Sites, MARK FREY<sup>1</sup> and LEWIS STRINGER<sup>2</sup>** (<sup>1</sup>Presidio Trust, 34 Graham St., San Francisco, CA 94129; mfrey@presidiotrust.gov; <sup>2</sup>National Park Service, Fort Mason, Building 20, San Francisco, CA 94123; Lewis\_Stringer@nps.gov).

When the Presidio was a military post, the Army disposed of waste at several landfill sites that range in size from one to five acres. These landfills contain building debris, fill soils, and contaminants of concern. Through a unique agreement, funding was allocated by the US Army for cleaning up the sites. A multi-agency partnership has been forged between the Presidio Trust, the National Park Service, and the Golden Gate National Parks Conservancy. As sites are remediated, the partners are restoring them as natural areas, forest groves, and recreation sites. Already a complex process, restoration planning is further complicated by fluctuating remediation schedules, unexpected contamination, and unknown native site conditions once the sites are excavated. Only after excavation can uncertainties about soil type, hydrologic conditions, and topography be

resolved. During the excavation, the restoration team works closely with the remediation team and its contractors to ensure the conditions necessary for restoration. Grading plans, soils and hydrologic testing plans, and Vegetation Restoration Action Plans are some of the process's guiding documents. The restoration sites include wetlands, endangered species, and many plant communities. A handful of sites have been implemented and are now undergoing intensive stewardship and a few sites are planned for implementation to begin in the coming year. The Presidio's extensive volunteer program makes planting and maintaining these sites possible.

**46 Rare Plants and Citizen Science in the GGNRA, MICHAEL CHASSÉ** (National Park Service, Golden Gate National Recreation Area, Natural Resources and Science, Fort Mason Building 201, San Francisco, CA 94123; michael\_chasse@nps.gov).

The Golden Gate National Recreation Area (GGNRA) contains over 40 species of rare plants. The monitoring and management of such a high number of rare species in close proximity to dense urban areas creates both challenges and opportunities. Rare plants are often vital indicators of ecosystem health and can be threatened by urban park uses and invasive species. Recognizing this, GGNRA staff have invited the public to participate in rare plant monitoring and management efforts. In addition to building a community of dedicated park stewards, „citizen science“ in rare plant monitoring has provided a stronger feedback loop in the adaptive management of sensitive park habitat.

**47 Conserving and Managing Extremely Rare Species: The Presidio Manzanita (*Arctostaphylos montana* subsp. *ravenii*), V. THOMAS PARKER** (Department of Biology, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132, USA; parker@sfsu.edu).

The Presidio Manzanita (*Arctostaphylos montana* subsp. *ravenii*) is a serpentine endemic chaparral species now restricted to coastal exposures in the Presidio. This is an extremely rare species, whose population is now represented by a single individual. Given that these plants are principally out-crossing in their breeding system, this suggests a grim future. Fruit, however, have appeared on isolated cloned individuals. I present evidence that most of the seedlings raised successfully from the fruit are the result of selfing. Re-establishing functional reproducing populations is now possible. Strategies for conserving and managing this species are illustrated. The recommendations are complex, and involve additional manzanita species, mycorrhizae and prescribed burning as a method of establishing long-term system dynamics.

**48 Species Invasion in California Ecosystems: Linking Changes in Plant Composition to Changes in Local and Global Climate, LAURIE KOTEEN<sup>1</sup>, JOHN HARTE<sup>1,2</sup> and DENNIS BALDOCCHI<sup>2</sup>** (<sup>1</sup>Energy and Resources Group, 310 Barrows Hall, University of California, Berkeley, CA 94720-3050; <sup>2</sup>Department of Environmental Science, Policy and Management, 137 Mulford Hall, University of California, Berkeley, CA 94720-3114; lkoteen@berkeley.edu).

Grassland ecosystems of California have undergone dramatic changes, resulting in the almost complete replacement of native perennial grasses by non-native annuals across millions of hectares of grassland habitat. Our research investigates the effects of this community shift on carbon, water and energy cycles at two sites in northern coastal California. The broader goal is to understand

how species invasion in California's grasslands has affected local and global climate through 1. shifting the balance of carbon storage between terrestrial stocks and the atmosphere, and 2. altering the water and energy regimes that heat or cool the earth's surface. Across both study sites, we found that non-native grass invasion has resulted in the transfer of from 3 to 6 tons of carbon per hectare from the soil to the atmosphere. Over the years 2004–2006, we found energy partitioning into latent and sensible heat flux to be similar among annual and perennial grass communities during intervals of sufficient soil moisture availability. During seasonal periods of low soil moisture, however, the ratio of latent to sensible heat loss is reduced in annual grass communities relative to perennials. Albedo between the two grass types differs year-round, but is generally higher in native grass communities. During the summer and autumn, differences in albedo can result in temperatures that are up to 6°C higher midday in non-native annual communities relative to native perennials. In sum, this study reveals that the grassland invasion by non-native annuals has contributed to both global and local warming in California.

**49 Bees, Beetles, and Spiders: Species Assemblage Patterns Within the San Francisco Presidio, MISHA T. LEONG<sup>1</sup> and JOHN HAFERNIK<sup>2</sup>** (<sup>1</sup>Department of Environmental Science, Policy and Management, University of California, Berkeley, CA 95720; <sup>2</sup>Department of Biology, San Francisco State University, San Francisco, CA 94132; mishaleong@berkeley.edu).

Bioindicators are selected based on how well they represent biological processes at a particular site. Often they have been used in aquatic systems to detect habitat quality, but they may also be used as a measurement of general species richness. Arthropod assemblages have proven to be notoriously difficult to predict despite the usage of a wide range of metrics including plant species composition, vegetation structure, environmental conditions, floral diversity, and landscape usage. Part of the problem may be due to the different requirements of arthropod groups.

Bees, beetles, and spiders have been surveyed within the San Francisco Presidio through a cooperative agreement between San Francisco State University and the Presidio Trust. Because site consistency was maintained between surveys, species assemblages at sites can be generally compared amongst taxa. Bees and spiders fluctuated the same way in species richness and abundances at sites. Because bees and spiders are in different functional groups, it is possible that other species follow similar patterns of assemblages. On the other hand, spiders and carabid beetles, which are both generalist predators, displayed little similarity. This finding is consistent with other research between spiders and carabid beetles, where competitive exclusion may be occurring. Although multiple groups need to be sampled, arthropod bioindicators may be the best way of predicting arthropod assemblages. Future research could develop which are the easiest and most consistent groups to use.

**50 Assessment of a Stream Restoration Project Using Benthic Macroinvertebrates in an Urban Park, THERESA L. SHELTON and JOHN HAFERNIK** (Department of Biology, San Francisco State University, San Francisco, CA 94015; tshelton@smcmad.org).

Examining aquatic communities is a critical component of riparian habitat conservation and restoration. Benthic macroinvertebrate communities are useful indicators of the health of urban stream habitat. Invertebrate diversity, assemblage structure and tolerance metrics provide information regarding the health of stream

habitat. Through a comparison of streams within an urban park, we investigate changes in community composition over time and to determine whether macroinvertebrate richness is associated with plant communities and water quality. We focus our analysis on a restoration project to determine whether it has led to the establishment of a diverse macroinvertebrate community. We expected that stream sites that underwent restoration and rehabilitation would contain richer, more pollution-sensitive aquatic communities. Analysis of benthic samples found that overall aquatic diversity within the Presidio was low and comprised of species highly tolerant of pollutants, particularly at the restored reach and upstream within the same watershed. Upland plant species richness and the presence of native versus exotic vegetation had no effect on aquatic invertebrate richness. Dissolved oxygen was the only water quality measurement to positively influence invertebrate richness. The restored site was not providing habitats for diverse aquatic life, despite the efforts of the park service. It appears that further actions are required to restore an area impacted by urbanization.

**51 Sustainable Nursery Practices, MICHELE LASKOWSKI** (Golden Gate National Parks Conservancy, Presidio Restoration Nursery, Building 201, Fort Mason, San Francisco, CA 94123; mlaskowski@parksconservancy.org).

Located in the Golden Gate National Recreation Area, a network of five Restoration Nurseries play a crucial role in restoring and preserving the native ecology of this urban national park. The Nurseries supply up to 170,000 plants for environmental stewardship projects throughout the park on an annual basis. Using the latest protocols, including many developed and refined in-house, the nursery staff successfully propagates 411 of the 622 species native to the park.

Our Restoration Nurseries have become the leading edge and training ground for a movement towards sustainable nursery production with focus on ethical and efficient resource use. Deliberate steps are taken throughout the entire propagule collection and growing process to minimize the production "footprint" and to assure responsible use of the required natural resources and materials.

The Nursery's commitment to sustainable growing practices draws on several years of accumulated knowledge and scientific experimentation to inform specific methods and practices. More recently, research efforts have focused on several key areas: 1) improving germination rates of difficult to grow species through pre-germination treatment trials, 2) exploring the alternatives to peat moss based germination mixes, 3) assessing the performance of seven organic pelleted fertilizers, and 4) measuring the effects of bio-fungicide treatments on powdery mildew. There is more to learn about sustainable nursery practices, however, these research projects, and others, provide a model of advancement through informed decision making and putting new information into immediate practice on the ground.

**52 Sustainable Approaches to Park Management, AIMEE VINCENT** (Operations Department, Presidio Trust, PO Box 29052, San Francisco, CA 94129; avincent@presidiotrust.gov).

The Presidio Trust is responsible for managing and maintaining one of the country's most unique national parks. A former Army base, the Presidio is a National Historic Landmark as well as a home to a vibrant community of residents and workers who occupy former military buildings. It is the job of the Operations Department to upgrade and maintain the buildings, grounds and infrastructure

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of this 1400-acre site. Over the past 10-years the in-house crews have been employing sustainable practices while rehabilitating historic and non-historic buildings, improving landscapes, managing an aging forest and updating antiquated utilities.

A few of important sustainability programs include a closed-loop, on-site compost operation that transforms organic debris into valuable soil amendments for use in the park, a robust waste reduction program and a model integrated pest management (IPM) program. Workers in the building trades are trained in both historic preservation and green building practices. The Presidio Trust has been widely recognized for making significant strides to reduce waste, eliminate toxins, and offer transportation solutions. Many of our tenants and partners have implemented cutting edge green building projects setting an example for both new construction and rehabilitation. This talk will offer a quick behind-the-scenes glimpse at the Presidio.

### New Humanities and Science Convergences:

#### Darwin and Culture

Monday, 1:15 p.m. in HENSILL HALL 667

**53 Not Everything Is Darwin: Evolution and Archival Change Theory in Light of Field-Theoretic Thought,** **FRED MASSARIK** (University of California, Los Angeles, Anderson Graduate School of Management, D501b Cornell Hall, Los Angeles, CA 90095-1481; fred.massarik@anderson.ucla.edu).

In a year in which the contributions of Charles Darwin are focus, it is timely to consider the forces shaping this current attention. We propose that Kurt Lewin's field-theoretic viewpoint serves as a suitable conceptual framework. As a Darwin precursor, we cite Charles White's *An Account of the Regular Gradation in Man* (1793, 1799) regarding skull types and animal analogs. We suggest that "evolution" and "natural selection" emerge center stage from complex forces in science and society relating to figure (*prägnanz*) and ground (*hintergrund*), and to value orientations (*wertanschauung*). Also to be noted are assumptions about "acceptable" scientific method. With views on sociology of knowledge, including those of Karl Mannheim and others, and Marshall McLuhan's media psychology, we examine *The Descent of Man, and Selection in Relation to Sex* (2d ed) and briefly consider positioning in science and in popular thought of selected other Darwin publications, including *A Naturalist's Voyage Round the World*; *The Movements and Habits of Climbing Plants*; *On the Structure and Distribution of Coral Reefs*; and *Geological Observations on the Volcanic Islands*. Finally we pose the query: Who reads Darwin, and why?

**54 Darwin's Orchids: Cross-Pollination from Two or Three Perspectives,** **BARBARA YABLON MAIDA** (University of California, Los Angeles, Department of Geography, 1255 Bunche Hall, Los Angeles CA, 90095-1524; bymaida@ucla.edu).

At the time of publication for *On the Origin of Species*, critics, as well as Darwin himself, were frustrated by his lack of concrete examples of natural selection. His next book, *On the Various Contrivances by which British and Foreign Orchids are Fertilised by Insects* (1862), addressed these critics, providing details of pollination and diversity, and supporting the idea that complex reproduction methods were the best strategy for continued adaptation to environment. If there were gaps in the knowledge—what insect pollinated which orchid—his surmises were later bolstered by

the investigations of Alfred Wallace, working to support his own naturalist writing by specimen collection, sending these materials and information back to England. The hobby of orchid collection became, in Victorian times, "orchidelirium," though as with so many 19<sup>th</sup> century hobbies, orchids were the provinces of the wealthy. One hundred years later, orchids fired the imagination of John Laroche (he of *The Orchid Thief*), a self-taught plant specialist living in Florida; his collection methods resulted in arrest for trespass, and poaching endangered plants. Though apparently opportunist, Laroche's motivation—breeding rare orchids through cross-pollination, in order to make them affordable—is more complex, and corresponds to separate facets of both Darwin and Wallace. Looking at the backgrounds of these three men—Darwin educated and well to do, Wallace partly-educated and financially struggling, Laroche self-taught and financially struggling—one may construe that there are many paths to the obtainment of esoteric knowledge. In a sense, they were, as Darwin has elsewhere written, "twigs of a single branch."

**55 How the Mouth Evolved into an Organ of Love,** **GEORGE W. BERNARD** (Departments of Oral Biology, Medicine and Neurobiology, UCLA Schools of Dentistry and Medicine, 10833 Le Conte Ave, 73-090 CHS, Los Angeles, CA 90095; gbernard@dent.ucla.edu).

The beginning of the Cambrian "explosion" of animals heralded evolutionary changes after 10 million years of volcanos, ice, and storms, including: All animal body plans were developed with initiation of jaws. Jawless sponges produced collagen fibers, which bound tissues and plumped lips in evolving vertebrates. Flatworms added head muscles, nerves and gonads and lateral symmetry to anchor its mouth. Protochordates like Pikiia, hydra, mollusks, and starfish, without backbones, developed mouths, muscles, nerves, and symmetry, making them acceptable as vertebrate ancestors, while gastrulation produced ecto-, endo- and mesoderm, neurulation developed the nervous system, and neural crest cells migrated from the closing neural tube to initiate bone and cartilage. Structures of the vertebrate body plan, including a vertebral column of bone and nerves, head, feeling, mobility as jaws, tongue, and lips organized the mouth as an organ of love, beginning the era of macroscopic animals. Darwin knew that animals adapted to changing environments. Freud, like Darwin, postulated a developmental journey from infant animals to humans and from the human infant to the adult, grafting the instinctual to social behavior. This paradigm was amplified from observations of humans by psychiatrists, Bowlby, Mahler, Spitz, Joyce, Ackerman, and Freud who added kissing and primary lovemaking to the evolved sensual mouth. Sucking was necessary for the emergence of the sensual mouth that begins with the nursing baby seeking nutrition, and continues as the infant bonds with mother, developing a love relationship. This love extends to others and finally evolves from early mother/infant love into adult-type lovemaking.

**56 Community as Experience: Dewey, Darwin, and Aesthetic Ecology,** **CARL A. MAIDA** (University of California, 63-037 Center for the Health Sciences, Los Angeles, CA 90095; cmaida@ucla.edu).

The Progressive Era's intellectuals upheld a Darwinian belief in the manipulation of the environment and of behavior to bring about social improvement. Progressive philosopher John Dewey viewed social institutions as primary instruments of reform,

providing individuals with the tools for “effective self-direction.” For Dewey, social reconstruction could only take place after individuals used scientific inquiry to reflect upon their experience and to understand the social consequences of their behavior. It is only in and through a “community of inquirers” that cognitive processes for regulating human behavior could be developed and tested. Dewey’s progressive school and other reconstructed institutions were the places where rules, based on such experientially derived knowledge, were socialized and used to guide further inquiry, presumably for community betterment. Instrumentalist modes of thought were highly valued by Progressives in their commitment to efficiency and scientific inquiry, but also to self-determination and freedom. Progressives attempted to manipulate the environment to bring about a “cumulative evolution,” in Darwinian terms, from individualistic to associational modes of behavior and of consciousness. Dewey set forth a principle of “creative transiency,” which points to life’s journey, rather than its destination, as the chief source of significance and personal meaning, and considered the aesthetic as elemental to all experience, believing that aesthetic experience must not be limited solely to judgments about artistic phenomena. Dewey held that aesthetic sensibility, rather than rational calculation, should guide our lives, and promoted an “aesthetic ecology,” based upon affective feelings and gestures, especially for rapidly transforming educational and political institutions.

**57 Victorian Poets Adapt to Darwin,** ROBERT LOUIS CHIANESE (California State University, Northridge, Department of English, Northridge CA, 91330; robert.chianese@csun.edu).

Major Victorian poets were public figures, obligated to grapple with issues of their day, including cosmology, biology, and anthropology. Darwin’s *On the Origins of Species* (1859) and *The Descent of Man, and Selection in Relation to Sex* (1871) rocked Victorian society’s assumptions about the destiny of the human soul, the place of human beings in the cosmos, the progress of human development in society, the nature of civilized versus “primitive” human beings, as well as the mechanisms of life itself and the operations of chance and determinism driving the whole system.

Four poets surveyed here struggle in published works to find ways to accommodate Darwinian ideas into their evolving intellectual assumptions; each in his own way “adapts” or adjusts or distorts a key Darwin concept rather than outright rejects it. Alfred Tennyson posits a mystical force of spiritual energy “evolving” the whole of biological and human nature toward perfection. Robert Browning sees “primitive,” pre-existing forms of human beings stuck in limited philosophical ruminations about the meaning of life and the relation of human beings to the cosmos. Matthew Arnold envisions a vast gulf between human beings in a Darwinian random universe that makes human relationships nearly impossible and argues against a science-based education for acquiring general knowledge. Finally Thomas Hardy depicts chance factors shaping conflicts between human beings and material nature as essentially malevolent. These responses by poets to Darwin shape continuing debates to this day.

**58 Darwin: C.P. Snow and Also Fundamentalism,** G. ARTHUR MIHRAM<sup>1</sup> and DANIELLE MIHRAM<sup>2</sup> (<sup>1</sup>Princeton, NJ 08542-1188; <sup>2</sup>University Libraries and Department of French and Italian, University of Southern California, 650 W. 35<sup>th</sup> Street #113, Los Angeles, California 90089-2571; dmihram@usc.edu).

We note both an ‘unsuspected attribute of Darwinism’ and the

resolution of the ‘debate’ between religious fundamentalists and Darwinian Evolution.

CP Snow’s “Two Cultures and the Scientific Revolution” (1959) helps conduct the celebration this year of Darwin’s birth (1809) and his *ORIGIN OF THE SPECIES* (1859) by means of the imminent publication this year of the appreciation of the quite biological foundation of the Scientific Method: the search for the very explanation for (i.e., for the truth about) any particular naturally occurring phenomenon.

Mankind constructs models for survival outside the (biological) genetic and neural systems; yet, the one-to-one correspondence between the six stages (and the three corrective feedback loops) of the Scientific Method mimics the same ‘stages’ (and loops!) by which (first, any plant or animal species; then, the neural systems of the ‘higher’ species of animals) ensure their respective species’ survival.

Mankind’s Scientific Method mimics also Humanists’ metaphorical process, together providing a heretofore unwitting mimicry of the (single!) biological model-building process which accounts for the survival of all Life on Earth to date.

Furthermore, note Anawati’s one-word descriptions [*Princeton Weekly Bulletin* 15.X.1986: p. 4] of Judaism, Christianity, and Islam: respectively, righteousness; love; peace, yet the consequent one-word description of justice becoming, respectively: vengeance; forgiveness (w/reconciliation); and mercy (situational).

If ‘peace’ be “domestic tranquility”, one must conclude that the chronological ‘evolution’ of religions, from (truly fundamentalist) Judaism, then Christianity, then Islam, fails to mimic Darwinian Evolution’s continually progressive character, wherein truth-seeking, the ultimate underlying guide, equals survival.

**59 Educating for the Future: The Need for an Evolutionary Process in Teaching and Learning,** SUSAN MASSARIK ASLAN (Los Angeles Unified School District P.O. Box 4, Somis, California 93066; Marsena27@aol.com).

Charles Darwin started a revolution in thought. The idea of species changing can be applied to subject areas from astronomy to education. The universe was once viewed as an unchanging entity, rather than a big bang to an ever-expanding phenomenon. And education used to mean just learning the basics: “reading, writing, and ‘rithmatic.” There is so much more to education in this ever-changing world. The world is not a stagnant place. People must have the ability to adapt and change to meet the varying conditions we are faced with. There is a great deal that we need to know. There are many things that the students of today will need to have knowledge of that we do not even know yet. Therefore, education needs to be an evolutionary process, or “edulution.” There are many pieces to the puzzle of evolution; many theories needed to come together to make sense of it all. So it goes for education as well. How do we deal with the mass amount of information in today and tomorrow’s civilization? The trick, I believe, is to stop being so focused on the information itself and more on how to think. How can we better teach students in order to process information and problem solve, regardless of the problem?

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### **Good Science is Only Part of the Job: Communicating Science to the Public**

Monday, 2:00 p.m. in HENSILL HALL 113

**60** *Interacting with Science Journalists*, GREG CRITSER (science and health book author, long time science and medical journalist, Pasadena, CA; critser@earthlink.net).

How to use journalistic methods to transform research into compelling media discourse--from newspapers and magazines to the Internet and the blogo-sphere. Modern readers confront a vast array of news about science, medicine, and public health, largely written by people who are not scientists or physicians. The results often infuriate -or at the very least puzzle - academics, but they often find themselves unable to respond meaningfully. They simply do not know the rules of the road when it comes to mainstream journalism-how it works and how they have to 'work' it.

**61** *Journals? We Don't Need No Stinkin Journals*, MICHAEL EISEN (Department of Molecular and Cell Biology, and Genomics Division of the Lawrence Berkeley National Lab, University of California, Berkeley, CA; mbeisen@lbl.gov).

Efforts to reinvent scientific communication are often met with a common refrain "But what will this do to journals?" as if the maintenance of the existing journal hierarchy must be an irreducible first principle of any publishing reform. But do we really need journals? What role do they really serve?

In my talk I will imagine a scientific community without journals, and will present some simple ideas about how we can do all the good things that journals now do far expensively and far more efficiently and effectively. My focus will be on peer review – and how a hybrid system of open individual and group ratings, comments and reviews will replace journal functions of protecting the integrity of the scientific literature, targeting papers to the right readers and measuring the impact of an individual's contribution to the field – while making the literature far more dynamic, interconnected and accessible.

**62** *Blazing Your Own Trail: Writing Directly to the Public*, MICHAEL WHITE (Department of Genetics and Center for Genome Sciences, Washington University School of Medicine, Washington University, St. Louis, MO; MWhite22@wustl.edu).

Scientist bloggers - they deflated the hype over the Ida fossil, they exposed a stealth creationist paper in a peer-reviewed journal, and they have relentlessly pummeled dubious claims about vaccines, stem cells, climate change, and personalized medicine. Science blogging has engaged a rapidly growing community of research scientists, but what does this community add to other mechanisms of science communication like science news, institutional press releases, popular books, and science television? Is science blogging destined to replace professional science journalism?

**63** *Constructive Debates When Science and Politics Mix*, EUGENIE SCOTT (National Center for Science Education, 420 40th Street Suite 2, Oakland, CA 94609-2509; scott@ncseweb.org).

Science is a product of human beings, which means it is affected by human institutions – including politics. The education system in the United States is highly politicized as a result of the nation's history, and because the teaching of evolution is socially (if not scientifically) controversial, politics enters into whether and how evolution will be taught. Scientists working to improve the

teaching of evolution need to keep in mind that science per se is necessary but not sufficient to succeed. One must also keep in mind the various stakeholders in the controversy, their needs and goals, and where compromise is and is not possible.

### **Sustainability as a Way of Life:**

#### **Learning, Practice and Experience**

Tuesday, 8:30 a.m. in the FORUM Theatre at the California Academy of Sciences

**64** *Sustainability: How the Idea Evolved and Where It Will Lead Us*, JURGEN SCHMANDT (Houston Advanced Research Center and University of Texas, Austin, TX 78712; jas@harc.edu).

In the 18<sup>th</sup> century sustainability was introduced as an economic concept in forest management: how could the land owner achieve a safe yield over time? The second stage came two hundred years later: how and why should we conserve natural resources? The final stage was reached in the aftermath of the *Limits to Growth* debate: how would the world organize to achieve balanced growth? Or: how do we combine economic and ecological goals?

Have we made progress? And what about the future? I will use the case of climate change to offer tentative answers to these questions. To conclude I will describe the work on sustainability on the part of a business leader—George P. Mitchell. I have worked with Mitchell for over twenty years. His example helps this presentation to conclude on a moderately optimistic note about progress made and progress to be made.

**65** *Mainstreaming Sustainability: The Opportunity Presented by Climate Change*, PAUL M.E. BUNJE (Institute of the Environment, University of California–Los Angeles, La Kretz Hall 300, Box 951496, Los Angeles, CA 90095; paulbunje@ucla.edu).

Sustainability requires a different set of methods for achieving implementation than traditional environmental issues, which can employ particular political tactics to obtain their goals. Because sustainability is based on the principle that society must adopt certain paradigms or modes of operation in perpetuity, it is essential that acceptance of sustainability as an ethic be adopted widely by both society's leaders and the public. Perhaps counter-intuitively, climate change provides arguably the best opportunity for mainstreaming the concept of sustainability and thus galvanizing widespread adoption of sustainable practices. As the intent of sustainability is to mitigate negative future consequences by encouraging strategies by which humans and natural systems can survive and adapt indefinitely, it is critical that an integrated approach be adopted.

Climate change has, arguably for the first time, demonstrated the inter-related nature of environmental and human systems to many more sectors of society in a salient manner. The causes and consequences of climate change include issues as diverse as food production, resource use, energy, national security, economic growth, trade, migration, and the natural environment. As a result, climate change provides a unique rubric for engaging diverse societal actors in identifying solutions. Importantly, most of the solutions to either excess greenhouse gas emissions or the impacts of global warming are also key components of sustainable communities. By engaging members of these communities in an unprecedented way, the issue of climate change provides an opportunity to mainstream the concept of sustainability and begin crafting more sustainable societies.

**66 Evaluating and Designing Urban Food Systems: The Role of Local Initiatives**, **ALISON M. MEADOW** (Department of Anthropology, University of Alaska Fairbanks, 310 Eielson Building PO Box 757720 Fairbanks AK 99775; ffamm1@uaf.edu).

In the search for solutions to environmental and human-health problems linked to the dominant global food system much attention has been given to the scale of food systems but little attention given to the specific practices and outcomes of various food system components and initiatives. Three studies of the current food system and local food initiatives in the community of Fairbanks, Alaska examine whether local food initiatives can improve an urban food system's social equity and environmental sustainability. The first study examines community-wide physical and economic access to fresh foods in general and locally grown foods in particular. The second study examines local food production at an individual scale at a community garden. A third, regionally scaled study, is the focus of this presentation. In it, I speculate about the region's ability to meet the community's food and nutritional needs using only local resources and develop a tool, the local food system footprint, to conduct such an assessment. The region could grow enough food to feed the current population, but the diet might be limited. The local food system footprint method could be a valuable tool to help communities identify needs, resources, and food-production priorities.

Vulnerabilities in the food systems of urban areas must be addressed to ensure long-term, positive environmental and human-health outcomes. If local food system initiatives are to be used in this capacity, more rigorous evaluation of local food system components and practices as well as tools and frameworks appropriate to the task are required.

**67 Coming to Terms with Northern Foods, Northern Futures**, **S. CRAIG GERLACH, LAWRENCE K. DUFFY and PHILLIP A LORING** (Department of Anthropology, 310 Eielson Building, PO Box 757720, University of Alaska, Fairbanks, AK 99775; ffscg@uaf.edu).

Rural and urban Alaskan communities are experiencing times of rapid (extreme events) and gradual change (cumulative). In combination with a statewide economic, cultural, and demographic restructuring, the rising cost of food and fuel is rendering all communities vulnerable, but also innovative with respect to the development of new approaches to local food production, conservation, and the use of alternative energy systems. In this paper we use the Alaska food system to discuss how social and ecological changes are shaping the way people in Alaska live, the way we eat, the way we cope with the present, and how we think about the future. Food choices are shaped by culture and availability, by ecological and institutional opportunities and constraints. Apart from emerging gardening and agricultural initiatives, it is social, political and economic choices made outside Alaska that most often determine the foods that appear on the shelves of commercial stores, and how much they cost. We discuss the harvest of traditional foods in rural Alaska, but expand beyond the narrow definition of subsistence to situate rural food systems in a context of the Alaska food system as a whole. Small and large-scale food production and agricultural systems are also challenged by limitations in infrastructure, climate, and economics. We close the presentation with an overview of some of the new Alaskan initiatives that are emerging to increase local food production, to decrease dependence on outside sources, and to increase individual and community health, along with the health of the ecosystem.

**68 Ecologies of Hope: Cross-Cultural Perspectives on Sustainability and Social Justice**, **KRISTA HARPER** (Department of Anthropology and the Center for Public Policy and Administration, University of Massachusetts, Machmer Hall 215, Amherst, MA 01003; kharper@anthro.umass.edu).

What does it mean when residents of the same town, citizens of the same country, live in quite different environmental conditions? The environmental justice frame challenges this form of inequality and the stereotype that low-income people and members of minority groups do not care about the environment. When some landscapes and social groups are perceived as "beyond the pale" of environmental regulation, public participation, and civil rights, it creates local sites for externalizing environmental harms. The presenter will share findings from a recent research collaboration with a grassroots Romani (Gypsy) community organization in northern Hungary that used the PhotoVoice methodology to generate knowledge and documentation related to environment, health, and the dynamics of social exclusion and environmental inequalities.

**69 Going Green in Cartoon Sitcoms**, **MARTY RAPP SAYLES** (Department of English, California State University Northridge, 18111 Nordhoff Street, Northridge, CA 91330-8248; marty.sayles@csun.edu).

All television programming that succeeds by being topical now features concepts of sustainability, and this includes popular cartoon sitcoms. *The Simpsons* lead the way with eco-friendly Lisa Simpson. Last season *King of the Hill* jumped on purchasing carbon offsets as a plot device. Certainly, Comedy Central's *South Park* – a show so topical that it aired an episode featuring President Obama the day after he was elected – is no exception. But how does the viewer react to serious concepts when reflected in a funhouse mirror?

Many a Hollywood agent has suggested that "There is no such thing as bad publicity." The fact that *South Park* is calling any attention at all to greenhouse gases, water conservation, and forest preservation can be considered a good thing, even if such concerns are ultimately made fun of. Satire in no way diminishes its target; on the contrary, it often emphasizes the subject's importance. But the manner in which "going green" is presented, and the scenarios that surround this message, can legitimately give *South Park* viewers pause.

This paper will examine two specific episodes of *South Park*, taking into consideration the use of hyper-irony, a postmodern comedic technique, and its affect on the message of sustainability. I will also examine issues of race, class, and sexuality to question their possible affects on pro-environmental issues. Ultimately, I wish to foster a discussion as to whether laughter leads the viewer to positive action or merely leaves one satisfied with happy awareness.

**70 Chiropractic for Sustainability – Aligning Ourselves, Our Business Systems, and Our Change Initiatives for Lasting and Intended Impacts**, **JONATHAN KEVLES** (Clean Energy Solutions Campaign, Sierra Club, 85 2<sup>nd</sup> Street, San Francisco, CA 94105; jonathan.kevles@sierraclub.org).

Buying a front-loading washer, a duplex printer for the office, or enacting a policy requiring new homes to be more energy efficient are important decisions in the path to sustainability. Yet if these decisions are not made in a larger framework leading to lasting sustainability, the goals that we as individuals, businesses, and

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society want to – indeed that we must – achieve will remain elusive. The process for decision-making must change.

The process must be – pick your favorite phrase – holistic, comprehensive, systems-based. First, develop consensus on the vision for sustainability and the values and principles that guide the decisions in striving for realization of the vision. Next, identify the system's components, such as behavioral tendencies, the rules that drive behavior, budgeting practices, and data management. Then identify where elements of each component are counter-productive to the vision or in conflict with the values and principles. The needed changes are the chiropractic therapy necessary to bring the system components into alignment with the intended goals of the system owners.

For example, individuals and businesses must replace up-front cost with lifecycle cost when making purchasing decisions, perhaps including in the analysis currently externalized costs, because one's values compel it. In change initiatives, recognize that policies spurring demand for increased investments in energy efficiency will not be sufficient to achieve that important goal; other pieces of the marketplace – trained workers, efficiency improvement businesses with sufficient technical training and working capital, and customer financing mechanisms – need tending to through coordinated public-private-non-profit partnerships.

**71 The San Diego Bay Study: Community-Based Conservation,**  
**JAY VAVRA** (High Tech High, 2861 Womble Rd., San Diego, CA, 92016; jvavra@hightechhigh.org).

Using San Diego Bay as an outdoor laboratory, students and teachers of High Tech High have published a series of books on the urban ecology of the region. The biological research involved has ranged from ecological surveys of species abundance and diversity, to DNA barcoding for identifying invasive species. Each publication has involved student researchers as practitioners of John Steinbeck's and Ed Ricketts' philosophy of environmental holism. The topics we have researched have required the ability to make fundamental connections, an awareness of complexity, and the necessary compassion to understand and care for the environment.

High Tech High's unique approach to education provides the support and freedom, which allows teachers and students the ability to design their own learning experiences. In the process of researching, photographing, graphing, interviewing, sketching, mapping, and writing about San Diego Bay student researchers have developed a greater awareness of themselves and their surroundings. With strong local partnerships, involving collaborators from industry and academia, the San Diego Bay Study has demonstrated what effective community-based conservation programs can achieve.

The naturalist writing of Steinbeck and biological anthropology of Jared Diamond have been at the core of the published series. This approach to scientific literacy has led to discovering the natural history of one's place, as well as the search for the innovative approaches to sustain life. Once established, such a program sustains itself through ongoing research, the discoveries students make, and the fresh and meaningful perspectives provided through our approach across disciplines in the curriculum.

**72 An Arctic Dimension of Sustainability: Resource Development, Legacies, and Education,** **LAWRENCE K. DUFFY** (University of Alaska Fairbanks, Department of Chemistry and Biochemistry, Fairbanks, AK 99775; fflkd@uaf.edu).

As extreme environments, the Arctic and sub-Arctic

ecosystems are particularly fragile and sensitive to disturbance. As cold-climate ecosystems, they are susceptible to global warming and accumulation of industrial contaminants. Sustainability of the region must be understood in terms of the interactions within vulnerable ecosystems with the goal of long-term stewardship for the land and its people. Analysis should accent changing relationships between diverse phenomena related to ecosystem services, including foodwebs, waste and toxin accumulation, and human health and justice issues. The complex system dynamics of northern ecosystems and global human activity impact the indigenous people and the cultures of the region. As global demand increases for the north's resources, mining and oil development will increase pressure on both the ecosystem and social system. Important scientific and policy issues in the Arctic must have widespread stakeholder input. Past legacies of development and activity such as mining and the Cold War use of Amchitka Island can be used as case studies on the complexity of system disturbance on people and their culture and how monitoring and stewardship plans can be developed. Lastly, a new education consortium, the UARCTIC, can be used as a vehicle for engaging the next generation of students in Arctic sustainability issues.

**73 Bootstrapping into Resilience: Science Education as/for Sustainability,** **WOLFF-MICHAEL ROTH** (University of Victoria, Victoria, BC, V8W 3N4; mroth@uvic.ca).

Resilience is the capacity of a social-ecological systems not only to change and adapt over time but also to protect itself against disturbances that would transform it into a radically different system (a catastrophe in catastrophe theory). Resilient systems increase their capacity for learning through increasing self-organization, which include, for example, grassroots environmental and stewardship movements. Because human beings are endowed with agency, the power to act and change their condition, social-ecological systems can manipulate their own reproduction, for example, through science education. What might science education look like that has the potential to bootstrap entire communities into resilience, that is, helping them to manage not only with respect to change generally, but with respect to disturbances that might flip a system into a less desirable state? I report from one attempt to work in and with a community to provide a context for learning where classes of 11-12-year-old students already participate in environmentalism. The aims of science education therefore include not only the training of students for sustainability as future goal but also implement sustainable practices right here, now, and today. Because in a number of recent theoretical frameworks participation *is* learning, such exemplary curricula are the beginnings of bootstrapping processes that make communities resilient. Science education thereby not only allows students to enact sustainability as it educates them *for* it.

**Recent Advances in Pharmacology and Toxicology**  
Tuesday, 8:40 a.m. in HENSILL HALL 113

**74 Biochemical Analysis of Parasitic Protozoan Methylthioadenosine Nucleosidases as a Target for Antibiotic Therapies,** **DANIEL QUAPP** and **KENNETH A. CORNELL** (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; danielquapp@u.boisestate.edu).

Development of new antiparasitic drugs poses a problem since the close homology between human and parasite metabolism causes many agents used to treat parasitic infections to be toxic to the patient as well. This requires scientists to scan human and parasite metabolic pathways to discover distinct key differences that can be targeted for drug development against the pathogen yet remain harmless to the patient. One such enzyme found in *Entamoeba histolytica* and *Giardia lamblia* is methylthioadenosine (MTA) nucleosidase (MTN), a protein required by the parasites to salvage adenine (for purines) and methylthioribose (for methionine). Because MTA is an inhibitor of polyamine synthases and various methylases, inhibiting the enzyme would work in a number of ways to block parasite proliferation. These include causing a “starvation” for essential biomolecules like spermidine and spermine polyamines, methionine, adenine, and biotin, among others. Humans use a different route to recycle MTA, thus drugs targeting the parasite enzyme should be specific. Crystallographic structures of human MTA phosphorylase and the modeled parasite MTNs suggest a number of drug modifications that could be used to design parasite-specific therapies. Using genetic homology between the parasite and bacterial MTNs, the genes for *E. histolytica* and *G. lamblia* MTNs were cloned, expressed and purified by affinity chromatography. Enzyme kinetics of the recombinant MTNs with MTA and a number of potential MTA analogs are now being performed to characterize these proteins as drug targets. Preliminary evidence indicates that several of the inhibitors work at low nanomolar to picomolar concentrations.

**75 Evaluation of MTA/SAH Nucleosidase Inhibitors as *B. burgdorferi* Antibiotics and Biofilm Suppressors, TONY MARTINEZ and KENNETH A. CORNELL** (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; tonymartinez@u.boisestate.edu).

Drug development against bacterial pathogens lags behind the emergence of antibiotic resistance, creating an urgent need for the identification of physiological and metabolic targets unique to pathogens. One such class of molecules is the MTA/SAH nucleosidases involved in purine and methionine salvage, polyamine synthesis and production of quorum sensing autoinducers. Nucleosidase inhibition should cause an accumulation of intracellular MTA and SAH that can selectively kill microbes or significantly diminish their growth within a host. We have examined the importance of MTA nucleosidase in bacterial cell signaling and biofilm formation as well as Lyme disease causing *Borrelia burgdorferi*. Lyme disease causing *Borrelia burgdorferi* is a prevalent pathogen that produces three MTA/SAH nucleosidases; Pfs, Bgp and MtN. We have determined the potency of four MTA/SAH nucleosidase inhibitors of Pfs and Bgp activity. We further employed structure-based modeling to evaluate the molecular basis of the functional activities of these inhibitors on Bgp and Pfs nucleosidases.

**76 The Tumor Suppressor p53 Regulates DNA End Joining Activity in Normal Human Oral Keratinocytes, AURIELLE MODSTER and KI-HYUK SHIN** (University of California Los Angeles School of Dentistry, 10833 Le Conte Ave., Los Angeles, CA 90095; aurielle.modster@gmail.com).

The p53 gene is the most commonly mutated gene found in human cancer, whose protein product is a tumor suppressor. Many studies have suggested that it has a role in DNA repair. In normal human oral keratinocytes (NHOK), DNA double-strand breaks

(DSB) are constantly generated and repaired by DNA end joining process (EJ). If DSBs are not repaired or incorrectly repaired, they eventually result in mutations. This alarming fact can increase the probability that the cells with defective DNA EJ activity will convert into cancer cells. The goal of the present study is to determine whether or not the tumor suppressor p53 is directly involved in the repair of DNA DSBs via the EJ process. In order to investigate this, we first knocked-down wild-type p53 protein of NHOK by p53 small-interfering RNA (siRNA) technique. Afterwards, we isolated DNA and performed PCR to amplify their DNA strands. Then we examined the effect of p53 on DNA EJ by comparing DNA EJ activity of NHOK with normal amount of p53 protein to those with knocked-down p53 protein. We found that the p53 knockdown notably inhibited both the efficiency and the fidelity of DNA EJ in NHOK. These results indicated that p53 played a critical role in the efficacy and fidelity of DNA EJ to repair DSBs. With this data, we can suggest that the loss of p53 increases aberrant DNA EJ activity and leads to accumulation of mutations, which eventually contributes to the development of human cancer.

**77 Finding MRSA's Kryptonite: Computational Directed Combatant Pentapeptides, REED B. JACOB, KENNETH A. CORNELL, and OWEN M. McDUGAL** (Department of Chemistry and Biochemistry, Boise State University, ID 83725; greengiant99@gmail.com).

A combination of nullomer pentapeptides and in silico de novo design of antibiotics effective against methicillin-resistant *Staphylococcus aureus* (MRSA) is described. In Kirby-Bauer assays, pentapeptide 128 (amino acid sequence: WCWKW) when administered with oxacillin restored the efficacy of oxacillin toward a resistant strain of bacterium. Oxacillin is an antibiotic with a known binding affinity for MRSA; it was used as a control for computational studies. Penicillin binding protein 2a (PBP2a), a protein that producing rigid protective cell walls responsible for bacterial survival, is a plausible target for the combination therapy of 128 with oxacillin. Computational modeling using the program Autodock 4, allowed the free energy of binding between viable pentapeptides and PBP2a of MRSA to be predicted. An alternate binding site was discovered for oxacillin upon computer simulation of oxacillin and pentapeptide 128 simultaneously binding to the target protein. Pentapeptide 128 by itself is an inhibitor of MRSA to the same level of efficacy as oxacillin. Combined, oxacillin and peptide 128 exhibit a synergistic mode of inhibition based on the in silico studies. The mechanism and a proposed role of pentapeptide 128 will be presented.

**78 Worms, Brains, and Copper – A Recipe for Neural Damage, BRUCE A. O'GARA** (Department of Biological Sciences, Humboldt State University, Arcata, CA 95521; Bruce.OGara@humboldt.edu).

Copper is an essential element; however, it is toxic when present in excess. Excessive levels of copper can accumulate due to environmental exposure, and in humans, such accumulation produces Parkinsonian symptomatology. In addition, copper accumulation also occurs in the nervous system during several neurodegenerative diseases, including Wilson's, Parkinson's, and Alzheimer's diseases. Our laboratory examines the effects of copper exposure upon the nervous system and behavior of two invertebrate species, the freshwater annelid worm *Lumbricus variegatus* and the soil nematode *Caenorhabditis elegans*. *Lumbricus* has several escape behaviors that are easily quantified, including body reversal and

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helical swimming behaviors, which are elicited by touching the head and tail ends respectively. In addition, the electrical activity of single identified giant neurons that mediate rapid withdrawal responses can be monitored noninvasively, allowing for repetitive assessment of an animal's physiological status before, during and after toxicant exposure. Copper exposure disrupts both body reversal and helical swimming behaviors and slows the action potential conduction velocity of the giant neurons. We hypothesize that copper damages dopaminergic (and possibly other neuron types) to produce these deficits. Nearly complete behavioral and neural protection from copper toxicity is produced by the dopamine reuptake blocker nomifensine or excess dopamine (which overloads the dopamine reuptake pump – a potential route whereby copper may enter dopaminergic neurons). Our experiments on *C. elegans* take advantage of several transgenic strains where green fluorescent protein (GFP) is expressed in neurons expressing particular neurotransmitters. Copper exposure produces time- and concentration-dependent histological damage to both dopaminergic and GABAergic neurons.

**79 The Impact of Environmental Toxins on Bone Health: Mechanisms of Cadmium-induced Osteotoxicity, SARA J. HEGGLAND** (Department of Biology, The College of Idaho, Caldwell, ID 83605; shegglan@collegeofidaho.edu).

The heavy metal cadmium is a widespread environmental toxin that accumulates in the body and poses a threat to human health. There are several sources of cadmium emission into the environment; notable is the global increase in disposal of electronic-waste containing this toxic metal. Human exposure to cadmium is linked to the development of osteoporosis. Despite its recognized importance as an environmental toxin, little is known about how cadmium directly impacts bone-forming osteoblasts. Our laboratory uses an osteoblast cell line model to study the signaling pathways involved in cadmium-induced osteotoxicity. We have demonstrated that cadmium induces osteoblast apoptotic death via a caspase-3 dependent pathway. Furthermore, we have identified cadmium as an oxidative stress- inducing toxin in osteoblasts. Treatment of osteoblasts with cadmium leads to increased reactive oxygen species (ROS) formation, depletion of the intracellular antioxidant glutathione, and enhanced lipid peroxidation. More recently, our research has focused on the protective role of 17 $\beta$ -estradiol in cadmium toxicity. We hypothesize that a beneficial effect of 17 $\beta$ -estradiol in bone is to improve defense against oxidative stress. Our preliminary research indicates that pretreatment with 17 $\beta$ -estradiol protects against cadmium-induced ROS formation in osteoblasts. We are expanding our studies to also clarify the impact of cadmium on bone mineralization by identifying osteoblast genes targeted by cadmium, including RUNX2 and sclerostin. Importantly, our results provide a better understanding of how oxidative stress-inducing toxins, such as cadmium, directly impact bone and further insight into estrogen's protective role against osteoporosis. Research funded by NIH grants #P20RR016454 and #R15ES015866.

**80 Asbestos Autotoxicus: Inhalation Toxicology and Pathogenic Autoantibodies, JEAN C. PFAU** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209; pfaujean@isu.edu).

Pulmonary fibrosis is a relentlessly progressive disease that affects large numbers of people for whom the etiology can be idiopathic or associated with environmental or occupational exposures.

There is not a clear explanation for the chronic and progressive nature of the disease, leaving treatment and prevention options limited. However, there is increasing evidence of an autoimmune component, since a) fibrotic diseases are often accompanied by the production of autoantibodies, and b) systemic autoimmune diseases often manifest with pulmonary or pleural disease. Because exposure to silicates such as crystalline silica and asbestos can lead to both autoimmunity and pulmonary/pleural fibrosis, these exposures provide an excellent tool for examining the relationship between these pathologies. We are exploring the possibility that autoantibodies induced by asbestos exposure might exacerbate and prolong the scarring process, making the autoantibodies a potential therapeutic target. We hypothesize that autoantibodies produced against the tissue initially damaged by the asbestos bind to fibroblasts and activate their collagen-producing function. Our data suggest a mechanism whereby autoantibodies may mediate some of the fibrotic manifestations of asbestos exposure by affecting fibroblast phenotype.

**81 In Vivo Regulation of Hepatocyte Proliferation by the Aryl Hydrocarbon Receptor, KRISTEN A. MITCHELL** (Department of Biological Sciences, Boise State University, Boise, ID 83725; kristenmitchell@boisestate.edu).

Halogenated aromatic hydrocarbons are widespread, persistent environmental contaminants that elicit toxicity by activating the aryl hydrocarbon receptor (AhR), a soluble, ligand-activated transcription factor. In rodents exposed to the most potent exogenous AhR agonist, 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD), one of the most sensitive effects is immunotoxicity. Exposure to TCDD has been shown to increase inflammation and alter lymphocyte trafficking, proliferation and differentiation. Whereas such AhR-mediated immune dysfunction typically correlates with decreased host resistance, less is known about the ramifications of immunotoxicity on organ systems that rely on the immune system for maintaining homeostasis in the absence of pathogen exposure. Accumulating evidence indicates that the innate immune system plays a fundamental role in regulating liver homeostasis. During liver regeneration elicited by surgical partial hepatectomy, the number of natural killer (NK) cells in the liver and peripheral blood increases. The expansion of activated NK cells and the abundance of interferon (IFN)- $\gamma$  produced by these cells attenuate the regenerative process as liver mass is restored. We have previously shown that exposure to TCDD suppresses liver regeneration following partial hepatectomy, and we hypothesize that this suppression results from alterations in the innate immune system (e.g. NK cells and IFN- $\gamma$  production). Our data suggest that exposure to TCDD enhances the recruitment of NK cells from the spleen to the liver during regeneration and that this recruitment may result from increased chemokine production. The implications of these findings in immunoregulation of liver regeneration will be presented and discussed.

**82 Retinoic Acid Induces Cardiac Stem Cell Differentiation Via Activation of L-type Calcium Channels and Calcium Signaling, ROUEL S. ROQUE<sup>1,2</sup>, T.J. BARTOSH<sup>2</sup>, and JEFFERY D. MOLKENTIN<sup>3</sup>**

(<sup>1</sup>Department of Basic Sciences, Touro University Nevada, Henderson, NV 89014; <sup>2</sup>Department of Cell Biology and Genetics, University of North Texas HSC, Fort Worth, TX 76107; and <sup>3</sup>Department of Molecular Cardiovascular Biology, Cincinnati Childrens Hospital Medical Center, Cincinnati, OH 45229; rouel.roque@tun.touro.edu).

Stem cell repair of damaged myocardium faces major

challenges from inappropriate differentiation, cellular uncoupling, and accelerated apoptosis of transplanted cells. Preliminary studies in our laboratory suggest that appropriate stem cell differentiation could prevent the development of these events. Hence, in this study, we examined the molecular mechanisms involved in retinoic acid-induced cardiomyocyte differentiation. A rat cardioblast (h9c2) cell line, capable of cardiomyogenic differentiation, was exposed to retinoic acid (RA), a potent regulator of cardiac development, and characterized for expression and/or activity of cardiac-specific proteins, L-type  $\text{Ca}^{2+}$  channels (LTCC), calcineurin, and MEF2C using Western blots, calcium imaging, and luciferase-reporter assays, in the presence or absence of pharmacological inhibitors and/or dominant negative (dn) plasmids. RA treatment, at nanomolar concentrations, promoted morphological changes and upregulation of cardiac myosin heavy chain (cMHC) and ventricular myosin light chain-2 (vMLC2) in h9c2 cells after 3 days in culture. These changes were preceded by rapid elevation of intracellular calcium concentration and increased transcriptional activity of MEF2, but not of NFAT. The effects of RA were attenuated by buffering  $\text{Ca}^{2+}$  with EGTA or Bapta-AM, blockade of LTCC with nifedipine, and inhibition of calcineurin with FK506. Forced overexpression of MEF2C-dn or CAIN, an endogenous inhibitor of calcineurin, abrogated RA-induced differentiation and MEF2 activity. Our study shows that RA promotes development of a cardiomyocyte phenotype through a  $\text{Ca}^{2+}$ -dependent pathway involving LTCC-calcineurin-MEF2C. This calcium signaling pathway may provide a novel target in stem cell programming to repair congenital heart defects or replace diseased myocardium.

**83 Pt(II) Complexes of 4,4'-disubstituted-2,2'-bipyridine: Structure and Cytotoxicity**, BYRON BENNETT<sup>1</sup>, R. DAVID GRIGG<sup>1</sup>, VAN VO<sup>3</sup>, ZEYNEP G. KABULOGLU-KARAYUSUF<sup>3</sup>, VIKAS SEHDEV<sup>2</sup>, SARA GILMORE<sup>2</sup>, JAMES C.K. LAI<sup>2</sup>, and ALOK BHUSHAN<sup>2</sup> (<sup>1</sup>Department of Chemistry, Idaho State University, 921 South 8<sup>th</sup> Ave., Stop 8023, Pocatello, ID 83209-8023; <sup>2</sup>Department of Biomedical and Pharmaceutical Sciences, College of Pharmacy, and ISU Biomedical Research Institute, Idaho State University, 921 S. 8<sup>th</sup> Ave., Pocatello, ID 83209; <sup>3</sup>Chemistry Department, University of Nevada Las Vegas, 4505 Maryland Parkway, Las Vegas, Nevada 89154: bennbyro@isu.edu).

The preparation and characterization of dichloro [4,4'-di(R)-2,2'-bipyridinyl] Platinum(II) complexes; where R = -(CH<sub>2</sub>)<sub>3</sub>CF<sub>3</sub> (**1**), -O(CH<sub>2</sub>)<sub>2</sub>CH<sub>3</sub> (**2**), -(CH<sub>2</sub>)<sub>3</sub>CH<sub>3</sub> (**3**) are reported. NMR spectroscopy confirms both the constitution of the complexes and their stability in DMSO via observation of <sup>1</sup>H, <sup>13</sup>C, <sup>19</sup>F, and <sup>195</sup>Pt. Solid state XRD data has been obtained for **1** (P2(1)/c; *a* = 14.3055, *b* = 9.3301, *c* = 17.9611,  $\alpha$  = 90.00°,  $\beta$  = 91.314°,  $\gamma$  = 90.00°; *d* = 1.204, *wR*<sup>2</sup> = 0.0557). In-vitro cologenic viability assay studies support the role of **1**, **2**, and **3** as cytotoxins for L1210 cells as IC50s of less than 10  $\mu\text{M}$  have been observed for all three complexes. In the context of literature and other complexes generated by the authors a preliminary structure activity relationship is proposed with respect to impact of substituent position on the pyridyl ring, isomerism within the substituent, and elemental composition.

**84 Pharmacologic Targeting of Bacterial Cell "Phones": Can You Hear Me Now?** KENNETH A. CORNELL (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725; kencornell@boisestate.edu).

Bacteria produce a variety of secreted extracellular signals

(autoinducers) to communicate and coordinate population-wide expression events both within and between species. These signals consist of furanones, acylhomoserine lactones, and peptides, and have been demonstrated to influence important processes such as biofilm formation, nutrient utilization patterns, and elucidation of virulence factors. Thus pharmacologic interruption of cell signaling processes has the potential to significantly attenuate bacterial growth and virulence. The enzyme 5' methylthioadenosine/S-adenosylhomocysteine nucleosidase (MTN) catalyzes a critical step in the catabolism of a byproduct of the synthesis of autoinducer-1 signals, and supplies a precursor for the synthesis of autoinducer-2. We will present data demonstrating that MTN inhibition decreases autoinducer dependent events, as well as the results of studies that explore novel peptides for their potential to create intercellular "static". Ultimately, we hope to develop these compounds as adjunctive therapies with the potential to improve the activity of standard antibiotics and alter the rate at which drug resistant phenotypes develop.

### The Evolution of Cooperation: Theoretical and Experimental Approaches

Tuesday, 9:00 a.m. in SCIENCE 101

**85 Cooperation and Conflict in a Biparental Cichlid Fish**, RONALD M. COLEMAN (Department of Biological Sciences, California State University, Sacramento 95819-6077; rcoleman@csus.edu).

Parental investment involving two parents presents an interesting challenge to our understanding of cooperation and conflict. The cooperation to successfully rear the current brood must be balanced against the conflict of differing long-term goals (i.e., future offspring from remating with different partners). The problem becomes particularly intriguing if the parents differ in their ability to provide care because of differences in their phenotype (e.g., large vs. small size). Using a combination of life-history and game theory models, I extend previous theory of biparental investment to consider situations in which parents are of different abilities. I test this theory using manipulative experiments on laboratory convict cichlids (*Archocentrus nigrofasciatus*), in which I altered brood number and relative body size of mates. The data indicate that the parents do respond to this asymmetrical game, altering their investment in accordance with their relative size.

**86 Vocal Duets Facilitate Cooperation Between Mates**, LAURYN BENEDICT (Museum of Vertebrate Zoology and Department of Integrative Biology, 3101 VLSB, University of California, Berkeley, CA 94720; LB43@berkeley.edu).

Vocal duets, where two partners coordinate acoustic communication signals, are relatively rare in nature, but occur in distantly related groups including birds mammals and insects. Theory predicts that either cooperation or conflict between duetting partners can promote the evolution of coordinated vocal signals, and empirical work has shown that duets serve different functions in different species. My work examined factors related to duetting behavior in birds. I present evidence from cross-species analyses suggesting that partner cooperation promotes duetting and that purely conflict-based duets are rare. Focused studies of duetting in California Towhees (*Pipilo crissalis*) suggest that despite the existence of conflict between mates over offspring paternity, duets are used in

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cooperative social contexts.

- 87 The Evolution of Greenbeard Cooperation and Mating System Transitions in Vertebrates,** BARRY SINERVO<sup>1</sup>, ALEXIS CHAINE<sup>2</sup> and DONALD B. MILES<sup>3</sup> (<sup>1</sup>Department of Ecology and Evolutionary Biology, University of California, Santa Cruz, CA, 95064; <sup>2</sup>Station d'Ecologie Expérimentale du CNRS à Moulis, USR 2936, Moulis 09200 Saint-Girons, France; <sup>3</sup>Department of Biological Sciences, Ohio University, Athens, OH 45701; sinervo@biology.ucsc.edu).

Altruism challenges evolutionary theory because selection should favor selfish over caring strategies. Greenbeard altruism resolves this paradox by allowing cooperators to identify individuals carrying similar alleles producing a form of genic selection. We describe new models of density regulation in which alternative greenbeard types compete at recruitment, and adult strategies influence juvenile recruitment depending on 3 different strategies. Strategies are also pleiotropically related to territorial behavior and correspond to polygynous, monogamous and sneak strategies, common in vertebrates. Our model was inspired by extremely similar greenbeard density regulation in two lizard species that have been separated for 175 million years. The side-blotched lizard and the European common lizard exhibit the 3 strategies noted above, which generates rock-paper-scissors [RPS] cycles. We suggest that mating systems diversity of vertebrates results from frequency dependent competition among alternative genetic social strategies fundamental to many social systems (aggression, cooperation, deception). Our model predicts three stable outcomes: promiscuity (3 RPS strategies), polygyny (aggression), and monogamy (cooperation). Phylogenetic analyses of 279 rodent taxa support model assumptions and predictions of mating system evolutionary dynamics and stable states. Phylogenetic analyses of 272 reptile taxa in the Phrynosomatid family also confirm model predictions. In mammals, monogamy is nearly an order of magnitude more common (26%) than previously thought (3%) and contributes to enhanced speciation rates as polygyny and sneak invade. Enhanced speciation due to such RPS dynamics is also a feature of reptiles. We show that genetically based clustering behavior and care drives mating system transitions and socially mediated speciation.

- 88 Demographic Aspects of the Evolution of Sociality: Food Sharing in the Family and Beyond,** RONALD D. LEE and CARL BOE (Department of Demography, 2232 Piedmont Ave., University of California, Berkeley, CA 94720; rlee@demog.berkeley.edu).

For species with parental support or broader cooperative breeding and food sharing, the demographic composition of the group matters. For example, the survival of dependent offspring is contingent on the survival of the mother when the social unit is no larger than mother-offspring (matriarchal) groups. Broader cooperative groups may have favorable or unfavorable dependency ratios which affect the reproduction and survival of group members. Larger cooperative groups experience less variation in age composition, reducing the variance over time in reproductive success of the participating individuals. Here we report results of experiments using single-sex stochastic microsimulation of human hunter-gatherer populations in which offspring inherit their mother's genome subject to a risk of mutations which alter the life history. In different experiments, kin sets of differing depth share food and participate to varying extents in broader sharing groups. We analyze the life histories that evolve over tens of thousands of generations in

these different circumstances. We also simulate non-interbreeding populations with different sharing configurations in evolutionary competition with one another to assess the selective advantages of sharing. In sharing groups versus matriarchies, lower infant mortality evolves to capture the benefits of reproductive free-riding and because the future resources freed up by an infant death cannot be largely recaptured as they can by matriarchies. At the same time, larger sharing groups provide family insurance such that offspring may survive maternal death.

- 89 Cooperation and Conflict Over Reproductive Skew among Parents and their Offspring,** ANDREW G. ZINK (Department of Biology, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132; zink@sfsu.edu).

Early models of reproductive skew recognized that, when parents breed together with their own offspring, genetic relatedness to future offspring is asymmetric (Emlen 1982, 1996; Reeve and Keller 1995, 1996; Vehrenamp 1983). Here I extend these initial skew models of genetic asymmetry to the more recent models of reproductive transactions. In particular, I consider the special case of conflict between non-breeding offspring and their cooperatively breeding parents over reproductive skew. A consistent prediction of the model is that both the direction and the degree of conflict depend on the mating system. Under polygyny, for example, offspring will tolerate a staying incentive (for their mother) that is smaller than the minimum their mother is willing to accept. Under monogamy, the situation reverses and offspring will demand a larger staying incentive (for their mother) than she requires to stay in the breeding group. Finally, parent-offspring conflict over reproductive skew disappears entirely under polyandry. These results predict that, under certain mating systems, non-breeding offspring will try to manipulate reproductive skew through mechanisms such as nepotism or cannibalism.

- 90 Incentives in Animal Teams: Implications for Parental-Investment Theory,** JOAN ROUGHGARDEN and ZHIYUAN SONG (Department of Biology, Stanford University; joan.roughgarden@stanford.edu).

Social-selection theory envisions that animals frequently work in teams, meaning they take coordinated actions in pursuit of a team goal. When a team goal is attained, the team reward must be divided so that members don't withdraw and so that team members honestly communicate their knowledge to other members of the team. Economic analysis in management science has investigated incentive structures that cause employees in a firm to act in ways that maximize the firm's production. A theorem of Groves (1973) exhibits optimal compensation rules for an organization called a conglomerate. The application of Groves theorem to parental investment is developed, in which the "biological conglomerate" consists of a bird's nest where the parent is the "manager" and the chicks are the "divisions." The optimal compensation rules amount to a mechanism whereby the parent "auctions" its food to the nestlings, and the nestlings indicate the price they are paying for their food by the extent of their begging behavior. The chicks signal to the parent how much demand they have for food at each price and the parent then sets the price so that all the food is consumed. This process causes the optimal strategies for each of the chicks to coincide with the optimal strategy of the parent, and thereby maximizes the fitness yield from the nest as a whole. This new approach to parental investment theory contrasts with contrasts with those

of Trivers (1972) and Alexander (1974) that predict universal and inevitable parent-offspring conflict. These predictions of universal family conflict been widely accepted in evolutionary psychology. However, Godfray (1992), using an ESS evolutionary argument, predicted honest communication from chicks to their parents. Our new approach confirms Godfray's results and show that if the parent implements optimal compensation policies, the parent and chicks work honestly together as a team to maximize the fitness produced by the nest. The optimal-compensation approach can be extended to predict the time of weaning ("spinning off" of divisions from the parent corporation) and to predict brood-pruning wherein brood size is reduced to accord with resources ("liquidation" of divisions).

**91 Two Conflicts Make a Cooperation?: Parental Aggression and Favoritism within Families,** DAIZABURO SHIZUKA and BRUCE E. LYON (Ecology and Evolutionary Biology, University of California Santa Cruz, 1156 High Street, Santa Cruz, CA 95060; Shizuka@biology.ucsc.edu).

Interactions between family members are driven by both cooperation and conflict. Parent-offspring conflict theory shows that while there are levels of parental investment where all family members are in agreement, conflicts of interest can arise when resources are limited. Here, we use American coots (*Fulica americana*), a waterbird with high parental investment, high competitive asymmetry between siblings, and extreme offspring mortality, to demonstrate the idiosyncratic nature of conflict and cooperation within families. Initially, scramble competition over parental feedings results in the youngest, most competitively inferior hatchlings suffering the highest mortality. However, parents later take control and use aggression to reduce begging and food theft by older siblings and thereby ensure that a few 'favored' chicks receive a disproportionate amount of parental feedings. Each parent favors a different chick, and these tend to be among the youngest of the brood to survive—evidence that parents facultatively adjust family size by actively salvaging some chicks. Furthermore, favored chicks 'pester' the parents and induce them to be aggressive towards older chicks, thus reversing the competitive asymmetry through parental intervention. This apparently cooperative behavior likely arises from the overlap in the interests of the parents that seek to optimize the distribution of food and the 'favored' chicks—those offspring that provide the greatest fitness gain per parental investment. Our results indicate that the resolution of conflict and cooperation in families depends on the specific parent-offspring dyad involved, and is also sensitive to contexts such as family size, competitive asymmetries, and resource availability.

**92 The Evolution of Multicellularity: A Minor Major Transition?** RICK GROSBERG<sup>1</sup> and RICHARD STRATHMANN<sup>2</sup> (<sup>1</sup>Center for Population Biology, University of California, One Shields Ave, 2320 Storer Hall, Davis, CA 95616; <sup>2</sup>Friday Harbor Laboratories, University of Washington, Seattle, WA 98195; rkgrossberg@ucdavis.edu).

The evolution of multicellular organisms from unicellular ancestors, like all other major evolutionary transitions, has been favored by the selective advantages of novel forms of cooperation and opposed by genetic conflicts between lower and emerging higher levels of biological organization. In the case of the transition to multicellular organization, pervasive benefits of increased size, and opportunities for functional specialization and division of labor, have repeatedly promoted the evolution of multicellularity.

The ease of this transition also reflects the fact that many of the requirements for multicellular organization, including cell adhesion, cell-cell communication and coordination, and programmed cell death likely evolved in ancestral unicellular organisms. At the same time, the evolution of multicellular organisms from unicellular ancestors may be opposed by genetic conflicts that arise when mutant cell lineages (defectors or cheaters) selfishly promote their own increase at the expense of the integrity of the multicellular organism. Numerous defenses have evolved that limit such genetic conflicts, perhaps the most important being development of the vast majority of multicellular organisms from a unicell (either a spore or zygote), whose clonally produced descendants remain together. Initiation of the organism from a unicell minimizes conflicts from selection among cell lineages and, each generation, redistributes genetic variation arising within multicellular individuals between individuals. With a unicellular bottleneck, defecting cell lineages rarely succeed beyond the life span of the multicellular individual; however, a unicellular bottleneck does not completely resolve pre-existing conflicts between intracellular symbionts and their host cells. When multicellularity arises through aggregation of scattered cells, or when multicellular organisms fuse to form genetic chimeras, there are more opportunities for defector cell lineages to join a multicellular organism. The resulting intraorganismal competition contrasts with the cooperation within a single clone of cells, and may partly explain why multicellular organisms that develop by aggregation generally exhibit limited differentiation (e.g., fruiting bodies), never achieving the cellular diversity of organisms that develop clonally.

**93 Germline Chimerism and Stem Cell Parasitism in the Colonial Ascidian, *Botryllus schlosseri*,** ANTHONY W. DE TOMASO (Department of MCD Biology, University of California, Santa Barbara, CA 93106; detomaso@lifesci.ucsb.edu).

The compound ascidian *Botryllus schlosseri* has been well-studied for the fuhc-based histocompatibility system which enables vascular fusion of genetically distinct genotypes. Fusion can lead to both somatic and germline chimerism within each partner, a process which has both hypothesized benefits, such as increased size and more rapid fecundity, as well as costs. For the latter, it has been shown that fusion can result in competition between genetically distinct stem cell lineages within a chimera, often leading to complete replacement of germline and/or somatic tissues over time by a single genotype. This process, called stem cell parasitism, is a repeatable and heritable trait, and is autonomous to the stem cells themselves as it is retained upon experimental transplantation. While initial studies were done between adult individuals, we are currently analyzing interactions between juveniles and adults. Preliminary results suggest that this interaction shows the least variability, with the establishment of low levels of chimerism which are maintained for the life of the recipient colony. Current results will be discussed.

**94 Environmental Variation in Allorecognition Behavior in Colonial Marine Invertebrates,** SARAH COHEN (Department of Biology, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94132; sarahcoh@sfsu.edu).

Allorecognition interactions between conspecific colonial tunicates are used to mediate space competition. Separate colonies sharing one or more alleles at a highly polymorphic recognition locus may fuse and form chimeric entities that harbor multiple

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genotypes within the same physiologically integrated unit. Alternatively, colonies that are less closely related or do not share alleles undergo a rejection process following initial tissue interactions. Rejection behaviors are variable within and between species and may involve minor or substantial tissue damage to interacting colonies. The energetic costs of tissue damage incurred during rejection are assumed to be balanced by the fitness gains of fusing with highly genetically similar individuals, e.g., close kin. There is an additional environmental component to the type and intensity of behavioral interactions that mediate the fusion/rejection behavior. Does the impact of environmental variation on behavior follow theoretical expectations on conditions that should promote cooperation or conflict between conspecifics? Results from experiments with field and lab raised colonies suggest that food limitation may severely alter the energetic costs of cooperative behaviors in one species. The implications of variable growth rates on behavioral variation between species will be discussed in light of these findings.

**95 The Mechanisms Underlying Individual Behaviors and Sociality of Ants**, NEIL D. TSUTSUI (Department of Environmental Science, Policy and Management, University of California Berkeley, 137 Mulford Hall #3114, Berkeley, CA 94720-3114; ntsutsui@nature.berkeley.edu).

The formation of cooperative colonies has allowed the social insects to proliferate and dominate many terrestrial ecosystems. Similarly, many invasive social insects are characterized by geographically expansive societies that numerically overwhelm native taxa. Multidisciplinary research, using the invasive Argentine ant (*Linepithema humile*) as a model system, has shed light on how the some of the properties of these societies can be explained by the behaviors of individual ants. In particular, recent advances in genomics, chemical ecology and neurophysiology are producing insights into the mechanisms underlying aggression, learning, memory and cooperation. Here, I will highlight some of our recent, ongoing, and future research that explores ant social behavior using 1) synthetic versions of chemicals that regulate important social behaviors, 2) experimental tests of learning, memory and aggression, and 3) powerful new genomic tools for dissecting the genetic basis of key social behaviors.

**96 Exploring an Opportunity for Selection Approach for Indirect Fitness Benefits**, ALAN H. KRAKAUER (Department of Evolution and Ecology, University of California, One Shields Ave, 2320 Storer Hall, Davis, CA 95616; ahkrakauer@ucdavis.edu).

Kin selection is frequently invoked as a possible explanation for cooperative behavior among individuals. Empirical studies testing this hypothesis typically examine whether aid is preferentially directed towards kin and what mechanisms lead to this pattern of nepotism. More rarely, indirect fitness benefits are estimated to determine whether kin selection can explain the cooperative behavior in question (e.g. Hamilton's Rule). Frequently these indirect fitness benefits are not sufficient to explain apparently altruistic behavior or are difficult to disengage from sources of direct fitness; I am interested in alternative ways to work with data describing the relatedness within cooperative groups and the fitness benefits of cooperation. Here I explore an opportunity for selection framework; currently this approach is being used to examine direct fitness in animal mating systems. Here the upper bound for selection on various components of direct fitness and interactions among those components is estimated. This technique could also be useful for kin

selected benefits, since these variables can also be related in a multiplicative manner. For example, one could ask whether variance in relatedness contributes more to total indirect fitness variance than does variation in the magnitude of help to the recipient, or quantify the importance in covariation between group size and relatedness. Measuring these variables directly is often prohibitively difficult; the utility of this technique will therefore depend on the ability to estimate these parameters using biologically plausible assumptions.

**97 The Role of Dispersal in the Exploitation of Communal Galling**, DONALD G. MILLER (Department of Biological Sciences, California State University Chico, Chico, CA 95929-0515; dgmiller@csuchico.edu).

In western North America, *Tamalia* aphids induce galls on *Arcostaphylos* (manzanita) shrubs. Galls are sometimes jointly occupied by multiple foundresses of the gall-inducer *Tamalia coweni* and its congener, *Tamalia inquilina*. The life histories of both species are closely coordinated and include alternation between stages specialized for gall occupation and those adapted for dispersal from galls. The inquiline, as an obligate parasite, must locate and enter galls established by *T. coweni* to complete its life cycle. Modes of dispersal from natal galls appear to differ markedly between gall-inducer and inquiline: most or all offspring of gall-inducers disperse aerially, whereas an unknown fraction of inquiline disperses on foot, potentially seeking additional galls to invade. In one experiment, I established field trials in which aphids exiting natal galls on foot were collected in sticky traps placed on the petioles of leaves bearing galls. Preliminary data indicate dispersing inquiline species are significantly more likely to be so trapped than are gall-inducers; hence, inter-gall dispersal may be more important for the inquiline species. In a second experiment, I marked dispersing juveniles with fluorescent powder by injecting the powder into natal galls. Relative rates of entry into nearby galls were then obtained through inspection of gall contents. These data are part of a general test of the hypothesis that greater population viscosity in the inquiline species may accelerate its rates of population differentiation.

**98 The Origins and Evolution of Uncooperative Symbionts**, JOEL L. SACHS (Department of Biology, 1208 Spieth Hall, University of California, Riverside, CA 92521; joels@ucr.edu).

Mutualisms are predicted to be destabilized by exploitative mutants that receive benefits from partners without reciprocation. Nonetheless, there has been little evidence for the spread of exploitation in mutualist populations. An outstanding example of mutualism is found in rhizobial bacteria which nodulate legume roots and fix nitrogen for hosts in exchange for photosynthates. Rhizobia are infectiously acquired from the environment and in such cases selection models predict the evolution of uncooperative mutants. Uncooperative rhizobia – including non-fixing and non-nodulating strains – appear common in agriculture, yet their population biology and origins remain unknown in natural soils. Here we conducted a phylogenetically explicit survey of *Bradyrhizobium* symbiotic quality in a natural population and used inoculation experiments to estimate both host and symbiont fitness during infection. We discovered uncooperative rhizobia that act as cheaters as well as the recurrent loss of nodulation ability in the symbiont population. Molecular analyses suggest that gain and wholesale loss of symbiosis-island loci are mechanisms by which uncooperative rhizobia can rapidly emerge in wild symbiont populations.

**99 Fitness Trade-offs in a Horizontally Transmitted Mutualism: Legumes and Rhizobia**, **ELLEN L. SIMMS<sup>1</sup>, MARTINE O. EHINGER<sup>1</sup>, TONI MOHR<sup>1</sup>, and JOEL L. SACHS<sup>1,2</sup>** (<sup>1</sup>Department of Integrative Biology, 3060 Valley Life Sciences Bldg. #3140, University of California, Berkeley, CA 94720-3140; <sup>2</sup>Department of Biology, University of California, Riverside, CA 92521; esimms@berkeley.edu).

In a horizontally transmitted symbiotic mutualism, partners reproduce separately, each competing for a share of communal resources. In a two-partner interaction, this resource trade-off can be operationally defined as a negative genetic correlation of the fitnesses of the two partners. Soil-dwelling rhizobia infect legume roots, differentiate into bacteroids and can fix atmospheric nitrogen in exchange for carbon-based resources provided by plant photosynthesis. Legumes reproduce by seeds and rhizobia are released into the soil from senescing nodules, suggesting that partners compete for communal resources. Rhizobia vary in the degree to which they improve host fitness, but only rarely has rhizobial fitness been examined. Our research examines if legumes and rhizobia exhibit fitness trade-offs and, if so, what any observed fitness trade-offs can tell us about the evolutionary trajectory of this mutualistic association.

**100 Genomics of Coral-Algal Symbiosis**, **MONICA MEDINA** (School of Natural Sciences, University of California Merced, 200 North Lake Road, Merced, CA 95343; mmedina@ucmerced.edu).

Coral-algal symbioses represent one of the most successful mutualisms in the sea, and a stable symbiosis is also representative of a healthy reef. My laboratory has focused in developing genomic tools to examine this relationship at a cellular level. We have already gained new insight into the onset of symbiosis and have identified some of the key processes driving the early recognition/rejection of algal symbionts. By examining thermally induced bleaching (i.e. loss of symbionts) we have also gained insight into the mechanisms involved in host response to disruption of symbiosis. I will discuss our findings in the context of climate change threatening reefs worldwide.

### Evolutionary Innovations: Where Ecology, Development and Macroevolution Intersect

Tuesday, 9:00 a.m. in HENSILL HALL 543

**101 How Genomics Is Reshaping Our Ideas About Evolution**, **CHRIS T. AMEMIYA, NIL RATAN SAHA, and JERAMIAH SMITH** (Benaroya Research Institute at Virginia Mason, Seattle, WA; camemiya@benaroyaresearch.org).

It is truly an exciting time for evolutionary biologists; we've come to see evolutionary principles being routinely applied to all fields of biological and medical inquiry. Sadly, however, it is also a time that coincides with a large public uneasiness with evolutionary principles. There are at least two reasons for this. First, as scientists we have largely failed to educate the public about the logic and sensibility of evolutionary biology. And, of course, there is a faction who continue to spread misinformation and to paint evolution in a very misleading and restricted framework; that is, as an antiquated Darwinian concept. This leads to the second point. While we have been very good at describing evolution we have done a poor job at fundamentally understanding the mechanisms by which evolution can occur. The onus is on us to move the field forward from one

of descriptive and theoretical biology to one based on *mechanistic inferences* and *empirical investigations*. With the melding of developmental biology and genomics with evolutionary biology, we are beginning to characterize evolution in much more mechanistic and molecular terms. In this talk, we will discuss a few vignettes from our work on basal vertebrates that emphasize noncoding changes and the nature of the empirical work that needs to be done to show functional significance, and ergo, evolutionary potential, of these changes. We will further discuss the grand challenge of Evo-Devo, particularly with regard to the utility as well as the caveats of genomics.

**102 Origin, Evolution and Variations of the Chordate Body Plan**, **BILLIE J. SWALLA** (Department of Biology and Friday Harbor Laboratories, University of Washington, Seattle, WA 98195; bjswalla@u.washington.edu).

Chordates share a unique body plan within the multicellular animals and include the invertebrate lancelets and tunicates as well as vertebrates. Tunicates have traditionally been thought to exhibit the ancestral body plan, but new molecular phylogenies, genomic and developmental evidence suggests that the tunicate adult body plan is a unique evolutionary innovation found only within that group. In contrast, the little known hemichordates, marine worms that are most closely related to echinoderms, share several characteristics with the chordates, suggesting that the deuterostome ancestor was much more chordate-like than had been imagined. We are currently using developmental and genetic data to assess the homologies of hemichordates and chordates.

Our work shows that hemichordate gill slits are homologous to chordate gill slits, and early gill cartilages were likely to be endodermal in origin and acellular. We are presently studying the central nervous system of hemichordates in order to determine whether it is convergent with the chordate central nervous system or homologous. Ptychoderid hemichordates share a feeding larvae life stage with echinoderms, and can completely regenerate their anterior features, including the CNS, when bisected. These interesting invertebrates are likely to be the closest extant invertebrate to the ancestral deuterostome. Therefore, echinoderms and tunicates have evolved unique body plans, whereas the chordates evolved from a vermiform ancestor that was likely to have gill slits and a CNS.

**103 Duplicate Hox Genes in Ray-finned Fishes and Their Role in the Evolution of Novelty and Diversity**, **KAREN D. CROW** (Department of Biology, San Francisco State University, San Francisco, CA 94132; crow@sfsu.edu).

One of the most intriguing and timely questions in evolutionary biology is to understand the types of evolutionary change responsible for generating novelty and diversity. Gene duplication is widely regarded as the predominant mechanism by which genes with new functions and associated phenotypic novelties arise. Genome duplication has been implicated as a key factor in the evolution of diversity, novelty, and reduced probability of extinction. Several genome duplications (WGD) have occurred throughout vertebrate evolution, including events before the origin of vertebrates, jawed vertebrates, the divergence of the paddlefish/sturgeon lineage, and a third WGD that occurred shortly before the origin of teleost fishes, the most diverse chordate group. Evidence for these WGDs was initially revealed by the discovery of duplicate Hox gene clusters. Because Hox genes play a key role in determination of body plan morphology, it is widely assumed that they play

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a key role in the evolution of body plan diversity. Therefore, it is particularly intriguing to understand the role of Hox cluster duplications in the evolution of vertebrate diversity. Some Hox genes experience diversifying selection after duplication, which may be relevant to adaptive evolution during the initial radiation of diverse groups. Other duplicated Hox genes experience asymmetric rates of evolution associated with functional divergence of paralogs, and the development of novel features. The discovery of an independent HoxA duplication in paddlefish (39–71 mya), allows a remarkable opportunity to directly compare the same genes that were duplicated independently in the zebrafish lineage (285–334 million years ago).

**104 Genetic Analysis of Loss and Gain Traits in Threespine Sticklebacks**, CRAIG T. MILLER (Department of Molecular and Cell Biology, 142 Life Science Addition, Berkeley, CA 94720-3200; ctmiller@berkeley.edu).

The genetic basis of evolved differences in natural populations is poorly understood, especially in vertebrates. Threespine sticklebacks offer a powerful system to genetically dissect evolutionary change. Derived freshwater stickleback populations have repeatedly and rapidly evolved from ocean-dwelling ancestors. Despite dramatic morphological divergence, different populations can be crossed by artificial fertilization. We are using genome-wide linkage mapping in sticklebacks to identify factors underlying evolved patterning changes. We previously showed that a major locus controlling pigmentation evolution in sticklebacks maps to the *Kit ligand* gene, and that this gene also underlies pigmentation evolution in humans. In addition to these pigmentation changes, head skeletal changes, particularly in the branchial skeleton, have evolved as derived fish adapt to different food sources in freshwater environments. The most intensively studied head skeletal trait in sticklebacks is the reduction in number of gill rakers, a set of internal bones in the branchial skeleton used during feeding. The branchial skeleton displays two other evolved traits in freshwater fish: an increase in branchial bone size and a doubling of pharyngeal tooth number. All three skeletal traits are under strong genetic control, as we have mapped chromosome regions controlling aspects of each trait. We aim to identify the genes underlying these traits and understand how these genes alter development to confer evolved changes in skeletal pattern.

**105 Evolutionary Innovations and Multidisciplinary Explanation in Biology: Prospects and Problems**, ALAN C. LOVE (Department of Philosophy, Minnesota Center for Philosophy of Science, University of Minnesota, Minneapolis, MN 55455; aclove@umn.edu).

One of the central problems in current evolutionary developmental biology (Evo-devo) is the origin of evolutionary innovations and novelties, such as avian flight or vertebrate jaws. Because Evo-devo is composed of a cluster of overlapping biological sub-disciplines (e.g., developmental genetics, ecology, embryology, evolutionary genetics, morphology, paleontology, and phylogenetic systematics), an overlooked but significant feature of the problem is how these different approaches mesh together to produce an empirically robust and descriptively adequate explanatory framework. In this paper I argue that one way to address this issue is to pay attention to the structure of the problem itself.

Reviewing earlier work, I briefly characterize the problem in terms of the origin of qualitatively distinct variation at specific phylogenetic junctures, which distinguishes the problem of innovation

and novelty from other central biological problems like adaptation. Then I focus on three distinct aspects of the problem of innovation and novelty (form versus function; level of biological organization; degree of generalization) and extend my earlier analysis with eight sets of questions that provide further structure to this complex problem. These sets of questions clarify how multidisciplinary explanations of evolutionary innovations might emerge from specific combinations of the empirical findings derived from Evo-devo's diverse sub-disciplines. In conclusion I emphasize that conceptual reflection on the nature and structure of biological problems is a potentially fruitful methodology for all areas of life science inquiry.

**106 The Role of Integration, Intersections and Trees in Providing Insights into Evolutionary Innovations of Snails and Whales**, DAVID R. LINDBERG (Department Of Integrative Biology and Museum of Paleontology, University of California, Berkeley, CA 94610; drl@berkeley.edu).

Recognizing, documenting, and hypothesizing evolutionary innovation is a difficult task that requires many data inputs and a framework on which to array data and test hypotheses. The integration of data from different and sometimes traditionally disparate fields and disciplines can be problematic. Moreover, these data often come from a variety of temporal and spatial scales requiring their integration across different levels of resolution as well. While not resolving all of these issues, the framework of the phylogenetic tree provides a critical component in the discussion and recognition of evolutionary innovations. Two examples utilizing integration, intersections, and trees in understanding putative evolutionary innovations are present. The first looks at the evolution of echolocation in odontocete whales and concludes that echolocation in early odontocetes aided nocturnal feeding on cephalopods and other prey items, and that this early system was exapted for deep diving and hunting at depths below the photic zone where abundant cephalopod resources were available 24 hours a day. In the second example, the macroevolutionary events that have produced the incredible diversity of the molluscan body form is examined from a paleontological, ecological, developmental perspectives. These data suggests that although diverse, the developmental and ecological underpinning are shared, albeit convergent in the major molluscan clades and that these patterns date to the Cambrian and included extinct taxa.

**107 The Origin and Diversification of *Drosophila* Sex Combs**, ARTYOM KOPP, OLGA BARMINA, KOHTARO TANAKA, and CHEN-SIANG NG (Section of Evolution and Ecology, University of California Davis, Davis, CA 95616; akopp@ucdavis.edu).

The sex comb of *Drosophila* is an excellent model for reconstructing the genetic and molecular mechanisms responsible for the origin and diversification of new morphological traits. This male-specific array of modified bristles evolved recently in one *Drosophila* lineage, and shows dramatic diversity within that lineage. Sex comb evolution is associated with the origin of novel interactions between HOX and sex determination genes. Activity of the sex determination pathway was brought under the control of the HOX code to become segment-specific, while HOX gene expression became sexually dimorphic. At the same time, both HOX and sex determination genes were integrated into the intra-segmental spatial patterning network, and acquired new joint downstream targets. Together, these changes reflect the assembly of a

novel sex-specific developmental pathway under sexual selection. Similar sex comb morphologies evolved independently in multiple *Drosophila* species. Convergent evolution at the phenotypic level reflects convergent changes in the expression of HOX and sex determination genes, involving both independent gains and losses of regulatory interactions. However, the downstream cell differentiation programs have diverged between species, and in some evolutionary lineages similar adult morphologies are produced by different morphogenetic mechanisms. Sex combs often change on microevolutionary timescales, and can differ spectacularly between sibling species and show quantitative variation within species. To understand the genetic and cell-biological basis of these changes, we have combined quantitative-genetic analysis with microarray profiling of sex- and segment-specific gene expression. Our results suggest that quantitative changes in the expression of multiple genes can produce qualitatively novel morphological phenotypes.

**108 The Origin, Function, and Diversification of Eyespot Patterns in Butterflies**, ANTONIA MONTEIRO (Department of Ecology and Evolutionary Biology, Yale University, OML 326a, P.O. Box 208106, New Haven, CT 06520-8106; antonia.monteiro@yale.edu).

Butterfly eyespots are evolutionary novelties that function in sexual communication and in interactions with predators. They appear in some butterfly and moth lineages in one or more repeated units per wing. Nymphalid butterfly eyespots appear to be produced by a complex developmental network that is deployed repeatedly on the wing. This network easily switches on and off during the course of evolution. Work in my lab is exploring the evolution of this network within nymphalids. Specifically, how the network got put together in the first place, and how it evolved in number and acquired its modular properties.

In order to answer the first question we are performing gene comparative studies across several nymphalid species. We are also trying to empirically distinguish network co-option from de novo network evolution by using a novel conceptual framework and newly developed functional genetic tools for butterflies.

In order to answer the second question we are mapping eyespot presence and absence across a phylogeny of 700 nymphalids to infer ancestral states for each of the wing compartments that carry eyespots.

**109 Innovations and Novel Structures: The Evolution of the Stamen Whorl in Tropical Gingers (Zingiberales)**, CHELSEA SPECHT (Department of Plant and Microbial Biology, University of California Berkeley, 431 Koshland Hall, Berkeley, CA 94720; cdspecht@nature.berkeley.edu).

The Zingiberales, or tropical gingers, comprise a major component of tropical ecosystems and include crop plants (banana, ginger), sources of traditional medicines and spices (cardamom, turmeric), and ornamentals (heliconias, Bird-of-Paradise, Cannas). The order contains ~2,500 species that form specialized pollination relationships with birds, bees, bats, dung beetles, moths, butterflies, and primates via major alterations in floral form. Unlike most flowers where petals are used to attract pollinators, ginger flowers present a unique developmental pattern in which the male reproductive organs (stamens) are converted to non-fertile, petal-like structures. In two derived families, Zingiberaceae and Costaceae, 2 or 5 (respectively) staminodes fuse together to form a novel structure, the labellum. This labellum comprises the main visual aspect of the

floral display and is involved in creating the variety of pollination syndromes found in these highly diverse families. Here we investigate the role of the MADS-box transcription factor PISTILLATA (PI), a B-class gene with known function in petal and stamen organ identity, in the development of the stamen whorl of Zingiberales. We present the phylogenetic relationships of four copies of PI recovered from across the Zingiberales. Expression studies are used to determine the role of the various copies in stamen and labellum formation in *Musa* (5 fertile stamen) and *Costus* (1 fertile stamen plus labellum). Results are discussed in the context of unravelling the genetic mechanisms underlying the evolution of the stamen whorl within the Zingiberales.

**110 Hsp90 and Evolvability: Opportunity or Constraint?** SUZANNAH RUTHERFORD, CHARLES CAREY, KRISTEN GORMAN, BECKY HOWSMON, CLAIRE MILTON, CHRIS ULANE, and JENNIFER KNAPP (Division of Basic Science, Fred Hutchinson Cancer Research Center, 1100 Fairview Ave N, Seattle, WA 98109-1024; srutherford@fhcrc.org).

Evolution poses a dichotomy of stasis and change. While molecular chaperones such as the heat shock protein Hsp90 act as phenotypic buffers to restrict the expression of heritable variation, they could also promote its accumulation and release in bursts of morphological evolution during environmental change. We studied mechanisms of morphological change controlled by Hsp90. By buffering highly polygenic variation affecting the strength of signal transduction, reductions in Hsp90 promote modular change in typically invariant quantitative and qualitative traits, increasing their capacity to evolve. We present a model whereby Hsp90 protects thresholds in highly conserved gene networks underlying developmental stability.

### Weird Life

Tuesday, 1:30 p.m. in HENSILL HALL 206

**111 What Is Weird Life — Why Should We Care?** JOHN BAROSS (University of Washington, School of Oceanography, Marine Sciences Building, Box 357940, Seattle, WA 98195; jbaross@u.washington.edu).

This contribution will be a very brief introduction to the symposium providing some background on the National Academy of Sciences study and publication “The Limits of Organic Life in Planetary Systems.”

**112 Life on Earth, Part II**, CHRIS MCKAY<sup>1</sup>, PAUL C. W. DAVIES<sup>2</sup>, STEVEN A. BENNER<sup>3</sup>, CAROL E. CLELAND<sup>4</sup>, CHARLES E. LINEWEAVER<sup>5</sup> and FELISSA WOLFE-SIMON<sup>6</sup> (<sup>1</sup>NASA Ames Research Center, Building N245; Room 212, Moffett Field, CA 94035; <sup>2</sup>Beyond Center for Fundamental Concepts in Science, Arizona State University, PO Box 876505, Tempe AZ 85287; <sup>3</sup>Foundation for Applied and Molecular Evolution, 1115 NW 4<sup>th</sup> Street, Gainesville FL 32601; <sup>4</sup>Department of Philosophy, CB 232, University of Colorado, Boulder CO 80309-0232; <sup>5</sup>Planetary Science Institute Research School of Astronomy and Astrophysics, Mt Stromlo Observatory Cotter Road, Weston Creek, ACT 2611 Australia; <sup>6</sup>Department of Earth and Planetary Sciences, Harvard University, 20 Oxford Street, Cambridge, MA 02138; cmckay@nasa.gov).

The search for a second, different, example of life has focused

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on microorganisms on the other worlds of our solar system, the search for biosignatures on extrasolar planets, and SETI. Comparatively, little attention has been paid to the possibility that our own planet might also host a second genesis of life. If life arises readily in Earth-like conditions, as many astrobiologists contend, then it may well have formed many times on Earth itself, which raises the question whether one or more shadow biospheres have existed in the past or still exist today. In this paper, we discuss possible signatures of weird life and outline some simple strategies for seeking evidence of a shadow biosphere.

**113 Extremophiles We Already Know and Love: What Do They Suggest?** ROCCO L. MANCINELLI (Carl Sagan Center for the Search for Life in the Universe, SETI Institute, 515 N. Whisman Rd., Mountain View, CA 94043; rmancinelli@seti.org).

Recently we have come to realize that where there is liquid water on earth, essentially no matter what the physical conditions, no matter where, there is life. Environments we previously thought of as having insurmountable physical and chemical barriers to life, such as extremes in temperature, pH, and radiation, are now seen as yet another niche harboring “extremophiles”. This realization, coupled with new data on the survival of microbes in the space environment, and modeling of the potential for transfer of life between planets suggests that life could be more common than previously thought. Data from recent Mars missions support the notion that Mars had abundant liquid water on its surface in the past, and has salts in its regolith. It could also have brine pockets that may either be an “oasis” for an extant biota, or the last refuge of an extinct biota. To better understand what it takes to survive extreme conditions we study microbes and how they live, survive, and die from the lagunas in the Bolivian altiplano to the space environment in earth orbit. We have shown that terrestrial life can survive away from earth in a simulated Mars environment and in the space environment. This research represents the first step in understanding what it takes for life to survive away from its home planet.

**114 Using New Space Agency Technologies to Search for Weird Life,** SIMON P. WORDEN (NASA Ames Research Center, Mail Stop 200-1, Moffett Field, CA 94035; Pete.Worden@nasa.gov).

The development of new technologies for NASA space-based missions and the ground support thereof, has led to sensors capable of identifying minute traces of molecular compounds. These sensors may eventually prove useful for directly detecting weird life missed by current sequencing methodologies based on DNA, or for remotely detecting the biosignatures of life as we don’t yet know it in the atmospheres of distant habitats. This talk discusses some of the most recent technologies and developments, as well as those challenges still in search of solutions.

**115 How Strange Can Life Be?** CHRIS IMPEY (University of Arizona, Department of Astronomy, 933 N. Cherry St., Room N24, Tucson, AZ 85721; cimpey@as.arizona.edu).

Science is in its most precarious position when it argues inductively about the general properties of a phenomenon based on one example. It is formally possible that life on Earth is a unique accident, but the evidence accumulates that the ingredients for biology are widespread in the cosmos. The range of life on Earth - the result of one set of physical constraints and evolutionary outcomes - spurs speculation on how strange life might be in the large number of potentially habitable locations elsewhere. The talk will explore

these levels of strangeness.

**116 Distant Biosignatures: Life on Exoplanets,** JOHN BAROSS (University of Washington, School of Oceanography, Marine Sciences Building, Box 357940, Seattle, WA 98195-794; jbaross@u.washington.edu).

Since Earth is the only planet that unequivocally supports ecosystems, it is logical as a first-order priority to search for extra-solar planets that have measurable characteristics that resemble Earth. The very basic requirements of Earth-life are liquid water, sources of carbon, nitrogen, light or chemical energy, and other nutrients. Their identification in the atmosphere of an extra-solar planet would be exciting and profound. An argument can also be made that obtaining evidence for active tectonics and hydrothermal activity, mechanisms that are vital for extracting life-supporting volatiles and elements from rocks and creating diverse environmental settings, would also increase the probability for a life-supporting planet. However, inasmuch as we can use Earth-life as a point of comparison, the search for extra-solar Earth-like planets is limited by our incomplete understanding of the more than four billion years of environmental changes associated with evolving physiological diversity of life and changing ecosystems and the elucidation of contingent factors directing the evolution of life. An Earth-like extra-solar planet may evolve successful ecosystems and even highly complex organisms that bear no resemblance to Earth life either at the biochemical level or in the way the biosphere modulates atmospheric conditions. However, we expect that life on an Earth-like planet to be supported by chemical and/or light energy a concept referred to as the “unity of metabolism”. The Earth-like planet model also predicts that the earliest microbial ecosystems would have been characterized by extremely high densities of specific metabolic groups of microbes that I refer to as “the enrichment period” since heterotrophic eukaryotes (microbial predators) had not yet evolved. The following questions will be addressed in the context of our search for extra-solar planets. How versatile and adequate is the carbon-based model to environmental conditions that extend beyond the bounds found on Earth? Are there alternate carbon-based biochemistries that would allow organisms to exist under very different environmental conditions than can Earth-life? What are the limitations to evolutionary innovations in carbon-based life?

**117 Searching for Weird Life of the Intelligent Kind,** JILL TARTER (Center for SETI Research, SETI Institute, 515 N. Whisman Road, Mountain View CA 94043; jtarter@seti.org).

Unless life on Earth is the result of interstellar panspermia, any life in a distant planetary system, that is detected by SETI (search for extraterrestrial intelligence) observing programs, must by definition be weird life. SETI is in fact a misnomer because it is not possible to detect intelligence directly; instead SETI observations attempt to detect manifestations of the technologies of another intelligent civilization. This talk discusses new instrumentation that is currently being constructed or commissioned to expand and speed up SETI searches at radio and optical wavelengths, and what we might expect in the next few decades.

**Near-Earth Objects:  
A Threat and Response Update**  
**Wednesday, 8:30 a.m. in HENSILL HALL 543**

**118 The NEO Environment: What We Know and What's Coming,**  
**DAVID MORRISON** (Director, NASA Lunar Science Institute, and Senior Scientist, NASA Astrobiology Institute, NASA Ames Research Center, Moffett Field, CA 94035; David.Morrison@nasa.gov).

Over the past 10 years the Spaceguard Survey, a directed telescopic survey, has discovered 6,300 near-Earth objects (NEOs), asteroids and near-Earth comets whose orbits cross or approach that of the Earth. Included in these objects are about 865 larger than 1 kilometer in diameter, 83% of the anticipated total population of approximately 1040 such objects. The original goal of the Spaceguard Survey was to have discovered 90% of these large objects by the end of 2008.

Recognizing the regional and local danger posed by smaller impacting objects, Congress called on NASA in 2005 to upgrade its surveys in order to discover 90% of objects 140 meters in diameter and greater by 2020.

Based on our surveys and other analytic methods we now have a solid understanding of the statistical distribution of NEOs and can fairly accurately estimate the future discovery rate of object of various sizes. We also have a good understanding, through improved analytic modeling, of the damage caused at the Earth's surface by the smallest, most populous cohort of objects of concern. If the 1908 Tunguska impact (3-5 megatons TNT equivalent energy) is assumed to be the limiting case of concern the total population of objects above this threshold is 600,000 to 1.2 million, of which today we have discovered less than 0.4%.

The driving force in much of the NEO activity today lies in the recognition that in meeting the revised Spaceguard goal we will discover on the order of 400,000 dangerous objects in the next 10-15 years.

**119 NEO Deflection; An Overview and Some Perspective,** **RUSTY SCHWEICKART** (Chairman, B612 Foundation, 760 Fifth St. East, Sonoma, CA 95476 and Chairman, Near Earth Objects (NEO) Committee, Association of Space Explorers (ASE), 1150 Gemini Ave., Houston, TX 77058; rs@well.com).

The obvious question which immediately follows on any report of our discovery and tracking of near-Earth objects is, "and what do we do about it when we find one with our address on it?"

This obvious question was the organizing motivation for the formation of the B612 Foundation and for most of the subsequent work that has been done on this issue by the Foundation and others since 2001. A great deal has been learned in this period of research while a great deal remains to be done to be fully accountable to the public interest.

The good news is that it now appears that over 95% of the NEO impact threat can be eliminated, using arguably existing technology, provided adequate early warning is provided.

The bad news is that none of the deflection concepts implied in this statement has yet been fully demonstrated or validated.

The basic elements on which these two claims are made are explored and elaborated on in this presentation, including both the technical and legal impediments to their realization.

A sense of the technical challenge involved in NEO deflection can be appreciated in realizing the factor of 1,000,000 variation

required in total impulse for various deflection scenarios. Similarly the legal challenge is easily appreciated in that there is today no agency within the US Government (nor any government in the world) with the assigned responsibility of preventing or mitigating asteroid impacts.

**120 Know Then Tow: The Role of Transponder - Gravity Tractor Spacecraft in Asteroid Deflection Campaigns,** **EDWARD LU** (Google, Inc., 1600 Amphitheatre Parkway, Mountain View, CA 94043 and B612 Foundation, 760 Fifth St. East, Sonoma, CA 95476; edlu123@gmail.com).

I will discuss the mechanics of deflecting asteroids, and why preventing an impact should be considered as a campaign with multiple steps, rather than a single event or mission. critical part of such a campaign is highly accurate tracking both before and after deflection, as well as the ability to fine tune the deflection. A single spacecraft known as a Transponder - Gravity Tractor can accomplish both tasks. I'll show the results of a JPL/B612 Foundation study, as well as animations of how such a campaign would look.

**121 The Geopolitics of NEO Deflection and Mitigation,** **RUSTY SCHWEICKART** (Chairman, B612 Foundation, 760 Fifth St. East, Sonoma, CA 95476 and Chairman, Near Earth Objects (NEO) Committee, Association of Space Explorers (ASE), 1150 Gemini Ave., Houston, TX 77058; rs@well.com).

"We can know an asteroid is coming at us, and we can have the capability to prevent it from impacting, but unless there exists a standing process to make a timely, internationally coordinated decision to act, we'll likely take the hit."

This statement has been repeated many times in characterizing the geopolitical challenge posed by the threat of asteroid impacts. While true it is not readily appreciated, even by many involved in the technical issues of asteroid impact deflection and mitigation.

The key to understanding the issue here is in understanding the uncertainties implicit in the global nature of the threat and the geographic shifting of the risk profile in the process of eliminating the risk to all.

All asteroid impact threats, with the exception of the rare last minute discoveries, will present an uncertain impact region, referred to as the "risk corridor," which typically extends across the entire planet. This surprisingly narrow corridor (generally 10s of km wide) will often not be reduced to a specific region or point (nation or nations) until long after the decision to deflect will have to be made.

Furthermore in the process of deflection the nominal impact point will effectively have to be shifted along this risk corridor until it is "removed" off either the leading or trailing limb of the Earth. The binary choice of which direction a deflection is taken translates into a very dicey political decision indeed.

## CONTRIBUTED ORAL PRESENTATIONS

### Working on Darwin

Monday, 8:10 a.m. in HENSILL HALL 206

**122 Darwin and the Gardener's Chronicle, 1841-1877, MICHELE L. ALDRICH and ALAN E. LEVITON** (Department of Herpetology, California Academy of Sciences, 55 Music Conservatory Drive, Golden Gate Park, San Francisco, CA 94118; maldrich@smith.edu).

In January 1841, the *Gardener's Chronicle* (GC), a weekly horticultural newspaper, began publication. The botanist John Lindley edited GC until his death in 1865, when botanist Maxwell Masters took over; both shared scientific interest with Charles Darwin (orchids and teratology respectively). Darwin first published an item in GC in August 1841. Across his life, a plurality of his printed articles appeared in the GC. In 1869, *Nature* started publishing and Darwin shifted allegiance to publish many short papers there (in part to address a wider range of topics), although he continued to send occasional pieces to the GC until 1877. Among the advantages of GC publication for Darwin were its fast turn-around (many of his articles were published within a week of submission) and large circulation (6,000 subscribers, reflecting the passion of Victorian England for gardening but nonetheless remarkable for its time). Darwin published notes and queries in GC on double flowers, mould formation, soils, manures, and other horticultural topics. Several of his articles related to major topics addressed in his books, such as on orchids, hybrids, bees and fertilization of flowers, and natural selection. Darwin used GC readers to collect data and to try out ideas that were more fully developed in his longer articles in scientific journals published by the Linnaean Society and the Geological Society of London. Arguably his most sustained reporting (1852-57) in GC involved seed viability across time and under conditions such as salt-water immersion, questions important for theories of species dispersal and longevity that related to evolution. Darwin worked to ensure favorable reviews of his books in the GC, and usually succeeded in obtaining them.

**123 Darwin's Second Voyage Around the World – This Time by Royal Mail, JANET BELL GARBER** (independent scholar, 7734 West 81<sup>st</sup> Street, Playa del Rey, CA 90293; janetgarber@UCLA-lumni.net).

Why are there so many kinds of flowering plants? What causes each variation? Darwin asked in his *Origin of Species* (pp.197-8) Is there momentum to variation? Why is there seemingly capricious sterility of some flowers? His first idea was that the physical environment must have an influence, which immediately suggested experiment. Other ideas included cross-fertilization, and correlation of change in two or more features.

He set to work, with pots in his study and the kitchen garden, adding a hothouse in 1862, but his mind churned out more ideas for experiment than he had time for. He already had many correspondents, more than 300 of them outside the United Kingdom. But he wanted more. He sent queries to the British Museum, the Linnean and Zoological Societies, nurseries, botanical gardens throughout the Empire and at Harvard, universities, the *Gardeners' Chronicle*, to recruit laboratory assistants. He suggested experiments to them, and gave directions for experiment. Darwin himself experimented

on over 1,600 plants in 54 species and made microscopic studies of pollen tubes to prove the advantages of cross-fertilization.

Over 60 of his correspondents contributed to Darwin's three books on fertilization of flowers. This paper details Darwin's correspondence with a few of his foreign correspondents who were of the most help to him in his busy years from 1861-1881. Herrmann Müller in Germany, Herrmann's brother Fritz Müller in Brazil, Fedrico Delpino in Italy and Friedrich Hildebrand in Germany.

**124 The Evolution of Methodological Naturalism in the *Origin of Species*, STEPHEN C. DILLEY** (St Edward's University, 3001 S. Congress Ave., Austin, TX 78704; stephend@stedwards.edu).

I analyze Darwin's deployment of methodological naturalism in the *Origin of Species* from the first edition through the sixth edition. (Methodological naturalism, as I use the term, is the view that supernatural explanations are not permitted in science, but rather only naturalistic explanations.) I argue that methodological naturalism plays an important, yet largely tacit, role in the first three editions of the *Origin*. After Darwin's views had become increasingly accepted by the scientific community, however, he altered later editions of the *Origin* to include explicit endorsements of methodological naturalism. This shift allowed Darwin to marginalize special creationism from the scientific discussion altogether; no longer was it a poor scientific explanation, but now it was not a scientific explanation *at all*—it was not even fit for discussion in scientific circles. I argue that Darwin's explicit deployment of methodological naturalism in later editions was essentially a rhetorical move—rather than an epistemic one—which functioned as part of his non-epistemic strategy to undermine a rival view. While Darwin may have had epistemic reasons for adopting methodological naturalism, his explicit use of this method seems to have been political or rhetorical in nature.

**125 Darwin vs. Wallace Revisited: On Adaptedness and Inheritance, JOHN O. REISS** (Department of Biological Sciences, Humboldt State University, 1 Harpst St., Arcata, CA 95521; jor1@humboldt.edu).

The independent proposal of a theory of evolution by natural selection at the hands of Charles Darwin and Alfred Russel Wallace is a classic episode in the history of science. Under the supervision of Lyell and Hooker, a joint publication of their theories appeared in the Linnean Society Journal in 1858, and Darwin hastened to publish the "sketch" of his theory called *On the Origin of Species* the following year. How similar were the two theories? Here I highlight two significant differences: 1) For Darwin, in his early theorizing, and even in the *Origin* of 1859, the variations that adapt a species to changing environmental conditions appear due to the disturbing effects of the changed environment on the reproductive system. In fact, it is maladaptedness to the new environment that *causes* the variations. For Wallace, the variations are already present when conditions change, and there is no maladapted phase. 2) Darwin's population model was of a sexual population in which differences in survivorship and reproduction interact with "laws of variation" and "laws of inheritance" to produce evolutionary change. Wallace had no such model, but instead thought only in terms of "varieties" that were essentially self-perpetuating clonal lines. Darwin and Wallace thus differed critically in their conceptions of adaptedness and of inheritance. Although this divergence of viewpoint now dates back more than 150 years, there are lessons we modern "Darwinians" can learn from each of these founders of evolutionary biology.

**126** *The Humorous Play of Evolution*, WILLIAM FINLEY FRY  
(156 Grove St., Nevada City, CA 95959; frywf@yahoo.com).

This year – 2009 – is the bicentennial anniversary of the birth of Charles Robert Darwin, the more senior of the two – with Alfred Russel Wallace – widely honored procreators of the scientific masterpiece, *The Theory of Evolution*.

Tradition views the creation process in the development of the theory of evolution engaging the efforts of both biologists – working in two vastly different environments. Darwin on the boat journey of the HMS Beagle and at the family farm in rural England, Wallace in the semi-tropical Amazon Valley and in Malaysia – as being arduous, grim, intensely serious, and overbearing. That tradition fails to take account of the significant roles played by Humor and its associated behavior, Play, during the creative processes engaged in by both theorists during their studies.

This paper will present instances of humor and play contributing to the creative processes in the development of the Theory of Evolution. I will expound on several ways in which those contributions enhanced that development.

**127** *From Darwin to Dayton: Cartoonists Interpret Evolution, 1860-1925*, MARK ALDRICH (Department of Economics, The Gables, Smith College, Northampton MA 01063; maldrich@smith.edu).

Darwin's writings coincided with the rise of a mass popular press and technical improvements that allowed low cost cartooning. The man and his work proved to be a cartoonist's dream and the illustrators in turn, introduced evolution to a popular audience, both criticizing and defending it. While few cartoons focused on evolutionary mechanisms, a central theme was human descent, and many images trace the increasing skepticism with which the Americans viewed the idea of progress. Artists also employed evolution as a humorous gimmick and to comment on a wide range of social and cultural issues. Sometimes it might be subversive -- spoofs of monkeys in tuxedoes skewered the pretensions of the nouveau riche. But by the Scopes trial evolution had become a symbol for all of science, and belief came to symbolize cultural enlightenment.

**128** *Darwin and the Dragon: Evolution's Influence on John Dewey and China*, DARRYL E. BROCK (History Department, Fordham University, 441 East Fordham Road, Bronx, NY 10458; darryl-brock21@yahoo.com).

The American educational theorist John Dewey arrived in 1919 China on the eve of the May Fourth Movement, a nationalist imperative driven by the twin goals of democracy and science (Mr. Democracy and Mr. Science). The rising second generation of Chinese intellectuals—the May Fourth generation—embraced Darwinism as universal law of nature and society, popular magazines employing buzzwords such as “survival of the fittest.” Dewey found the Chinese drama most stimulating, and stayed in China for two years to influence this emerging China. The first foreign scholar invited to lecture in China, Dewey presented nearly 200 lectures, attended by thousands at a time while widely reported in the press. Dewey's focus: Science, democracy and education. Proclaimed a “Second Confucius,” the American Dewey advocated an experimental, scientific mode of inquiry to resolve societal problems. Darwinism, in particular, provided a way for modern thinkers to abandon a view of a static nature and society, while embracing new concepts of a dynamic universe, as perceived through Darwinian evolution of species. The pragmatic approach offered by Darwin's

theory frees the human imagination from the static and fixed to changing, heterogeneous possibilities. Ideas are not true because they seem to explain perceived realities, but they must be verified and tested as hypotheses. In Dewey's view, experimental thinking provides a more reliable knowledge to drive human behavior. The Dewey disciple and future Chinese Ambassador to the United States, HU Shih, would embrace and extend Dewey's Darwinist philosophy with his own brand of pragmatism.

**129** *G.G. Simpson, Paleontology, and the Neo-Darwinian Revolution*, LÉO F. LAPORTE (University of California, Santa Cruz, CA; laporte@ucsc.edu).

Darwin's *On the Origin of Species* (1859) argued successfully for the reality of organic evolution (his “descent with modification”), but he failed to convince that the mechanism was natural selection operating on the inherited variation of traits existing within a population of sexually reproducing organisms. Throughout the next several decades other theories were proposed claiming that intergenerational transformation was instead due to Lamarckian-like inheritance of acquired characteristics, large scale mutations inducing instant new species, or internal factors acting independently and driven by quasi-nonmaterial forces.

Only with the discovery of chromosomes and genes, and the formulation of the foundation of modern genetics in the early part of the last century, did it become clear that Darwinian natural selection could serve as the chief explanation for the temporal transformation of life. Much of this research came to George Gaylord Simpson's attention in the mid-1930s, particularly seminal papers by R.A. Fisher (esp. 1930), Sewall Wright (esp. 1931), and J.B.S. Haldane (esp. 1932), and in particular T. Dobzhansky's book, *Genetics and the Origin of Species* (1937).

By virtue of Simpson's heavy dose of biology while a graduate student at Yale, his institutional contact with biologically oriented colleagues at the American Museum of Natural History – Osborn, Matthew, and Gregory – and his own deep study of mammalian paleontology, he was able to extend the “New Genetics” into a dynamic reading of the fossil record that went beyond the more usual descriptive morphology and taxonomy of the day. Simpson's *Tempo and Mode in Evolution* (written from 1938 to 1942, published in 1944), together with Dobzhansky's book, Ernst Mayr's *Systematics and the Origin of Species*, and G. Ledyard Stebbins's, *Variation and Evolution of Plants* (1950), were the pillars of the “modern evolutionary synthesis,” a phrase coined after Julian Huxley's, *Evolution: the Modern Synthesis* (1942).

### **Joint Session of the Anthropology and Archaeology; Cell and Molecular Biology; Ecology, Organismal Biology and Environmental Sciences; and Industrial Science and Technology Sections** Monday, 8:15 a.m. in HENSILL HALL 201

**130** *A Simpler Origin of Life between Mica Sheets?* HELEN GREENWOOD HANSMA (Department of Physics, University of California, Santa Barbara, CA 93106; Helen.hansma@gmail.com).

Many problems with the origin of life are solved by the hypothesis that life originated between mica sheets. Ancient natural “books” of mica sheets provide a secure environment, an endless

## ABSTRACTS – Contributed Oral Papers

energy source, confinement chemistry effects, and a grid of anionic mineral sites bridged by exchangeable potassium ions ( $K^+$ ).

Mica's clay-mineral atomic structure has a lattice spacing of 0.5 nm, equal to the spacing of amino acid residues in peptide beta-sheets, the nucleotides in single-stranded nucleic acids, and lipids in a lipid film. The spaces between mica's thin mineral sheets provide stable cell-like compartments for the evolution of ribozymes and other prebiotic polymers.

Up-and-down movements of these sheets are powered by solar energy and moving water. This provides endless energy for covalent bond formation by mechanochemistry. The energy of a carbon-carbon bond at room temperature is approximately equal to a mechanical force of 6 nanoNewtons (nN) moving a distance of 100 picometers.

The discovery of Intrinsically Disordered Proteins (IDP) turns the protein structure-function dogma upside down, because a single IDP can assume many transient structures and perform many functions (Dunker, et al. J. Molec. Graphics Modelling **19**,26(2001)). Thus the earliest unstructured peptides could have had simple functions.

Mica's movements, pressing on lipid vesicles containing proto-cellular macromolecules, might have facilitated the blebbing off of 'daughter' protocells. This blebbing-off process has been observed recently in wall-less L-form bacteria and is proposed to be a remnant of the earliest cell divisions (Leaver, et al. *Nature* **457**,849(2009)).

**131 Reconstructing Historical Coral Reef Ecosystem Conditions in the Hawaiian Archipelago**, JOHN N. KITTINGER<sup>1\*</sup>; JONATHAN H. BLODGETT<sup>2</sup>; JENNIFER K. SCHULTZ<sup>3\*</sup>; LOREN McCLENACHAN<sup>4</sup>; KEPA MALY<sup>5</sup>; TERRY L. HUNT<sup>6</sup>; THOMAS S. DYE<sup>7</sup>; BRUCE A. WILCOX<sup>8\*</sup>; and JOHN M. PANDOLFI<sup>9,10</sup> (<sup>1</sup>Department of Geography, University of Hawai'i at Manoa, 445 Saunders Hall, 2424 Maile Way, Honolulu, HI 96822 USA; <sup>2</sup>The Centre for Marine Studies, The University of Queensland, St. Lucia, QLD 4072, Australia; <sup>3</sup>Department of Zoology, University of Hawai'i at Manoa, 2538 McCarthy Mall, Edmondson 152, Honolulu, HI 96822 USA; <sup>4</sup>Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0208, USA; <sup>5</sup>Kumu Pono Associates, LLC, P.O. Box 631599, Lanai City, Hawai'i, 96763, USA; <sup>6</sup>Department of Anthropology, University of Hawai'i at Manoa, 2424 Maile Way, Honolulu, HI 96822 USA; <sup>7</sup>T. S. Dye and Colleagues, Archaeologists, Inc., 735 Bishop Street, Suite 315, Honolulu, HI, USA, 96813; <sup>8</sup>Asia-Pacific Institute for Tropical Medicine and Infectious Diseases, Division of Ecology and Health, John A. Burns School of Medicine, University of Hawai'i, 651 Ilalo Street, BSB 320, Honolulu, HI 96826, USA; <sup>9</sup>The Centre for Marine Studies and, <sup>10</sup>Department of Earth Sciences, ARC Centre of Excellence in Coral Reef Studies, The University of Queensland, Brisbane, Queensland 4072, AUSTRALIA; <sup>\*</sup>National Science Foundation, Integrated Graduate Education, Research and Training (IGERT) Program in Ecology, Conservation and Pathogen Biology, University of Hawai'i at Manoa; jkittinger@gmail.com).

Existing scholarship on coral reef ecosystems has attributed historical declines of coral reefs to a small set of direct human activities, or proximate impacts, including the primary threat of over-exploitation of marine species. Global-scale studies have revealed regional differences in the trajectories, timing and extent of coral reef ecosystem decline, highlighting the need for in-depth regional case studies in historical ecology. This transdisciplinary research

reconstructs coral reef ecosystem conditions over the past 1000 years in the Hawaiian Archipelago. A method will be presented for historical reconstruction of ecosystem change using different types, including archaeological data, historical-archival information, and modern data on marine species. Preliminary results will also be presented, which suggest that anthropogenic impacts from overharvesting differ at two spatial scales, including at the island level, and at the archipelagic level. From a conservation perspective, understanding historical trends is critically important in determining the current state and long-term trajectory of coral reef ecosystems and the threats to achieving desired future ecosystem states. This transdisciplinary research addresses the human dimensions of global environmental change for coral reef ecosystems, bridging ecology and the social sciences, which is necessary for formulation of appropriate conservation strategies and sustainable ecosystem management in the Pacific islands and beyond.

**132 Profiling Microbial Biodiversity and Abundance in Corals Plagued with Yellow Band Disease using 16S rRNA Microarrays**, COLLIN J. CLOSEK<sup>1</sup>, SHINICHI SUNAGAWA<sup>1</sup>, TODD Z. DESANTIS<sup>2</sup>, YVETTE M. PICENO<sup>2</sup>, EOIN L. BRODIE<sup>2</sup>, CHRISTIAN R. VOOLSTRA<sup>1</sup>, GARY L. ANDERSEN<sup>2</sup> and MÓNICA MEDINA<sup>1</sup> (<sup>1</sup>School of Natural Sciences, University of California, Merced, 5200 North Lake Road, Merced, CA 95343; <sup>2</sup>Center for Environmental Biotechnology, Lawrence Berkeley National Laboratory, Berkeley, CA; cclosek@ucmerced.edu).

It is understood that corals have symbiotic algae and associated microbial organisms, which comprises the coral holobiont. As an integral part of the coral holobiont, prokaryotic organisms are used as indicators of coral health. Coral reefs are threatened throughout the world. These intensified threats have paralleled disease outbreaks in many endangered reefs. Yellow Band Disease (YBD) is increasingly more common and is known to lethally affect four species of boulder star corals (*Montastraea* spp.), as well as the boulder brain coral *Colpophyllia natans*. YBD epizootic events occur most prevalently in the Caribbean Sea, where *Montastraea* spp. serves as a dominant reef building species. In this study, high density 16S rRNA gene microarrays were used to investigate the microbial community associated with *Montastraea faveolata* displaying phenotypic signs of YBD. Using this high-throughput platform, relative microbial abundances were compared to healthy colonies and other diseased colonies to identify possible pathogens.

**133 An Estuarine Copepod from Asia: Genetic Diversity in Two Recent Introductions**, ALLEGRA BRIGGS, C. SARAH COHEN and WIM KIMMERER (Romberg Tiburon Center for Environmental Studies, Department of Biology, San Francisco State University, 3150 Paradise Drive, California 94920; allegra@sfsu.edu).

The estuarine copepod *Tortanus dextrilobatus*, native to estuaries along the coast of southern China, was first reported in Seomjin River estuary, South Korea and San Francisco estuary, USA in the early 1990s. The populations in these two estuaries are thought to have been introduced via ballast water. We obtained samples from these two introduced populations and from one population (Xiamen estuary, China) within the reported native range. We used mitochondrial DNA (cytochrome oxidase c subunit I) to compare genetic diversity in these native and introduced populations in order to test for source populations, test for reduced genetic variation within introduced populations, and determine whether multiple introductions had occurred. We found unexpectedly high haplotype

diversity among all populations (86 haplotypes from 94 individuals). There were no shared haplotypes among the sampled populations and thus we cannot identify the source for either introduced population. There was strong bootstrap support for a clade formed by the Xiamen and Seomjin populations and also strong bootstrap support for the sub-clade formed by the Seomjin population. Most of the genetic variation (4% average sequence divergence) was between the San Francisco population and the group formed by the Seomjin and Xiamen populations. The Seomjin population had reduced nucleotide diversity in comparison with the Xiamen population, compatible with a founder effect. The San Francisco population, in contrast, showed no sign of reduced diversity. We estimated past changes in global effective population size using Bayesian coalescent analysis and to increase sample size for this, the three populations were combined.

**134 Evaluating the Potential for Spread of an Invasive Forb, *Limonium ramosissimum*, in San Francisco Bay Salt Marshes, GAVIN ARCHBALD and KATHARYN BOYER** (Biology Department, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132 and 1Romberg Tiburon Center for Environmental Studies, 3152 Paradise Drive, Tiburon, CA 94920; archbald@sfsu.edu).

Because invasive plants threaten San Francisco Bay's salt marsh plant communities, evaluating whether recently introduced species will spread rapidly can help managers prioritize conservation actions. Several populations of *Limonium ramosissimum* (Algerian sea lavender) were discovered in South San Francisco Bay in 2007. While this halophytic forb is invasive in southern California, whether *L. ramosissimum* is likely to spread by rapidly dispersing, recruiting, and reproducing in marshes across the Bay's salinity gradient, is unknown. We floated seeds at different salinities in aquaria to test effects on germination, and grew *L. ramosissimum* from seed to flowering under crossed inundation and salinity treatments in a tidal simulator experiment testing the potential for an estuary-wide invasion. Whether seeds floated for 1, 2, 4, 7, or 14 days or in 0, 15, or 30 salinity water, on average 86.7% of seeds across treatments germinated 16 days after being removed from aquarium tanks- indicating seeds have high dispersal potential. In the second experiment, after two months of *L. ramosissimum* growth in the tidal simulator, regardless of treatment, seedling mortality was extremely low (99.9% survivorship), however both salinity (0, 15, or 30) and inundation treatments (daily, bi-weekly or bi-monthly) affected growth. Plants grew 27 percent faster at salinities of 0 than 30, and 40 percent faster when inundated bi-monthly than daily, indicating while seedling survivorship is high across salinity and inundation gradients, plants will grow more rapidly both in the high marsh and further up-estuary where salinities are lower. *L. ramosissimum*'s potential to spread warrants early removal.

**135 Resistance Risk Assessment for Novel Reduced-Risk Insecticides in Obliquebanded Leafroller, *Choristoneura rosaceana* (Lepidoptera: Tortricidae), ASHFAQ A. SIAL, JAY F. BRUNNER, JOHN E. DUNLEY, and MICHAEL D. DOERR** (Department of Entomology, Washington State University, Tree Fruit Research and Extension Center, Wenatchee WA 98801; ashfaqsial@wsu.edu).

Obliquebanded leafroller (OBLR), *Choristoneura rosaceana* Harris (Lepidoptera: Tortricidae), is one of the most destructive pests of pome fruits in Washington. Use of broad-spectrum insecticides against OBLR for decades has led to the development of

insecticide resistance in this pest. In this situation, the recently registered reduced-risk insecticides with novel modes of action such as chlorantraniliprole and spinetoram show promise for OBLR control, but resistance remains a threat. The risk assessment for resistance to a particular insecticide before its occurrence in the field could be valuable in developing strategies to manage susceptibility. It can be done by testing field-collected populations and selecting for resistance in the laboratory. Studies were initiated to test field-collected populations and select a laboratory population for resistance against chlorantraniliprole and spinetoram to determine the risk of resistance evolution using quantitative genetic techniques. We treated 2000 neonates at LC<sub>70</sub>-LC<sub>90</sub> for 96 hours using diet incorporation method at each generation. After six generations of selection, 7- and 4-fold increases in LC<sub>50</sub> values were recorded for chlorantraniliprole and spinetoram, respectively. Realized heritability (*h*<sup>2</sup>) of resistance was estimated as 0.17 for chlorantraniliprole and 0.18 for spinetoram using threshold trait analysis. Response quotient (Q) was used to compare the rates resistance development in OBLR against these insecticides. The Q values were estimated as 0.11 and 0.07 for chlorantraniliprole and spinetoram, respectively. These results indicate that the risk of resistance development in OBLR exists against both of these insecticides, but resistance development in OBLR would be slower against spinetoram than that against chlorantraniliprole.

**136 Anthropogenic Sounds and Animal Songs: Conservation Biology in a Noisy World, M. BETH DAWSON** (Department of Biological Sciences, San José State University, San José, CA 95192-0100; mary.dawson@sjsu.edu).

Animals use acoustic communications in a range of social contexts, from establishing territory to finding mates to raising the alarm when predators are nearby. Many species have adapted to communicating in habitats influenced by noise from waterfalls or from loud choruses.

Anthropogenic sounds are a relatively new source of acoustic interference. Sounds from highways, power plants, and other anthropogenic sources have been shown disrupt acoustic communications in a wide variety of animals, including birds, whales, and frogs. In some cases, animals do not use habitats that are near sources of loud sounds. In other examples, when noise is present animals change their behavior in ways that may alter their fitness or reproductive success. Cricket frogs calling near highways produce less attractive calls and water sources near highways may become reproductive deserts for this species.

Sound recordings of both the noise and the acoustic signals can be used to predict acoustic conflict. Behavior studies are also needed to verify the effect of the urban sounds on nearby species. Anthropogenic noise may be an under-looked aspect to habitat restoration. Conserving habitat should include an analysis of acoustic communications of the species that use that habitat as well as noise sources and their possible impacts on those communications.

**137 Simulations of the Microcirculation in Rat Spinotrapezius Muscle and Muscle Fascia, FRANK JACOBITZ, CASEY WEISS and MATTHEW GABBARD** (Mechanical Engineering Program, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; jacobitz@sandiego.edu).

Properties of the microcirculation in rat spinotrapezius muscle and muscle fascia is studied using a computational approach. The simulations are based on a realistic microvascular network structure

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obtained from microscope observations and consider both blood rheology and vessel elasticity. An improved model for the apparent viscosity of blood is developed to take the shear thinning nature of blood into account. Capillary bundles of muscle tissue are composed of vessels that mainly follow the direction of muscle fibers. In muscle fascia, however, the capillary vessels form a mesh like network without a preferred direction. This structural difference of the microvasculature leads to significant differences in properties of the microcirculation. In the muscle fascia, vessel length, velocity, and shear rate follow a lognormal distribution. In muscle, however, the data does not support a lognormal distribution. For both networks, the hematocrit follows an approximately normal distribution.

**138 Developmental Canalization of Body Proportions in Sulawesi Booted Macaques: A Possible Connection to Locomotor Ecology,** ROBERT R. STALLMANN (Department of Anthropology, University of California, Davis, CA 95616 and Anthropology Program, School of Social Sciences, Humanities and Arts, University of California, 5200 North Lake Road, Merced, CA 95343; rstellmann@ucmerced.edu).

In this paper I examine the effects of developmental environment on limb proportions in Sulawesi (Indonesia) booted macaque monkeys (Cercopithecidae: *Macaca ochreata sensu lato*), while also providing new data on the locomotor behavior of this species. I then suggest a possible functional-evolutionary relationship between the observed developmental pattern and booted macaques' locomotor ecology.

I analyzed absolute and relative (allometric) growth of body segments in free-ranging Sulawesi booted macaques, including both wild-feeding and orchard-raiding populations. I supplemented my field data with published data on pet *M. ochreata* (T. Watanabe, Y. Hamada, B. Suryobroto, and M. Iwamoto. 1987. Kyoto University Overseas Research Report of Studies on Asian Non-Human Primates 6: 49-56) to assemble a sample spanning three environmental conditions with different dietary quality and activity levels.

Results suggest that relative growth of the trunk is faster under food-enhanced or activity-limited environmental conditions, though the differences disappear by adulthood. The relative growth of limb segments, however, appears to be highly canalized, with no differences observed between animals from the three different environments. The femur, moreover, shows evidence of strongly positive allometry relative to the trunk and to the other limb segments, across all environments. Behavioral data that I collected on random transects in a primary-forest population show that *M. ochreata* engages in arboreal locomotion > 90% of the time. The rapid and highly canalized growth of the femur is thus consistent with intense stabilizing selection on arboreal leaping ability.

I thank the L.S.B. Leakey Foundation and NSF (award 0622545) for crucial support.

**139 A Survey of Alleged Yeti Tracks: Is the Himalayan Mystery on Firm Footing?** D. JEFFREY MELDRUM (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007; meldd@isu.edu).

Indigenous populations of the Himalayan region have traditionally asserted the existence of a hair-covered man-like animal referred to as the Yeti. The attention of modern science was directed to the question in the twentieth century when western mountaineers reported sightings of the alleged creatures. In some instances these encounters were lent a degree of physicality by the discovery of

seemingly inexplicable tracks. The most widely publicized of these was the footprint photographed by Eric Shipton and Michael Ward in the Menlung Basin of Nepal in 1951.

A survey of footprints attributed to the yeti, documented photographically, and n rare instances preserved as plaster casts, was undertaken to more systematically assess the nature of these data. Footprints were categorized as indeterminate, ursine, or hominoid. The majority of cases were attributable to the first two categories. The latter group comprises three notable cases, the Shipton-Ward footprint, the McNeely-Cronin footprints, and the Gates footprints. The first two suggest a hominoid foot with a divergent hallux, while the Gates footprint indicates a hominoid foot lacking a divergent hallux. The implications of this contrasting morphology among a limited line-up of candidate footprints, are considered.

### Sustainability

**A Special Topic Joint Session of the Agriculture and Horticultural Sciences; Earth Sciences; Ecology, Organismal Biology and Environmental Sciences; and General and Interdisciplinary Sections**  
Monday, 1:15 p.m. in HENSILL HALL 206

**140 Unsustainable Water Demand: A Central California Example,** DAVID CEHRS (Math and Science Department, Reedley College, Reedley, CA 93654; Kings River Conservation District, Fresno, CA 93725; David.Cehrs@reedleycollege.edu).

The demand for water in Fresno County, California has outstripped supply since 1945. Water supply to the area is finite, yet demand for water has grown: increasing populations and increasing irrigated agriculture are preeminent. Three consecutive years of below normal precipitation have stressed the system leaving junior water right holders with little available water. Current arguments over water now pit agriculture versus the environment, yet municipal water use trumps all others.

What is missing from the discussion is demand versus supply. Until demand is reduced by all water users to meet available supply the current water fights will never end. But water allocation (demand reduction) is ultimately a political decision; one that is a lose-lose proposition for politicians as most constituents will be mad at decreased water supplies and the ensuing life-style changes.

To attain water sustainability in Fresno County, at current average water inputs with fixed populations and irrigated agriculture, would require about a 10% reduction in yearly demand. To achieve this would necessitate retirement of some irrigated lands, increased efficiency in all irrigation practices, and decreased per capita consumption by municipalities. But climate change models indicate a future reduction in precipitation (decreasing supply), planners indicate a doubling of the population by 2050 (increasing demand), and irrigated agriculture will be looked upon to provide needed food (increasing demand) for this increasing population. This is an untenable situation of decreasing supply and increasing demand that needs to be addressed immediately and will require great political will and leadership that is currently absent.

**141 Investigating the Effects of Reduced Surface Water Deliveries on the Aquifers of California's Central Valley,** CHARLES F. BRUSH<sup>1</sup>, LARRY L. DALE<sup>2</sup>, NORMAN L. MILLER<sup>3</sup>,

**SEBASTIAN D. VICUNA<sup>4</sup>, EMIN C. DOGRUL<sup>1</sup>, TARIQ N. KADIR<sup>1</sup>, and FRANCIS I. CHUNG<sup>1</sup>** (<sup>1</sup>Bay-Delta Office, California Department of Water Resources, 1416 Ninth Street, Sacramento, CA 95814; <sup>2</sup>Energy Analysis Department, Lawrence Berkeley National Laboratory, One Cyclotron Road, Mail Stop 90-4126D, Berkeley, CA 94720; <sup>3</sup>Climate Science Department, Lawrence Berkeley National Laboratory, One Cyclotron Road, Mail Stop 90-2012, Berkeley, CA 94720 and Geography Department, University of California, Berkeley, CA 94720; <sup>4</sup>Civil and Environmental Engineering Department, University of California, Berkeley, CA 94720; cbrush@water.ca.gov).

California's water-supply infrastructure incorporates moderately-sized reservoirs, and relies heavily on the storage of winter precipitation as snow in mountain watersheds surrounding the Central Valley. The higher elevations of the Sierra Nevada Mountains have already experienced a 0.6°C rise and 10% reduction in snowpack, and continued warming may reduce snowpack volume by 25% by 2050, with further reductions likely as lower-elevation precipitation increasingly falls as rain. Surface water deliveries may be further constrained by environmental restrictions and recurring droughts. California water users have historically increased groundwater pumping to replace surface water during droughts. Groundwater extractions increase for a short period of time, and groundwater levels recover in subsequent years when precipitation (and recharge) and surface water supplies return to historical levels. Groundwater pumping in response to long-term reductions in surface water supplies due to climate change or an extended drought may significantly impact Central Valley aquifers. These impacts are being studied using the California Central Valley Groundwater-Surface Water Simulation Model (C2VSIM), an integrated hydrologic model that simulates land surface processes, groundwater flow and surface water flow. C2VSIM can also simulate changes in crop mix in response to economic factors, including those associated with reduced surface water availability. During a simulated extended drought, groundwater heads decline significantly in areas with high irrigation demands, reaching new equilibrium levels in some areas. Subsequent simulations incorporating economic criteria indicated that changes in crop mix and increased fallowing could significantly reduce groundwater head declines.

**142 Worldwide Impacts of Wastewaters and Wastes from the Cities of the Developing World, WILLIAM F. GARBER** (Assistant Director, Bureau of Sanitation, City of Los Angeles (retired); williamgarber@cal.berkeley.edu).

Proper treatment and disposal of wastes from the very large cities of the world is an environmental imperative. World Bank estimates are that by about 2015 all of the largest cities with populations over 10 million will be in the "Developing World". Only four or five will be in the "Developed World" and provide "proper" treatment. This represents a worldwide problem since contaminants from cities are not confined by national borders or by geographical features such as oceans. Los Angeles as an example contributes contaminants but also receives air and water contaminants as well as public health issues from other world areas. Realistically most of these other cities cannot afford the treatment use in the Developed World. The USA with 19 and 22 percent of the population of China and India respectively has respectively 2.7 and 5 times the funds available for treatment purposes. Procedures and standards appropriate to fund availability need to be developed. Worldwide scientists, engineers, regulators and societal groups need to aid the

development and application of such affordable applications to cities having almost no treatment to help the stressed worldwide environment. Data illustrating the magnitude of the problem with some tested possible avenues towards solution or amelioration are presented. A plea is made to recognize the accomplishments of workers in the cities of the developing world for how much they have already accomplished with their very limited funds.

**143 New Estimates of Loadings of Suspended Sediments to San Francisco Bay, California, LESTER J. MCKEE** (Watershed Program, San Francisco Estuary Institute, Oakland, CA 94621; lester@sfei.org).

Information on suspended sediment loads is of paramount importance for managing urbanized estuaries due to associated degradation of water and sediment quality, recreation amenities, native species habitat, and disruption of commercial shipping operations. In San Francisco Bay, suspended sediment information is critical in at least four management areas:

- 1) Sediments are pollutants by themselves, degrading habitat through siltation,
- 2) Sediments carry particle-associated pollutants, such as mercury, PCBs, and legacy pesticides,
- 3) 4.4 million cubic yards (2007 figure) of sediment is dredged annually from shipping channels therefore an understanding sources assists planning authorities,
- 4) Sediment budgets in each Bay segment are critical for tidal wetland restoration projects.

Allochthonous suspended sediment is supplied to the Bay from two main pathways; the California Central valley via the Sacramento/San Joaquin River Delta (154,000 sqkm) and from small urbanized tributaries of the nine-county Bay Area (8,200 sqkm). Suspended sediment supply from atmospheric deposition and wastewater treatment is minimal. Research in the 1970s and 80s provided evidence that approximately 80% of the sediment supply was from the Central Valley but that sediment loads from the central valley were trending downwards, a premise most recently promulgated by Krone (1996) in Hollibaugh (Ed.) San Francisco Bay: The Ecosystem.

In this paper we present evidence that on average 1 million metric t of suspended sediment enters the Bay from the Central Valley and about 1.3 million metric t is supplied from the tributaries of the nine-county Bay Area, thus the balance is tipped even more than Krone had predicted.

**144 Sources, Pathways, and Loadings of Hg, PCBs, and other Pollutants of Concern to San Francisco Bay, California, LESTER J. MCKEE** (Watershed Program, San Francisco Estuary Institute, Oakland, CA 94621; lester@sfei.org).

A tremendous amount of effort has been applied over the past decade to locate sources of pollutants of concern (POC) in watersheds tributary to San Francisco Bay and measure or estimate mass loadings at a variety of scales. For the most part, these efforts have been authored by the Bay Area Stormwater Agencies Association (BASMAA), the San Francisco Bay Regional Water Quality Control Board (Water Board), and San Francisco Estuary Institute (SFEI). In most cases also, these efforts have largely occurred in response to the Clean Water Act and the need to better understand pressures on, and the impairment of, the beneficial uses of San Francisco Bay.

Given all Bay segments are 303(d) listed for Hg and PCBs,

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and fish consumption advisories have been in existence for more than 10 years, the majority of effort has been placed on measuring and estimating loadings on mercury and PCBs. However, there has also been assessment of loadings of other priority POC such as PBDE, copper, nickel, pharmaceuticals, PAHs, organochlorine and other pesticides, and nutrients. In addition, there are efforts underway by researchers at SFEI through the Regional Monitoring Program for Water Quality (RMP) to measure loadings of dioxins, and to better understand mercury methylation and Hg and PCB speciation towards improved urban best management practice (BMP) and more rapid attainment of desirable water quality standards.

This paper will present the history of effort and the most recent estimates and measurements of speciation and loadings of pollutants entering the San Francisco Bay.

**145 An Integrated System for Wastewater Scrubbing and Bio-energy Production, CATHERINE HARE<sup>1</sup>, JOHN KOZLOWSKI<sup>1</sup>, RACHEL McCORMICK<sup>2</sup>, TIM NELSON<sup>3</sup>, LILY CHEN<sup>2</sup> and MICHAEL F. COHEN<sup>1</sup>** (<sup>1</sup>Department of Biology, Sonoma State University, 1801 E. Cotati Avenue, Rohnert Park, CA 94928; <sup>2</sup>Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco CA 94132; <sup>3</sup>Department of Biology, Seattle Pacific University, 3307 3rd Avenue West, Ste. 205, Seattle, WA 98119; chare@sfsu.edu).

Passage of municipal wastewater effluent (MWE) through constructed wetlands can lower levels of residual contaminants and nutrients in the water. As a demonstration project, two 37 m<sup>2</sup> Channelized Aquatic Scrubbers (CAS), each composed of three channels ranging in depth from 12 to 46 cm, were constructed at the City of Santa Rosa Laguna Treatment Plant and stocked with native floating aquatic vegetation and algae. Flows of MWE through the CAS ranged from 1 to 20 mm sec<sup>-1</sup>. From June 2008 to April 2009 nitrate removal efficiencies of the CAS averaged from 318 to 1775 mg N m<sup>-2</sup> d<sup>-1</sup> (mean ± SE). Denitrification constituted the primary mechanism of nitrate removal. Additionally, preliminary results from juvenile trout bioassays show that the CAS substantially decrease levels of estrogen-mimicking compounds in the water. Net productivity of the CAS, estimated from regular harvests, averaged from 1.3 to 13.7 g dry weight m<sup>-2</sup> d<sup>-1</sup>. Anaerobic digestion of harvested biomass at 35 °C yielded 145 ± 22 ml biogas g<sup>-1</sup> dry weight; an approximate 40% synergistic enhancement of biogas production from the biomass was attained by co-digesting with a mix of winery and dairy waste. On a larger scale, energy generation from digester biogas could increase the feasibility of constructed wetlands for wastewater polishing.

**146 Investigation of Microbial Population Dynamics During MTBE Biodegradation in Groundwater with Nanoparticle Based DNA Assay, REEF B. HOLLAND, RADOMIR SCIMIDT, AHJEONG SON and KRASSIMIRA R. HRISTOVA** (Department of Land, Air, and Water Resources, University of California Davis, One Shields Avenue, Davis, CA 95616, USA; rbholland@ucdavis.edu).

Our study provides a novel approach to monitoring contaminated aquifers and provides new tools in understanding methyl tert-butyl ether (MTBE) contamination of aquifers. *Methylibium petroleiphilum* strain PM1, a methylotroph representing a new species within the *Rubrivivax* group of the β-proteobacteria, naturally degrades the fuel additive MTBE in oxic environments. MTBE is a major groundwater contaminant in CA and a suspected carcinogen.

Biodegradation of MTBE in groundwater is slow and often terminates at the recalcitrant breakdown product *tert*-butyl alcohol (TBA), a known carcinogen. California removed MTBE from gasoline in 2003, however its persistence in groundwater continues. In this study we aim to link the degradation of MTBE in ground water to functional gene copy numbers to elucidate the relationship of microbial population dynamics to degradation using a novel method for quantification of functional genes. This method uses a high throughput, non-PCR, nanoparticle-based DNA hybridization assay for detecting genes in the environment. We are targeting two important functional genes in the biodegradation pathway. The first gene, *mdpA*, is related to *alkB*-type alkane monooxygenases. This gene encodes the enzyme MTBE monooxygenase involved in the first step of MTBE degradation. The second gene, *mdpJ*, encodes for TBA hydroxylase that converts TBA to hydroxy methyl propanol. This step is critical for complete MTBE degradation. Microcosm studies were conducted to determine gene expression of the two functional genes during MTBE degradation. Gene expression was quantified using both our novel nanoparticle based assay and qPCR.

**147 Sustainability and Ethics of Animal Breeding, WENDY M. RAUW** (Department of Animal Biotechnology, University of Nevada Reno, Mail Stop 202, Reno, NV 90557; wrauw@cabnr.unr.edu).

In his work “On the Origin of Species”, Darwin cited William Youatt with “It is the magician’s wand, by means of which [the agriculturist] may summon into life whatever form and mould he pleases”. However, after decades of intensive artificial selection, undesirable side effects of increased production efficiency in farm animal species are becoming increasingly apparent. Fast growing broiler chickens show an increased incidence of heart failure syndrome and leg problems. Increased mobilization of body reserves in high producing dairy cattle results in more days open and several metabolic diseases, and sows with very high lean tissue growth rate appear unable to meet their genetically improved growth rates and litter sizes by voluntary food intake, resulting in frequent reproduction problems. These side effects are often related to disturbed resource allocation patterns, and have obvious implications to animal welfare.

It is intuitively acceptable that output (production) requires input (food). Therefore, an understanding of resource allocation patterns is imperative to sustainable animal production and genetic improvement, and will offer the opportunity to understand, anticipate and prevent negative side effects of selection. The key ethical question is not if we should breed, but how we should breed. Animal wellbeing and welfare can be *improved* by breeding as well, when emphasis is placed on welfare associated traits in the selection index, such as longevity and health. Breeding companies are more frequently including functional traits in their breeding goal and this is successful. Implications for sustainable agriculture will be discussed.

**148 Sustainable Building Science: Technology and Building Methods, SHELLEY LOTZ** (Sustainable Living Programs, Box 1362, Ashland, OR 97520; lotz.shelley@gmail.com).

Building practices are rapidly changing, as new technology and scientific research are focusing on the green building industry. The objective of the green building industry is to meet the needs of the present without depleting resources faster than we can sustain

them. Residential and commercial buildings in the U.S. consume huge amounts of natural resources and energy. Site design, energy systems, solar technology, green materials, indoor environmental quality, and water conservation are all facets of sustainable building that will be discussed with examples.

A discussion of new trends in designing healthy, energy efficient dwellings with a smaller footprint and using fewer renewable resources will be presented, focusing on the three cornerstones of green building, namely, Environment, Economy and Social Equity.

The talk will also address the new green building certifications, standards and incentives that are aimed at helping the green building industry, and will discuss ways to navigate through the maze of information.

**149 The Gated Membrane: “Getting the Science Right” in Public Decisionmaking,** DEBORAH M. HUSSEY FREELAND (University of San Francisco School of Law, 2130 Fulton Street, San Francisco, CA 94117; dhusseyfreeland@usfca.edu).

I present a broadly applicable model of how science is integrated into legal and other public decisionmaking processes, described in terms of a gated membrane between scientific and legal realms. The gated membrane protects the decisionmaking mechanisms on either side, while allowing the different realms to communicate with each other with effective, immediate feedback and careful translation. Approaching the problem of “speaking science to law” from the perspective of professional ethics, the model addresses the differing goals, professional commitments and cultural norms of scientific and legal endeavors and suggests ways to harmonize these goals for more effective communication that protects scientific integrity.

I identify a scientific ethic that I call the *maieutic ethic*: the commitment of a scientist to bracket her subjective inclinations and let nature speak through her work. While this ethic represents an ideal that may not be realized, the striving of a professional scientist to conduct research in this manner affords science robust qualities that strengthen its claims to objectivity—that make science the best of our knowledge.

As a case study, I analyze the federal legal and regulatory structure for the restoration of the Florida Everglades through adaptive management, identifying the key features of a successful strategy for getting the science right in ecosystem management, and recommending refinements to the developing administrative structure.

I also apply the model to the different problem of multistakeholder environmental dispute resolution in the private sector. Based on this analysis, I offer an improved approach to science-based dispute resolution that protects the ability of participating scientists to exercise their professional judgment independently of the disputing parties.

I close by indicating other interfaces between science and public decisionmaking that can be well described by the gated membrane model, in which interdisciplinary interaction may be greatly improved by structuring decisionmaking procedures to support the scientist’s *maieutic ethic*.

**Joint Session of the  
Chemistry and Biochemistry and  
Health Sciences Sections**  
**Monday, 2:00 p.m. in HENSILL HALL 201**

**150 Toward Epigenetic “Voting”: Implications of Darwinian Biology for Health Care in the XXI Century,** FRANCESCO CHIAPPELLI<sup>1</sup> and OLUWADAYO OLUWADARA<sup>2</sup> (<sup>1</sup>Division of Oral Biology and Medicine, University of California Los Angeles School of Dentistry, CHS 63- 090, Los Angeles, CA 90095-1668; fchiappelli@dentistry.ucla.edu; <sup>2</sup>Department Anatomy, College Medicine, Ibadan University, Nigeria; oluwadara@yahoo.com).

Unquestionably, we are indebted to Charles Darwin (1809-1882) for having opened the gates to modern biology and the health sciences. In his treatise, *On the Origin of Species* (1859), a masterpiece of naturalistic observation, Darwin discusses little, however, how life emerged or how cells regulate their function. Molecular epigenetics studies factors related to the organism’s adaptation in the environment that modulate inheritance from generation to generation, and pertains to every domain of biology, including fundamental physiology and pathology. Molecular cartography, including genomics, proteomics, and interactomics, describes the multifaceted and intricate array of interacting genes and gene products, coding and non-coding DNA, that characterize the function and specialization of individual cells in the context of cell-cell interaction, tissue, and organ function. Molecular cartography in epigenetics, and chromatin studies contribute to our emerging knowledge and understanding about the control and regulation of gene expression, development, and aging in health and disease, from cancer to HIV/AIDS. Panels of molecular and genomic biomarkers can today be identified, whose signatures, taken together, are endowed with some degree of congruency, a coordinated “vote”. Epigenetic biomarkers are increasingly characterized, whose “voting”, taken together, will permit to develop of new and improved targeted clinical interventions into the XXI Century.

**151 Effects of Phenyl Propanoids on Murine B16-F10 Melanoma Cells,** HIROKI SATOOKA<sup>1</sup> and ISAO KUBO<sup>1,2</sup> (<sup>1</sup>Department of Nutritional Sciences and Toxicology, University of California Berkeley, Berkeley, CA 94720; <sup>2</sup>Department of Environmental Science, Policy and Management, University of California Berkeley, Berkeley, CA 94720; hiro\_satooka@berkeley.edu).

Eugenol (4-Allyl-2-methoxyphenol) and safrol (5-(2-Propenyl)-1,3-benzodioxole), two well-known phenyl propanoids, naturally synthesized from phenylalanine, were tested for their effects on murine B16-F10 melanoma cells. These phenyl propanoid showed various activities on mushroom tyrosinase-catalyzed (EC 1.14.18.1) oxidation of L-tyrosine or L-3,4-dihydroxy-phenylalanine (L-DOPA). Interestingly, safrol showed potent inhibitory effect on mushroom tyrosinase while eugenol did not affect on it. In a cellular assay, safrol slightly inhibits melanogenesis without any toxicity toward B16-F10 melanoma cells up to 200 µM (32.4 µg/mL) even though it is commonly known as a carcinogen. The agreement between cell-free and cellular assay gives possible the mechanism of melanogenesis inhibition. On the other hand, eugenol and its related compound, namely methyleugenol, isoeugenol, and methyl isoeugenol did not suppress melanogenesis, but rather significantly enhanced in melnocytes. In addition, eugenol exhibited cytotoxicity with IC50 of 225 µM (37.0 µg/mL). Other eugenol-related compounds also showed similar IC50s. Various additional

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other structurally related phenyl propanoids were also tested for comparison. The results suggest that safrol has the potential to be used as the melanogenesis inhibitor, and eugenol can be used as the melanogenesis stimulant to increase intracellular melanin level without affecting cell growth up to 50  $\mu\text{M}$ .

**152 Differential Effects of Mainstream and Sidestream Tobacco Smoke on the Genetic Integrity of Mouse Sperm and Early Embryonic Development, ARIS POLYZOS<sup>1</sup>, THOMAS ERNST SCHMID<sup>1,2</sup>, BELEM PIÑA-GUZMÁN<sup>3</sup>, BETZABET QUINTANILLA-VEGA<sup>3</sup> and FRANCESCO MARCHETTI<sup>1,4</sup>** (<sup>1</sup>Life Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720; <sup>2</sup>Present address: Klinikum rechts der Isar, Technische Universität München, Munich, Germany; <sup>3</sup>Toxicology Section, CINVESTAV-IPN, Mexico City, Mexico; <sup>4</sup>aapolyzo@sympatico.ca).

Substantial evidence from human studies is associating paternal cigarette smoking with increased chromosomal abnormalities in sperm and increased risk for spontaneous abortions, malformations and neonatal death. However, little is known of the mechanisms by which paternal smoking may damage germ cells and harm the developing embryo. Also, it is not known whether exposure to sidestream (SS) smoke, the main constituent of second-hand smoke, induces genetic lesions in sperm and how these lesions affect fertilization and embryonic development.

We are using a mouse model to investigate whether tobacco smoking by the father affects the genetic integrity of the sperm and early embryonic development, and whether male germ cells are equally sensitive to mainstream (MS) and SS tobacco smoke. A series of sperm DNA quality and embryonic endpoints have been measured after exposing male mice for two weeks to MS or SS smoke generated by either 3 or 16 cigarettes per day. Our results indicate that: (1) exposure of male mice to MS smoke affects sperm DNA integrity as measured by the comet neutral assay; (2) both MS and SS smoke increase DNA lesions that are observable with the sperm chromatin structure assay whereas (3) only SS significantly affects the motility of the sperm. The developmental effect of paternal smoking of either MS or SS significantly impaired fertilization and the numbers of embryos that reached the 4-cell stage after mating (4).

These results suggest that *in vivo* exposure of male mice to tobacco smoke affects the genetic integrity of germ cells and has detrimental effects on early embryonic development. They also indicate that male germ cells are more sensitive towards exposure to mainstream than to sidestream smoke and that smoking by the father may affect stem cells and produce long-lasting effects. These findings show that paternal smoking or exposure to second-hand smoke may significantly influence a couple's chance for a successful pregnancy and the birth of a healthy baby.

**153 The CDASH-HL7 BRIDG: How Harmonizing Clinical Trial and Healthcare Standards May Impact Data Users, CLINTON W. BROWNLEY** (American University, 4400 Massachusetts Avenue, NW, Washington, DC 20016; clintonbrownley@yahoo.com).

Efforts are underway to harmonize existing clinical trial and healthcare standards. What impact, if any, will this harmonization have on data users/analysts in clinical research?

The Clinical Data Acquisition Standards Harmonization (CDASH) initiative is a project supported by a collaborative group of organizations, and led by the Clinical Data Interchange Standards

Consortium (CDISC), to harmonize data collection standards for clinical and medical research. Through the Biomedical Research Integrated Domain Group (BRIDG), CDISC is collaborating with Health Level Seven (HL7), a leading healthcare standards development organization, to harmonize the CDISC clinical research with the HL7 healthcare standards.

This paper focuses on ways in which the ongoing efforts to harmonize clinical trial and healthcare standards changes the connections and requirements among the standards and how these changes may impact data users/analysts in clinical research.

**154 Chinese Patients' Behaviors and Problems in Eye Medication Adherence, AUDREY TAM<sup>1</sup> and SHIU Y. KWOK<sup>2,3</sup>** (<sup>1</sup>Department of Molecular and Cell Biology, University of California, Berkeley, CA 94704; <sup>2</sup>Vision Science Medical Group, 728 Pacific Ave., Ste 702, San Francisco, CA 94133; <sup>3</sup>Department of Ophthalmology, University of California, San Francisco, CA 94143; audreytam@berkeley.edu).

Purpose: To determine patients' adherence to eye medication and to systematically identify the various barriers to medication adherence for patients.

Method: 300 Chinese patients in an ophthalmologist private practice were interviewed by a volunteer in a non-confrontation way. The pattern of medication use was noted. Reasons for not using medication as prescribed were reviewed.

Results: 25% (26/104) chronic glaucoma patients, 26% (43/168) patients with dysfunctional tear syndrome/dry eyes and 71% (20/28) patients with allergic conjunctivitis reported to have used eye medication as prescribed. Patients' barriers to medication adherence include cognitive and psychological problems, e.g. forgetfulness (40%), emotional factors (5%); cost (10%); side effect of medication (7%); lack of symptoms (20%); lack of information (9%); and other priorities (5%). Physician' contributions (10%) including failure to explain benefits and side effects of medication adequately; and failure to consider patients' life styles. The health care system barriers (15%) are the high cost of medication and copayment; and restricted formulary.

Conclusion: Chinese patients have poor adherence to eye medication as compared to other ethnic groups. This study offers insight into these patients' eye medication behaviors. Question may be raised as whether similar adherence behaviors are found in other medical treatments for Chinese patients. Solution is likely to be multi-dimensional and individualized. Baseline screening for adherence predictors, and more importantly, a focused intervention in addressing the modifiable risk behaviors for poor adherence should be implemented in each physician-patient encounter.

**155 Solution to the Arrhythmia Problem, DAVID BLACKMAN** (retired, University of California Berkeley, 307 West Second, Phoenix, Oregon, 97535-7733; gribear@Mac.com).

Much theoretical work is been done on the cardiac arrhythmia problem. One such paper, done by Winslow et al. Has 11 currents 91 differential equations and 101 initial conditions and constants. The solution has three currents. First current is the sodium, calcium exchanger, second current is the combined passive current complex and finally the third current is sodium, potassium ATPase. Each equation has theoretical consequences: the first ties the polarization event to the contractual thermodynamically; the second is a quantum mechanical treatment of passive current explaining T-wave alternans; third equation predicts elevated potassium concentration

accelerates Sodium, Potassium ATPase. The trick to substitute active transport for passive transport deficit. How is this accomplished? Slightly elevated potassium (5-6 meq/L) should treat current lack inherent in the compromised myocytes. This hypothesis has been borne out by experimental use of potassium in arrhythmia patients rather dramatically. As reported by Drs. Hans Nieper, Gerhard Schurmann, and Garry F. Gordon in Brecher's book, in *Forty Something Forever*, Brecher, H. and A. Healthsavers Press, Herndon Virginia. Magnesium which also effects the ATPase system has similar effects.

**156 Propargyl Methyl Ethers: Novel Precursors to Cobalt-Complexed Propargyl Cations, SARINE SHAHMIAN<sup>1</sup> and GAGIK G. MELIKYAN<sup>2</sup>** (<sup>1</sup>Chaminade College Preparatory High School, West Hills, CA 91304; <sup>2</sup>California State University Northridge, Department of Chemistry and Biochemistry, Northridge, CA 91330; sarine.shahmirian@yahoo.com).

The generation of transition metal-stabilized organic cations under *neutral conditions* has long been sought after in the field of organometallic chemistry. Traditionally, unsaturated organic ligands are treated with strong Lewis acids, such as tetrafluoroboric acid ( $\text{HBF}_4^-$ ). This method, however, is inapplicable for substrates containing functional groups sensitive to acids, in particular benzyloxy and acetal groups. The novel method for the generation of  $\text{Co}_2(\text{CO})_8$ -complexed propargyl cations *under neutral conditions* was developed: employing the metal-bonded methyl propargyl ethers as substrates and triflic anhydride as a reagent. Ionic propargyl triflates are formed *in situ* as intermediates, due to successive nucleophilic substitution reactions. The transition of these reactive intermediates to the respective propargyl radicals readily occurs at 83°C (3-6 min), by way of the cluster-to-cluster and cluster-to-ligand single electron transfers. The carbon-carbon formation alpha to the metal clusters affords polysubstituted 3,4-diaryl-1,5-alkadiynes in high yields (>80%) and excellent *d,l*-diastereoselectivity (89-97%). The scope of the reaction was expanded by involving topologically diverse propargyl ethers, particularly those containing methoxy groups on the periphery of the aromatic nuclei.

### Joint Session of the Psychology and Social, Economic, and Political Sciences

Tuesday, 9:00 a.m. in HENSILL HALL 667

**157 Tariffs and Trusts; Profiteers and Middlemen: Popular Writers and Political Cartoonists Explain Inflation to the American Public, 1897-1920, MARK ALDRICH** (Department of Economics, The Gables, Smith College, Northampton MA 01063; maldrich@smith.edu).

Popular understanding of economic matters in a democracy is important, for the people are the ultimate source of economic policy. Yet much modern research suggests little popular understanding of important economic issues. This paper analyzes popular perceptions of the great inflation from 1897-1920 as manifested in editorials and especially political cartoons. While economists of that day and now attribute the inflation to monetary forces, the lay public subscribed to a hodgepodge of ad hoc, often conspiratorial, explanations for rising prices, blaming them on everything from monopolies and middlemen to supply and demand, incompetent farmers, lazy husbands and wasteful wives. These beliefs

had important consequences for Progressive-era public policy, supporting clothing and food boycotts, witch hunts for profiteers, tariff revision, railroad regulation, farm credit and antitrust prosecutions.

**158 The Expanding Role of the States in Science and Technology Policy, DEREK KAUNECKIS** (Political Science Department, University of Nevada, Reno, NV 89557; kauneck@unr.edu).

Important changes in the activity of state governments in science and technology (S&T) policy have occurred over the past decade. Traditionally the states have followed a research agenda set at the national level and acted as the implementation organization for federal funds. Today the states have taken on an increasingly proactive role providing independent funding for local research priorities, as partners in regional collaborative arrangements, as well as setting their own agendas both as complementary and even counter to that at the federal level. While the most high profile cases include stem cell research, alternative energy and climate change mitigation these are indicators of an increasingly autonomous and independent role of the states in S&T policy. Using a newly collected dataset, this paper examines the types of state-level S&T activities, their distribution and provides evidence to explain the variation among states. It utilizes a theoretical framework derived from research on public goods production within federal governance systems to explain the strategies adopted by the states in the new landscape of S&T policy in the American federal system. The paper concludes with implications for federal S&T support as well as lessons for state governments.

**159 Do Those Troublesome Students Have Attention Deficit Disorder and Depression or Are They Just Cognitively Different While Using and/or Abusing Substances? J. BARRY GURDIN** (To Love and to Work: An Agency for Change, 247 Ortega Street, San Francisco, CA 94122-4617; gurdin@hotmail.com).

Using Max Weber's notion of ideal type, a clinical sociologist outlines configurations that frequently arise when students who have learning difficulties may have been diagnosed with one or more categories of DSM-IV-TR™, and may be simultaneously experimenting with, using, or abusing various substances. Balancing his role of ethnographer with his roles as clinical sociologist, tutor, and counselor, this sociologist sketches common problems encountered when working with such students. Raising some sociological objections to psychiatry's and psychology's understandings of such problems, this clinical sociologist relates some effective techniques that helped his clients overcome their learning disabilities. He also records some of his clients' resistance to being viewed as different or as Americans with learning disabilities.

**160 Fashion Historiography: A Novel Theoretical Approach, DAMAYANTHI ELUWAWALAGE** (State University of New York, 218 Human Ecology Building, Oneonta, NY 13820-4015; eluwawd@oneonta.edu).

The lack of theoretical/historical knowledge in fashion and clothing has led some writers to misinterpret the fashion historiography. There are many noted discrepancies, in relation to various present day fashion/clothing writings. Differences in fashion theories also reflect different eras. For example, nineteenth-century social theorists, such as Veblen and Simmel, regarded differentiation and stratification as essential pre-conditions of fashion. By contrast, twentieth-century social theorist, Herbert Blumer, regards fashion as an expression of collective behaviour, that is, the fashion

## ABSTRACTS – Contributed Oral Papers

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mechanism appears not in response to a need for class differentiation and class emulation, but in response to a wish to be in fashion. Costume and, its application and meaning, has varied with each period. Costumes throughout the ages have symbolically expressed the inner philosophical thoughts which directed the behavior of a given epoch. Garment cutting and construction techniques also varied considerably from century to century as each era produced its own unique decorations and silhouettes. This paper explores the meanings encoded in the dress, adornment and social order as well as the evolution and development of fashion, clothing related theory and philosophy, focusing on the broader understanding, application and interpretation of fashion and clothing theory. The function of clothing was often used for more than its utilitarian purpose, for example, the analysis of gender in clothing reflects the sociological differences and the power relations between sexes. In that context, this paper examines attire as an aesthetic experience, as well as a social and cultural expression of the period.

**161 Effects of Facial Prominence on Predicted Job Performance... A Gender Disparity in Predicted Negative Behavior, JUSTIN L. MATTHEWS** (Cognitive Science Program, School of Social Sciences, Humanities, and Arts, University of California, Merced, P.O. Box 2039, Merced, CA 95344; jmatthews@ucmerced.edu).

Are predictions of job performance influenced by facial prominence? Does the “type” of job that is paired with a picture matter? Higher facial prominence has been linked to higher ratings on the following traits: intelligence, ambition, attractiveness, dominance, and assertiveness. Some research suggests that facial prominence is less important than gender and occupation when trait judgments are concerned, while archival studies of print media suggest that gender, facial prominence, and perceived occupation status are consistently related.

Research has shown that facial prominence, gender, and perceived occupation are related in media outlets. In the current study, 798 students completed a judgment task that examined whether differing levels of facial prominence paired with job types would influence thought about job performance. Results suggest that an incongruity between occupation and facial prominence leads to higher predicted levels of negative work-related behaviors for male, but not female, job candidates.

When career information (e.g. a résumé) is paired with a picture of a job candidate, facial framing influences predicted work-related behavior. Future research will explore to what degree raters' judgment of occupation “physicality” influence these types of behavior predictions.

**162 Brown Adipose Tissue in Human Adults: Commodity or Vestige? J. KEN NISHITA and ERIKA L. BENT** (Psychology Department, California State University, Monterey Bay, 100 Campus Center, Seaside, CA 93955-8001; ken\_nishita@csumb.edu).

Recent reports showing brown adipose tissue (BAT) present and active in healthy human adults have revived the debate on BAT functionality and its role in energy expenditure (Cypess et al., 2009; van Marken Lichtenbelt et al., 2009; Virtanen et al., 2009). In the human fetus and newborn, BAT has the primary function in heat production (Aherne and Hull, 1966). Most studies in human adults suggest a transition of multilocular BAT to unilocular white fat with advancing age, and this regression of BAT coincides with the development of the shivering mechanism (Hassai, 1977; Heaton, 1972; Tanuma et al., 1976; Wegener, 1951). BAT remains in varying

anatomical regions in humans throughout adult life, with similar distributions in both males and females, but in greater amounts in young adults. Accordingly, the role of functional BAT in human adults remains puzzling.

Nonshivering thermogenesis during cold exposure, diet-induced thermogenesis and adaptive thermogenesis (Lowell and Spiegelman, 2000) have been suggested to be linked to functional BAT in small mammals and humans. Recent investigators have related human BAT to the body-mass index (BMI) and individual energy expenditure speculating a possible BAT inactivity in obesity. These recent findings led us to re-evaluate our previous studies on cold-exposure in patients with anorexia nervosa (Nishita, Ellinwood, Jr., and Rockwell, 1984, 1985). We report supportive data using BMI and infrared thermographs.

**163 Psychological Barriers to Global Poverty Involvement, STEVEN F. BACON** (Department of Psychology, California State University Bakersfield, 24 DDH, 9001 Stockdale Highway, Bakersfield, CA 93311; sbacon@csub.edu).

Given the great wealth of Americans and the great need of the world's extreme poor, it is surprising that Americans have done so little to help. The purpose of this study was to describe cognitive barriers to involvement in global poverty relief efforts. 165 college students (80% female, 50% Hispanic) completed a brief questionnaire assessing their knowledge of world geography and global poverty, their current level of involvement in global poverty relief efforts, and their reasons for non-involvement. Results from 16 reasons for non-involvement were subjected to a principle components analysis with varimax rotation yielding four major factors which act as barriers to involvement in global poverty relief efforts. These factors were labeled resentment about giving, distrust of government, personal inconvenience, and overconfidence in markets. The implications of these four factors for interventions to increase involvement and suggestions for future research are discussed.

**164 Field Theories of Consciousness, EDWIN E. KLINGMAN** (Cybernetic Micro Systems, PO Box 3000, San Gregorio, CA 94074; klingman@geneman.com).

In 1940 Kohler proposed that the field detected by EEG was the consciousness field. Subsequent work discredited this view and the field approach to consciousness languished for decades. Recently the field view has received renewed interest.

Although some have suggested a quantum field as the mechanism of consciousness, others have recently discussed the electric field as a potential mechanism. Most agree that the energy of the field is relevant to its interaction with the physical brain. A non-electrical field proposed by James Clerk Maxwell circa 1860 was dismissed as too weak to provide meaningful physical interaction, but new experimental evidence calls this into question. This field has been proposed as crucial to the integral awareness of physical brains.

The above fields are discussed as well as the local and global significance of each field and the potential consequences for a Darwinian view of consciousness. The consensus view of consciousness as an artifact is discussed from the perspective of field theories, and a mechanism by which the field is coupled to a neural net is proposed.

### Science and Technology Education Section

Tuesday, 10:15 a.m. in HENSILL HALL 439

**165 Environmental Metaphors in Science and Society: Workflow of the Case Study “The Elephant and the Oak Tree,” V.G. MIN-NICH** (University of California Santa Barbara Donald Bren School of Environmental Science and Management, Santa Barbara, CA 93106; stokastika@yahoo.com).

The Elephant and the Oak Tree (EOT) is a first case study of formulating and applying a “media ecology” approach, or adaptive and integrative workflow of storytelling and audience feedback in concern of environmental metaphors in science and society. EOT was constructed in order to explore and address these two major questions: “How does one make the pursuit of science and environmental problem solving more accessible and inspirational to the broader public?” and “How does one convince scientists and diverse stakeholders to adopt a more integrative approach in feedbacks between collective learning and behavioral change? (e.g. science and policy)” Designing and engaging in this systematic workflow—from construction of multi-media narrative to dissemination and collective response—has the capacity to assimilate knowledge in the fields of (1) ecology, evolution, and earth sciences, (2) environmental institutions and the sociology of scientific practice, (3) cognitive layering/ sense-making of storytelling, and (4) public communications campaigns/ feedbacks between the storyteller and his or her audience. Feedback from specific audiences will be evaluated through surveys.

**166 Analysis of iTunes U Podcast Use by Undergraduate Biology Students Shows a Beneficial Outcome, CHRISTOPHER J. SMITH<sup>1,3</sup>, TANIA BELIZ<sup>1</sup>, and JEAN MACH<sup>2</sup>** (<sup>1</sup>Biology Department, <sup>2</sup>English Department, College of San Mateo, 1700 W Hillsdale Blvd, San Mateo, CA 94403; <sup>3</sup>Ginger Pharmaceuticals, Inc, San Mateo, CA; smithchris@smeccd.edu).

Recent changes in undergraduate science education include online or hybrid courses and electronic material such as textbooks and supplemental media. Electronically enhanced courses are attractive to educators as a way to bolster course material and provide students with more and varied learning options, approaches suitable to the era of internet information access. This study was undertaken to evaluate one such electronic supplement to undergraduate-level science courses. Audio podcasts of biology class lectures were posted on the College of San Mateo’s iTunes University website, provided by the Apple Corporation. Surveys were administered to students of three consecutive semesters to evaluate the use, effectiveness and outcome, as determined by course grade, of the podcasts. The results showed that the majority of students accessed the recorded lectures and those that used them the most felt that doing so improved their performance in the class. Data indicated that students most at risk of poor academic performance used the podcasts most frequently. This study indicates that electronic media supplementation enhanced science student performance. Further studies are underway in order to more effectively implement and use electronic supports and supplements to contribute to student success.

**167 Design and Implementation of a Software Tool for Managing and Assessing Scientific and Technical Achievements, OSCAR L. NAZARIO, MARK A. PISCOTTY, JOSEPH Q. PASCUAL, CHRISTINE M. GOMEZ, RULON K. LINFORD, and KEN-NETH J. JACKSON** (L-090, Lawrence Livermore National

Laboratory, Livermore, CA 94550; jackson8@llnl.gov).

A semi-automated, systematic software system has been developed for tracking, analyzing, and assessing the scientific productivity and technical output of large research and development organizations like universities, research divisions in industry, and national laboratories. This web-based research tool mines content from institutional databases, queries on-line resources, and accommodates manual entry of information. Data maintained by the software are currently organized into 27 data types in seven categories, affording analysis and documentation options that not only account for the commonly used metrics of publication in the peer reviewed literature, but also incorporate education, honors, awards, institutional publications, extramural collaborations, and milestones in the arena of intellectual property and programmatic achievement. This information is organized along the concept of professional curriculum vitae for each individual in the system, with data links tying unique records to relevant individuals within the organization. Analysis explicitly accounts for and informs the assessment of research achievements by individuals, flexibly defined groups of researchers, and the organization as a whole, while implementing the capability to control the quality and validity of data and protecting individual privacy. A rich set of reporting capabilities also provides dynamically generated plots for trend analysis. Potential uses for the system include performance assessment for individuals or groups, determining the efficacy of internal investments, and enabling comparisons with peer organizations.

**168 Teaching as a Community College Adjunct Instructor after Retirement, ARTHUR ALTSHILLER** (Los Angeles Valley College, 5800 Fulton Avenue, Valley Glen, CA 91401-4096; Los Angeles Pierce College, 6201 Winnetka Avenue, Woodland Hills, CA 91371; Altshiller@aol.com, altshial@lavc.edu).

What do we do after retirement? For me retirement had to be a gradual process after 33 years as a Physics Teacher with the Los Angeles Unified School District.

I currently teach Mathematics for Elementary Teachers at LA Valley College and Introductory Astronomy at LA Pierce College. In doing this I frequently encounter former students I taught at Van Nuys HS. Prior knowledge of student achievement encourages interesting instructional feedback loops. Being a secondary teacher empowers me to better understand the requirements of some of our community college students. Having taught evening community college classes throughout my secondary career underscored these differences.

This paper will address these issues and include observations, techniques and suggestions that address student readiness and outcomes. It will recognize the differences that exist between the adolescent and adult student and include useful personal classroom anecdotes. It will mention what has not worked well for me as well as what has. I will present several interdisciplinary topics that augment curricular subject material and content objectives.

Closure of a former career provides an eventful opportunity to extend ones own personal growth. Students especially appreciate any insight that a retiree can offer. This has been a golden experience that I hope to continue to enjoy.

## ABSTRACTS – Contributed Oral Papers

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### Joint Session of the Computer and Information Sciences and Physics and Materials Science Tuesday, 1:30 p.m. in HENSILL HALL 667

**169 Conductivity Measurements in a Semi-Dilute CPyCl/NaSal Micellar System, IAN TAYLOR and PANOS PHOTINOS**  
(Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR 97520; Photinos@sou.edu).

We present AC conductivity measurements in the micellar system cetylpyridinium chloride/sodium salicylate (molar ratio 1:1) in water. The sample concentrations were in the semi-dilute range, between 20mM/20mM and 40mM/40mM. The measurements were taken along two principal directions in a Couette cylindrical cell, namely parallel to the velocity and parallel to the vorticity. We find that the conductivity parallel to the velocity increases with increasing shear rate, while the conductivity parallel to the vorticity decreases with increasing shear rate. The onset of shear causes an overshoot/undershoot transient of about 5 seconds. The results are compared to similar measurements parallel to the third principal direction, parallel to the velocity gradient, which show substantially different behavior.

**170 Are the Laws of Physics Laid-down or Built-in? EDWIN E. KLINGMAN** (Cybernetic Micro Systems, PO Box 3000, San Gregorio, CA 94074; klingman@geneman.com).

Most physicists, when first learning the laws of physics, ask, “Where did the laws come from?” The usual answer is that the question is metaphysical, and not our concern as physicists. Ironically, most physicists, having rejected the anthropomorphic idea of God as “King”, nevertheless retain some vestige of the idea of the King’s “Laws”. However, physicist John Archibald Wheeler insisted the laws come into being with the Universe, and, in essence are “built-in”.

An analysis of the problem and a suggested approach are presented, and physical consequences are discussed. Based on a minimal assumption, a master equation can be written down and the solution analyzed. The additional assumption of mass-energy equivalence implies a quantum condition compatible with Heisenberg’s uncertainty principle. When rotation is considered, the Maxwell-Heaviside-Einstein GEM (gravito-electro-magnetic) equations are derived, with potential application to the dark energy assumed responsible for the current acceleration of the universe.

**171 A Rediscovered GEM, EDWIN E. KLINGMAN** (Cybernetic Micro Systems, PO Box 3000, San Gregorio, CA 94074; klingman@geneman.com).

One of the greatest physicists of all time, James Clerk Maxwell introduced the gravito-electro-magnetic (GEM) field, which was subsequently investigated by Heaviside, Lorentz, Einstein, and others before vanishing from most physicists’ radar screens. Gravity Probe B, new mysteries, new experimental results, and new theories appear to be bringing GEM back to life.

The GEM equations are presented, and their history, through Einstein discussed. The historical reasons for diminished interest in the field are reviewed. New factors that are causing a second look at the field are discussed, and modified GEM equations are introduced. These are reviewed with respect to Martin Tajmar’s experimental results, and their potential relevance to a number of current problems in physics is discussed.

**172 Physics 3.0: Why Computer Science Will Lead the Next Physics Revolution, STEVEN BRYANT** (Avitel Corporation, 1563 Solano Avenue, #205, Berkeley, CA 94707; Steven.Bryant@RelativityChallenge.com).

Computer Science has been a distinct discipline for less than a century. As a relative newcomer to the scientific landscape, knowledge has predominantly flowed from historically established disciplines, like Mathematics and Physics, into Computer Science. During the past 50 years, Computer Science has undergone explosive growth in its Body of Knowledge. With an emphasis on Type, Function, and Namespace Abstraction, 2D and 3D Geometric Transformations, and Reverse Engineering, Computer Science provides unique techniques for analyzing physical and mathematical problems, derivations, and theories. Here we reexamine the validity of Einstein’s 1905 Special Relativity Theory derivation, revealing several mistakes that are impossible to detect without the algorithmic reasoning tools and techniques uniquely found in the Computer Science Body of Knowledge. Support of these findings is obtained by showing that the corrected moving systems equations produce quantitatively better results than Einstein’s original equations for the landmark Michelson-Morley and Ives-Stillwell experiments. As a result, the revised equations may provide a basis for new algorithms, with increased accuracy, for position and navigation systems. Correcting the accepted equations, and their interpretation, will require that specific Type, Function, and Namespace Abstraction knowledge found in the Computer Science discipline, as well as its refined understanding of Geometric Transformations, be migrated into the Mathematics and Physics Bodies of Knowledge.

**173 A Novel Memory Organization with Distributed Intelligence, EDWIN E. KLINGMAN** (Cybernetic Micro Systems, PO Box 3000, San Gregorio, CA 94074; klingman@geneman.com).

A significant problem in computer architecture involves the disparity between on-chip and off-chip memory access. Off-chip access may require 10,000 or more processor cycles before data becomes available. This problem has typically been addressed by a hierarchy of on-chip cache memories.

For a limited set of problems, a novel approach, “intelligent memory”, offers a solution. These problems include string search, nearest neighbor calculations, protein folding computation, air traffic control, and similar many-body problems. The architecture applicable to these solutions is described and a prototype FPGA implementation is discussed.

## CONTRIBUTED POSTER PRESENTATIONS

### POSTER SESSION I

MONDAY

12:00 p.m. – 4:00 p.m.

HENSILL HALL 3<sup>rd</sup> Floor Hallway

### SCIENCE and TECHNOLOGY EDUCATION

**174** *Toward the Identification of Value Conflicts in Ecological Restoration*, MILTON O. MEUX<sup>1</sup> and BRIAN M. MEUX<sup>2</sup> (<sup>1</sup>1022 Colusa Ave, Berkeley, CA 94707; <sup>2</sup>Santa Monica Baykeeper, 3100 Washington Blvd, Marina Del Rey, CA 90292; miltmeux@yahoo.com).

Ecological restoration is a crucial part of sustainability because such restoration is crucial to bringing back the ecosystems that continue to decline worldwide. It is now clear that ecological restoration necessarily includes a wide range of values—ecological, social, economic, political, aesthetic, cultural, commercial, recreational, personal, and still others. Not only are these values inherent to ecological restoration, but so also are conflicts among these values. Unless these value conflicts are resolved, they interfere with the effectiveness, acceptability, and even the very undertaking of a restoration. However, the needed understanding and competencies for identifying and resolving such value conflicts are lacking. Thus, we argue some kind of education is needed for the successful identification and resolution of these value conflicts.

This presentation focuses on education for the first phase of resolving these value conflicts—the identification of value conflicts in ecological restoration. We draw from three general conceptual frameworks central to education for identifying value conflicts in ecological restoration: 1) the UN Millennium Assessment (2005): indirect and direct drivers of ecosystem change, ecosystem services, and constituents of human well-being; 2) Clewell and Aronson's *Ecological Restoration* (2007): conceptual planning, preliminary tasks, implementation planning, and evaluation; 3) Wenden's pedagogy for developing a value perspective for sustainability, in Wenden (Ed) *Educating for a Culture of Social and Ecological Peace* (2004): evaluation of one's values, alternative values, and alternative futures. The approach will be demonstrated with two case studies: the Santa Monica Baykeeper Kelp Restoration Project (2001-present) and the Chicago restoration project (mid-late 1990s).

**175** *Monitoring African Bushmeat in the Classroom: Global Conservation Education*, MEGAN MORIKAWA<sup>1</sup> and JAY VAVRA<sup>2</sup> (<sup>1</sup>Duke University/High Tech High, Box 90753, Duke University, Durham, NC 27708; <sup>2</sup>High Tech High, 2861 Womble Rd, San Diego, CA 92116; megan.morikawa@duke.edu).

The African Bushmeat Expedition focuses on teaching students in San Diego and East Africa advanced skills in molecular biology for the application of conserving biodiversity. The program has created international partnerships while teaching high school students how applied sciences can make a significant contribution to sustaining life. Although poaching occurs worldwide, impacts in East Africa have been devastating. Species identification of trace

samples with DNA analysis could be used for prosecution once poachers or traffickers are captured with illegal kill. The project has raised international awareness of the bushmeat crisis and aims to curb illegal poaching and trade in East Africa.

Students first learn DNA-based analysis in their high school classroom. This forum allowed for passionate students to pursue independent projects in wildlife conservation and molecular biology. Students then applied their skills to real-world issues by organizing a trip to northern Tanzania in the summer of 2008 to assess the needs for molecular-based conservation forensics in East Africa. As a result of the expedition, further collaboration with industry partners such as Life Technologies and the San Diego Zoological Society has led to international awareness of the efforts and goals of the expedition. The project also encourages a reciprocal learning approach for students to teach their newly developed skills to partners in East Africa. This opportunity will be carried out in a Bushmeat Identification Workshop led by the expedition members in July of 2009. The project additionally allows for the pursuit of individual leadership roles in conservation prior to college experiences.

**176** *Critical Science Outreach: Implementing an Ecology Education Program into a California Alternative High School*, RAYNELLE RINO<sup>1</sup>, CYNTHIA WILBER<sup>2</sup>, and RODOLFO DIRZO<sup>1</sup> (<sup>1</sup>Department of Biology, 385 Serra Mall, Herrin Bldg., Rm 453, Stanford University, CA 94305; <sup>2</sup>Jasper Ridge Biological Preserve, Woodside, CA 94062; raynelle@stanford.edu).

Science education is essential for the prosperity of society. Assessments of science education in the US show poor student performance and a chronic ethnic disparity among students pursuing higher education. Simultaneously, environmental problems are increasing locally and globally. Pedagogic improvements are needed to make science education (ecology) a rewarding, and fulfilling option for K – 12 students and teachers. Higher education institutions can contribute to these improvements by training new generations of ecologists and science educators in ecology outreach. The Redwood Environmental Academy of Leadership (REAL) program is an effort of Stanford University (faculty/staff/students) to collaborate with teachers and connect to students of Redwood High School (RHS) in place-based learning. This alternative/continuation high school supports under-represented students experiencing additional educational challenges in their respective traditional schools. The REAL Program is an example of a Critical Science Outreach program, which aims to expose and educate communities where programs are not commonly implemented. Goals are to (1) provide RHS teachers and students with sustainable resources to teach/learn ecology, (2) engage students in hands-on activities that enhance learning and confidence they can do well in science and (3) to produce a program that is replicable and transferable.

Quantitative analysis shows students have a stronger understanding of the skills in doing science and increased self-identity and confidence in being a scientist. The Cordilleras Creek, which flows through the RHS campus and outdoor laboratory settings are major assets of pedagogic improvements. California Education Standards within the curriculum is essential for long-term investment and program replicability.

**177** *CalSmiles: Innovative, Student-driven Education Program Increases Oral Health Knowledge and Awareness*, TANNER Y. ZANE<sup>1</sup> and PAMELA Z. HAN<sup>2</sup> (<sup>1</sup>University of California San

## ABSTRACTS – Contributed Posters

Francisco, School of Dentistry, 707 Parnassus Ave., San Francisco, CA 94143; <sup>2</sup>University of California Berkeley, School of Public Health, University Hall, Berkeley, CA 94120; tanner.zane@ucsf.edu).

A large proportion of patients entering university student dental clinics have serious oral health problems accompanied by a gap in knowledge of proper hygiene. This observation requires a solution to integrate efforts to increase community oral health education with a specific focus on reaching and educating youth--before they develop serious oral health issues. CalSmiles uses education to increase oral health knowledge and awareness through youth interaction and tools designed in the program to reach lower income, underserved communities in the Bay Area. The program is composed of a series of lectures and hands-on enrichment activities to expose students to common topics in the dental and medical fields. The program culminates in a student-designed project (an informational pamphlet) for dissemination of oral health information to their communities. Students were given a pre-program diagnostic exam and a post-program exam to assess oral health knowledge. Student recruitment was accomplished by flyering and making presentations to high school science classes. Students (N=7) designed an oral education pamphlet and distributed it in their schools and communities. Students showed an improvement in oral health knowledge test scores from 50% (pre-program) to 85% (post-program). Local contacts within schools and/or other outreach programs are invaluable to recruitment. With these relationships in place, implementing similar programs in other locations is feasible and may fill a niche-role in many communities. The program is rewarding and useful for participants, and also provides an effective means of bringing valuable oral health information to underserved areas.

**178 Telling a Molecular Story: Mevalonate Kinase – Initiating the Pathway to the Cure for Malaria, LINCOLN SMART TEAM<sup>1</sup>, LARS WESTBLADE<sup>2</sup>, KURT GILES<sup>3</sup>, RICHARD GIN<sup>1</sup>, and JULIE REIS<sup>1</sup>** (<sup>1</sup>Abraham Lincoln High School, 2162 24<sup>th</sup> Avenue, San Francisco, CA 94116; <sup>2</sup>Center for BioMolecular Modeling, Milwaukee School of Engineering, 1025 North Broadway, Milwaukee, WI 53202-3109; <sup>3</sup>Institute for Neurodegenerative Diseases, 513 Parnassus Avenue, University of California, San Francisco, CA 94143-0518; reisclan@comcast.net).

Malaria, an infectious disease caused by parasites of the genus *Plasmodium*, is responsible for 1 to 3 million fatalities each year. Artemisinin is a potent anti-malarial drug used as part of a combination therapy. It is extracted from the leaves of the plant *Artemisia annua* (*A. annua*). Yields of plant-derived artemisinin are low and highly variable, resulting in a worldwide shortage. Amyris Biotechnologies, in collaboration with UC Berkeley and the Institute for OneWorldHealth, has used synthetic biology to engineer *Saccharomyces cerevisiae* to produce semi-synthetic artemisinin by hijacking the endogenous yeast mevalonate pathway and inserting exogenous genes from *A. annua*. Mevalonate kinase (MK) initiates the mevalonate pathway; endogenous yeast MK is required to produce semi-synthetic artemisinin. Improved understanding of the MK molecule may lead to improved yields of semi-synthetic artemisinin.

Traditional methods for visualizing protein structures and interactions often limit the amount of information that can be conveyed. Using rapid prototyping technology at the Milwaukee School of Engineering's Center for BioMolecular Modeling, we have built a tangible 3D model of rat mevalonate kinase, based

upon the published crystal structure solved by Fu, et al (PDB 1kvk, *Journal of Biological Chemistry* 2002; 20: 18134-18142). Along with computer visualization tools, tangible 3D models allow students and scientists alike to more fully explore protein function. The SMART (Students Modeling A Research Topic) program, established by the Center of BioMolecular Modeling at the Milwaukee School of Engineering, involves partnerships between university researchers and local high schools. This work is funded by NIH-NCRR-SEPA and HHMI.

**179 Building Sustainability at Cal—What the Students Do, IRENE SELIVERSTOV and WILLIAM B.N. BERRY** (Environmental Sciences, University of California, Berkeley, CA 94720; Iseliverstov@gmail.com).

Students in the Building Sustainability at Cal program work in a number of campus buildings to educate building inhabitants on programmatic and procedural changes that can be made to reduce environmental impacts. Students provide detailed information on light and toilet fixtures to building facilities staff that will enable specific targeted action on facilities that tend to go unnoticed due to competing priorities. Sample projects carried out by students include: inventorying faucets in building to find out if aerators are present and installing them where none are present to reduce water use, inventorying lighting fixtures and replacing inefficient with efficient fixtures, inventorying toilet fixtures in rest rooms and identifying those that are leaking, establishing paper towel composting procedures, and advocating use of double-sided copying where possible. Notices are posted in many areas of building drawing attention to the recycling facilities and reminding building occupants and users to recycle. Student activities are carried out in independent study courses and coordinated with projects developed by the campus Director of the Office of Sustainability and the Vice Chancellor for Facilities management.

## CHEMISTRY and BIOCHEMISTRY

**180 Chemical Modification of Proteins to Improve Chemical Stability and Chromatographic Performance as SEC Standards, JERRY L. WILSON** (JLW Research, 1411 W. Covell Blvd., Davis, CA 95616; jlwin38@sbcglobal.net).

Molecular weight standards for Size Exclusion Chromatography (SEC) of proteins are currently expensive, some are not very stable, and the selection is quite small. I wish to report on some attempts to prepare useable proteins from inexpensive sources and, in some cases, chemical modifications that improve chromatographic performance and/or stability. In this paper, I report on the chemical modification of egg white proteins ovalbumin and lysozyme. Some data on porcine pepsin and a lima bean protein are also presented.

Ovalbumin is the only major egg white protein containing free sulphydryl groups (four). These can be chemically modified without affecting other major proteins and can still be isolated by reported techniques for the untreated protein. Some stability data on the alkylated ovalbumin are reported.

Due to a huge isoelectric pH, lysozyme often does not elute in accordance with its molecular weight on many SEC columns until the ionic strength of the elution buffer is raised above 0.2M. Furthermore, the chromatographic quality, as measured by the peak

height to 1/2 peak width is not good. Succinylation solves both these problems and produces a highly stable protein.

**181 Biogenic Silica Incorporated Bio Sensors for Ultra Sensitive Protein Detection, GAURAV CHATTERJEE<sup>1</sup>, VINDHYA KUNDURU<sup>1</sup>, KAI-CHUN LIN<sup>2</sup>, B. L. RAMAKRISHNA<sup>2</sup>, and SHALINI PRASAD<sup>1</sup>** (<sup>1</sup>Department of Electrical Engineering, Arizona State University, P.O. Box 875706, Tempe, AZ 85287-5706; <sup>2</sup>School of Materials, Arizona State University, P.O. Box 878706, Tempe, AZ 85287-8706; Gaurav.Chatterjee@asu.edu).

We have explored the impact of nanoscale confinement on biomolecule detection. Recent research has indicated that improved detection parameters such as ultrasensitivity, selectivity can be achieved in electrical detection by employing size based confinement techniques in nanomaterials.

We have previously observed that nanoporous membranes while improving biomolecule detection sensitivity had various issues regarding diffusion, transport and selectivity. We address those issues using biogenic silica as the nanoporous material.

Biogenic silica (diatoms) are single celled algae with rigid cell walls made of amorphous silica. They offer great symmetry, hierarchy and porosity, combined with excellent physical and electrical isolation. These properties make them amenable to nanoporous biosensors. We have designed the physical geometry utilizing them into protein detection.

We have incorporated a nanoporous biogenic silica membrane into a microelectronic platform. The membrane offers excellent nanoconfinement and aids in electrical detection of protein concentrations.

The sensor can be used to detect a variety of classes of proteins, potential candidates involve inflammatory proteins and glycosylated proteins.

It is the focus of this paper to investigate the functioning of a bio sensor device incorporating biogenic silica as a membrane material. The results obtained were validated using standard proteomic (ELISA) assays.

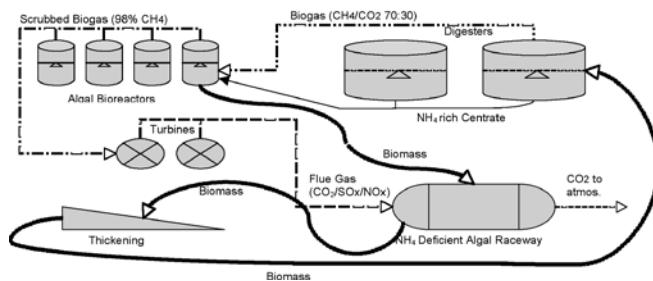
## INDUSTRIAL SCIENCE and TECHNOLOGY

**182 Conceptual Study of an Algal Bioreactor System for Nutrient and Pollution Mitigation and Supplemental Renewable Biogas Evolution at a Large Municipal Wastewater Treatment Plant, ERIC LARSEN, LINDA WINTERS, and CAROL WEIR** (East Bay Municipal Utility District, 2020 Wake Ave., Oakland, CA 94607; elarsen@ebmud.com).

Microalgae (algae) have been extensively investigated for production of liquid biofuels such as biodiesel and ethanol because of their prolific lipid production. The same lipids are easily converted by anaerobic bacteria to methane gas in an anaerobic digester. Algal ponds are also widely employed for nutrient reduction and stabilization of wastewater streams because algae rapidly metabolize ammonia, phosphates and dissolved carbon. However, land availability is a significant limiting factor for effective wastewater treatment employing algal lagoons in high density urban areas. A novel approach for nutrient and pollution mitigation, greenhouse gas capture and supplemental renewable energy generation could be use of an algal bioreactor system fed by a high strength ammonia side stream at a typical secondary aerobic wastewater treatment

plant that employs anaerobic digesters for sludge stabilization. The treatment (scrubbing) of biogas for combustion and flue gas for pollution control can be achieved by passing the gas through closed bioreactors and open air raceways, respectively, providing the algae with metabolic CO<sub>2</sub>. Algal biomass harvesting and disposal in anaerobic digesters can also provide increased renewable biogas yield for cogeneration. Presented here is a conceptual study for sizing the system using mass balances and other data derived from a large municipal wastewater treatment plant (East Bay Municipal Utility District's main wastewater treatment plant; 425 MGD peak wet weather, 70 MGD dry weather).

### Algae to Biogas System



**183 Nuclear Power for Propulsion and Power Supply for High Altitude Platforms, BRADLEY S. TICE** (P.O. Box 3868 Turlock, CA 95381; paulatice@bigvalley.net).

The presentation will focus on the theoretical design of nuclear power as a source of propulsion and energy supply for high altitude long endurance systems, HALEs, also known as high altitude platforms, or HAPS. These 'air satellites' are now being deployed as mid-range platforms for telecommunications relay points between terrestrial and space communications nodes. The paper will explore both propulsion design and energy supply aspects of nuclear power to the design of these high altitude long endurance platforms. The paper will also assess the critical issues of nuclear waste and dangers posed by the use of such material in airborne platforms.

## PSYCHOLOGY

**184 Alpha/numeric Data-based, Hypothesis-driven Treatment of Complex Psychiatric and Neurological Disorders, BHAVANA VISHNUBHOTLA** (Glen Eden Multimodal Centre, 8665 Barnard St., Vancouver, BC, Canada V6P 5G6; bvishnubhotla@gleneden.org).

Glen Eden Multimodal Centre is a not-for-profit, mental health facility offering treatment, schooling, and residential placement to children, youth and young adults who present with complex psychiatric and neurological disorders, and who have not responded successfully to medication and/or other school or hospital based programs. We work on the premise that most disorders that affect children's development are conceptualizations of symptoms and not pathologies in themselves, such that similar symptoms can be the result of different underlying conditions and dynamics. Therefore, rather than base treatment on psychiatric nomenclature (e.g. ASD, ADHD, etc.), we accept that effective treatment for one client may be very different than for another with the same diagnosis. There is an initial observation period during which we define an individualized "symptom universe" for each client, and develop hypotheses

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concerning the etiology of these symptoms and potential treatment strategies. Behavior (whether symptomatic or not) is monitored on a moment-to-moment or hourly basis using an alpha/numeric data recording system, which provides essential information for making and supporting hypotheses about the effectiveness of all aspects of treatment, including environmental manipulations. This alpha/numeric system minimizes the subjective interpretation inherent in the labels commonly used by other programs that record data with such clients (e.g. aggressive, self-injurious, inappropriate, etc.). Here I present data from two clients, one low-functioning individual diagnosed with ASD and one high-functioning individual diagnosed with sensory processing disorder, and show how these data have helped inform our hypotheses and treatment strategies for these clients.

**185 Independent Component Analysis of EEG Activity in the Mirror Neuron System (MNS) During Visual Perception of Body-Movements**, ANTHONY CARNEVALE BONILLA<sup>1</sup>, JENNIFER G. TORRES<sup>2</sup>, MAYRA ESTRADA<sup>2</sup>, CHLOE BOYLE<sup>2</sup>, KRISTINE SARNLERTSOPHON<sup>3</sup>, SCHUYLER S. ROCKWOOD<sup>4</sup>, and STANLEY E. LUNDE<sup>4</sup> (<sup>1</sup>School of Biological Sciences, University of California Irvine, 3210 Biological Sciences III, Irvine, CA 92697-1460; <sup>2</sup>Department of Psychology and Sociology, California State Polytechnic University Pomona, 3801 West Temple Ave., Pomona, CA 91768; <sup>3</sup>Department of Biomedical Engineering, The Johns Hopkins University, 3400 North Charles St., 310 Clark Hall, Baltimore, MD; <sup>4</sup>University of California Los Angeles, MRRC at Lanterman Developmental Center, Pomona, CA 91769; bonillaa@uci.edu).

This study examined the hypothesized neurological observation/execution matching system, the mirror neuron system (MNS), by measuring event-related increases and decreases of electroencephalographic (EEG) rhythms to video clips of body motion. The aim was to identify EEG spatiotemporal patterns of activation in brain areas during conditions that activate the MNS. Based upon the results of functional Magnetic Resonance Imaging (fMRI) studies, Iacoboni (2005) suggested that the following regions are involved in the MNS: the inferior frontal gyrus (within an important language area), superior temporal sulcus, insula, and posterior parietal cortex. It has been proposed that MNS dysfunction underlies the social deficits observed in autism spectrum disorders (Williams et al, 2001).

Healthy participants were presented 192 twenty-second trials of video clips of swimming and piano playing body movements as well as control video clips during 16 ~four minute blocks. They were instructed to imagine performing the movements during half of the blocks.

Sources of potential MNS responses in the 32-channel recordings were identified using independent component analysis (ICA: Bell and Sejnowski, 1995), implemented in EEGLAB, which uses the signal processing routines in Matlab. These components were localized in the brain using dipole analysis, DIPFIT2, implemented in the current version of EEGLAB (V6.03).

EEG sources of MNS activity were identified in inferior frontal, middle frontal, and superior temporal gyri; in the posterior parietal cortex; and in the anterior cingulate.

Elaborating the sources of the MNS may increase our understanding of neurodevelopmental disorders, such as autism, that involve purported deficiencies in the MNS.

**186 Computer Simulated Conflicts Assess Room Colors' Effects on Workplace Mood and Behavior**, KRISTEN M. CLARK (Department of Psychology, Washington State University Tri-Cities, 2710 University Dr., Richland, WA 99354; kristen1010@live.com).

This study explores the emotional impact of room color in the workplace using computer simulated personal conflicts. Three red, blue, and white-colored simulated private office settings were prepared, projected full size on a wall, and became backgrounds for projected simulations of five different office personal conflict scenarios. Thirty different participants were matched on gender and office experience, with ten randomly assigned to each of the three different room color settings, keeping the ratios of gender and experience equal within each room color. Participants read a description of the conflict, watched its visual simulation, and then filled out an 11 questions personal report on their feelings and ratings about the office worker simulated in the conflict, while viewing the projected room for equal amounts of time between each question.

Results showed statistically different levels of frustration, impulsivity, confrontation confidence and aggressive connotations in the red room compared with blue and white rooms, supporting prior research reporting emotional and cognitive differences with manipulations of red and blue colors to improve or hinder mood and performance. These prior studies range from computer screen presentations of Mehta and Zhu (2009) to actual constructed colored offices of Kwallack et al. (1988, 1990, 2007). The projected simulations created in this study create a mid-point in this simulation range.

The series of studies spanning two decades implies that color does have an effect on mood, task performance and interpersonal ratings in work settings. It suggests that environmental color can be used to improve workers behavior and performance.

## ANTHROPOLOGY and ARCHAEOLOGY

**187 Preparation as a Mechanism of Hominin Adaptation**, MICHAEL BIFERNO (Biferno and Associates, 1718 Claridge Street, Arcadia, CA 91006; Biferno@aol.com).

Many cultural practices, rituals and beliefs can be described as preparing for future events such as acquiring food, shelter, mating opportunities or a rewarding afterlife. Preparation is a concept employed in biological psychology to describe processes where perceptual-motor systems are “made ready” or primed to respond.

Mechanisms promoting perceptual-motor readiness can either be inherited (reflexes) or acquired (habits) with phylogenetic and developmental factors heavily influencing the relative contribution of each. To the extent that perceptual-motor readiness increases an organism’s probability of reproductive success or survival, it may be considered to be a process that promotes adaptation to current environmental demands. The ability of flatworms (*Platyhelminthes*) to learn preparatory responses (approach or avoid), suggests that basic mechanisms supporting preparation have been highly conserved during the evolution of animals.

Evidence of early hominin preparation can be inferred from tools, fire hearths and other artifacts created in advance of the time they were intended for use. For example, the construction and repeated use of a fire hearth suggests the control of fire, enabling the processing of food and other materials for future use. Similarly, the production of cave drawings or fertility objects enabled control

over future perceptual experience.

Viewing technology development as a preparatory response helps explain the complexity of our modern material culture and how a diversity of preparatory responses may have provided an adaptive advantage over our competitors.

## SOCIAL, ECONOMIC and POLITICAL SCIENCES

**188 Domestic Violence Suspects' Use of Illicit Drugs and Alcohol as a Risk Factor for Arrest, STEPHEN J. MOREWITZ** (Research Division, Stephen J. Morewitz, Ph.D., and Associates, IL and CA, Litigation Consultants, San Jose State University, Department of Sociology, 695 Noe St., Ste. 1, San Francisco, CA 94114; morewitz@earthlink.net).

Researchers and policy makers are evaluating why certain individuals who commit domestic violence offenses are more likely to be arrested by the police than others who engage in these types of offenses. Domestic violence offenders who use alcohol and certain illicit drugs may be at increased risk of committing major types of violence because of impaired judgment and reduced inhibitions, thus increasing their chances of being arrested. The present investigation evaluates the degree to which domestic violence offenders who use illicit drugs and alcohol are more likely to be arrested than domestic violence offenders who do not take illicit drugs and alcohol. A random sample of 519 newly filed domestic orders of protection was drawn from newly published domestic court case listings in two cities (Midwest and West regions) between 1997 and 1999. A domestic stalking and violence protocol was constructed to code self-report data obtained from a content analysis of the newly filed domestic orders of protection. Chi-Square and logistic regression analyses were used to test the null hypothesis that after adjusting for other predictor variables including the offenders' age, race, gender, and socioeconomic status, there are no differences among domestic violence offenders' illicit drug and alcohol use and their likelihood of being arrested. The null hypothesis will be rejected if there are statistical differences at the .05 level of significance. The null hypothesis is rejected based on the statistical results. Domestic violence offenders' use of illicit drugs and alcohol was correlated with the offenders being arrested (Chi-Square=6.46, df=1, p<.011). These statistical associations remained significant after controlling for possible predictor variables. In addition, the domestic violence offenders' race predicted whether they were arrested (O.R.=1.52, 95% C.I.=1.04, 2.21, p<.03).

**189 Partner Violence as a Risk Factor for Child Physical Abuse, STEPHEN J. MOREWITZ** (Research Division, Stephen J. Morewitz, Ph.D., and Associates, IL and CA, Litigation Consultants, San Jose State University, Department of Sociology, 695 Noe St., Ste. 1, San Francisco, CA 94114; morewitz@earthlink.net).

An important area of research is identifying the risk factors for child physical abuse in order to develop effective prevention strategies. Individual who assault their partners may be at increased risk of committing also physically abusing their partners' children. The present investigation evaluates the degree to persons who commit partner violence are more likely to also commit child physical abuse against their partners' children. A random sample of 519 newly filed domestic orders of protection was drawn from newly published domestic court case listings in two cities (Midwest and

West regions) between 1997 and 1999. A domestic stalking and violence protocol was constructed to code self-report data obtained from a content analysis of the newly filed domestic orders of protection. Chi-Square and logistic regression analyses were used to test the null hypothesis that after adjusting for other predictor variables including the offenders' age, race, gender, and socioeconomic status, there is no association between an individual hitting their partner and child physical abuse. The null hypothesis will be rejected if there are statistical differences at the .05 level of significance. The null hypothesis is rejected based on the statistical results. Persons who hit their partners were also likely to physically abuse their partners' children (Chi-Square=8.48, df=1, p<.004). These statistical associations remained significant after controlling for possible predictor variables.

## POSTER SESSION II

TUESDAY

9:30 a.m. – 1:30 p.m.

HENSILL HALL 3<sup>rd</sup> Floor Hallway

## CELL and MOLECULAR BIOLOGY

**190 Fluorescent Marker for Stem Cell Differentiation, ALBERT AVILA, GIPSON LYLES, AMIT DESHPANDE, WILLIAM CHENG, and YONG KIM** (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095-1668; albert.avila91@gmail.com).

Stem cells differentiate into various types of cells that make up our bodies. Many scientists want a method to track the differentiated cells derived from stem cells. Is there a marker that can display this change visually? This experiment was designed to generate a molecular marker that we can use to visually trace the extent of stem cell differentiation. The green fluorescent protein (GFP) gene was cloned downstream of the promoter of the Oct3/4 gene. Oct3/4 is expressed only in undifferentiated stem cells but turned off when cells differentiate. First, the mouse Oct3/4 promoter was amplified by polymerase chain reaction (PCR), and its integrity was confirmed by DNA sequencing. The amplified DNA was ligated to the GFP gene to generate the Oct 3/4-GFP-reporter construct. The results indicated that this construct can be delivered into embryonic stem cells (ESCs), and expression of GFP can be examined with fluorescent microscopy. Upon introduction of differentiation, ESCs will show changes in green fluorescence levels. Although the experiment was not complete, it holds promise as a marker of stem cell differentiation. This GFP reporter system will serve as a simple, efficient, and effective tool for stem cell analyses *in vitro*.

**191 Loss of Ectoderm Membrane Rafts Produce Variable Inhibitions of Myogenic Specification in Segmental Plate Mesoderm (SPM)-derived Somites in Chicken Embryos, ROSELLE VISAYA and WILFRED F. DENETCLAW** (Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; revisaya@sfsu.edu).

Myogenic specification in the SPM depends on molecular signals to activate the myogenic program for myotome progenitors

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that later give rise to primary myotome in somites. Multifunctional membrane rafts (rafts) mediate signal transduction activities in cells and are abundant structures in the ectoderm and somites. Rafts are destroyed by methyl beta-cyclodextrin (MBC) and in preliminary work, MBC blocks *myoD* expression and primary myotome formation in nascent somites suggesting that ectoderm rafts mediate signaling for the “determination front” in somitogenesis and myogenic specification. To investigate, embryos at 2.5 days of growth had ectoderms treated for 6 hours *in ovo* with 2 ml or 0.5 ml of 25 mM MBC. Myotome formation was inhibited in both cases, and 2 ml treatments showed inhibition in nearly all new segmented somites by titin antibody labeling. Titin labeling appeared more often in the somite ventrolateral dermomyotome, but infrequently in the somite dorsomedial domain. In these cases, titin positive cells had abnormal locations on the dorsal sclerotome surface away from their normal dermomyotome positions. A normal myotome fiber appearance with cranio-caudal cell growth across the somite was never observed. In addition, somite segmentation rate proceeded normally (90 minutes/somite), but occasionally abnormal large and small somites were produced. In 0.5 ml MBC treatments, less inhibition of somite myotome formation occurred but somite size abnormalities were similar in incidence. We conclude that ectoderm signals mediated through rafts regulate the SPM in somite segmentation and myotome precursor cell development. NSF-IOS-0821324, NIH-5R25GM048972

**192 Ectoderm-derived Sphingomyelin Signals Regulate Somitogenesis and Primary Myotome Formation in Chicken Embryos, TEN-ZIN BHUTIA and WILFRED F. DENETCLAW** (Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; sangmo04@yahoo.com).

Sphingomyelin (SM) produces several signaling lipids and is abundant in ectoderm and endoderm layers in chicken embryos but is very low in mesoderm tissues. The role of ectodermal SM is unknown in the development of somites. We therefore investigated segmental plate mesoderm (SPM) somitogenesis, somite patterning and primary myotome formation in 2 day-old chicken embryos with ectoderm exposed, *in ovo*, to neutral sphingomyelinase (bSMase) at 100-200 mU/mL for 6 hours. The reduction in SM was verified by lysenin toxin labeling. Ectoderm, untreated with bSMase, expressed variable lysenin-SM labeling with many large cell groups labeled extensively for SM while other groups either had numerous punctate SM micro-domains or showed an absence of SM except at cellular junctions. This pattern of ectoderm lysenin-SM labeling did not appear different between SPM and early somite areas. In cases of bSMase treatments, ectoderm cells enriched in SM were greatly reduced and coincided with an increase in cells showing punctate SM micro-domains and cells with SM only at cell borders. Furthermore, bSMase addition did not affect somite segmentation, but periodically produced somites smaller or larger than normal size. Also, somites had normal dorso-ventral patterning. However, bSMase treatment caused a complete or partial loss of myotome formation in somites made from the SPM following overnight embryo growth. We conclude that a transition of SM occurs in ectodermal cells from those abundant in SM to those with minimal SM presence to suggest SM signaling of the segmental plate mesoderm for somite formation and primary myogenesis. NSF-IOS-0821324.

**193 CXCL-1 and Rho-Gap 8 PTH Induced Primary Response Genes, EMILIO FRIAS, NOEMI ZALDIVAR, JEANNE**

**NERVINA, and VETEA MIKLUS** (Howard Hughes Medical Institute Pre-College Science Program, University of California, Los Angeles, School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095-1668; jaimelives@yahoo.com).

Understanding the mechanisms of bone creation and repair is essential in preventing bone fractures, a global health problem. This study looks at the role of two genes, CXCL-1 and RhoGap-8, which, under the presence of parathyroid hormone (PTH), may be responsible for bone regulation. Since PTH induces changes in osteoblasts, treating them with continuous amounts of PTH causes resorption, while intermittent presence of PTH creates bone. RhoGap-8 is involved in gene expression, cell proliferation, regulating membrane trafficking, and actin cytoskeleton organization while CXCL-1 plays a significant role in spinal cord development and bone repair. We hypothesized that both genes RhoGap-8 and CXCL-1 are PTH-induced primary response genes. To conduct the experiment we cultured primary mouse osteoblasts and treated them with PTH, following our two genes, using Beta-Actin as a control gene. Our genes were then treated with cycloheximide to isolate the RNA which we extracted using the Trizol method. From that RNA we created cDNA and analyzed using the PCR method to determine the genes expression. Our results indicate that CXCL-1 is a primary response gene. RhoGap-8 did have a level of expression but it was not significant enough to be considered a primary response gene under these experimental circumstances. Further research would have to be conducted to determine whether RhoGap-8 is a primary response gene. Knowing the role of these genes in bone repair will enable researchers to develop therapeutic methods for treating bone fractures.

**194 Effects of Resveratrol and Piceatannol on Cellular Replication of NHEK, MARISOL NUNEZ, KAROLYN BLANCAS, MO KANG, and ROY KIM** (Howard Hughes Medical Institute Pre-College Science Program, University of California, Los Angeles, School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095-1668; mnunez4@yahoo.com).

Cellular senescence is the natural aging process by which cells stop replicating and is believed to play a critical role in the suppression of tumor development. Our overall research involved the use of two chemicals to extend the lifespan of cells without increasing the risk of inducing cancer development. The study focused on the chemicals resveratrol and piceatannol's effect on cellular replication on NHEK (Normal Human Epithelial Keratinocytes) cells. These two chemicals are analogs that are known to induce SIRT1, and in turn extend the lifespan of NHEK and delay senescence. NHEK were treated with different concentrations of each chemical, and subsequently cellular proliferation was monitored followed by Western Blot analysis and SA-b Gal staining. The data showed that at 0.2 mM, both chemicals resveratrol and piceatannol, resulted in increased proliferation compared to the control and 2.0 mM. In fact, we had to discontinue the 2.0 um concentration because it had become toxic to the cells. Therefore, our data showed resveratrol and piceatannol extended the lifespan and delayed the onset of senescence of NHEK. These studies may contribute to our understanding of how these drugs may be used to prevent cellular senescence without the threat of cancer.

**195 *Myxococcus xanthus*: Cell Signaling and Programmed Cell Death, AARON BROWN, SHAYLN SMITH, ARTURO CALDERON-FLORES, CHRISTOPHER KAPLAN, and**

**WENYUANRTURO SHI** (Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095-1668; cubplayer14@sbcglobal.net and shalyn.smith@yahoo.com).

*Myxococcus xanthus* is known to form fruiting body formations and spores; however, the mechanisms by which different strains of *M. xanthus* die are not understood. Prior experimentation with *M. xanthus* has shown that it is capable of cell signaling and that it can be killed by an unknown peptide. It is unclear if the death is apoptotic, requiring cell signaling, or necrotic. Clearly, both the bap mutant strain and the DK122 wild type strain of *M. xanthus* are dying, and this mechanism may be a model for human disease to human cell function. This study sought to determine what was slowing the production of the *M. xanthus* spores, therefore prohibiting cell signaling. A peptide library was then tested to see its effects on *M. xanthus* cell death in the wild type or bap mutant strains. Research then sought to find a peptide that could kill *M. xanthus* and no other bacteria; however in the six-week trial period, no such peptide was found. We also tested various concentrations of wild type and bap mutant strains treated with a peptide to determine if one strain was more sensitive to cell death than the other. However, neither strain of the bacteria was favored, therefore confirming that *M. xanthus* does die, but we do not yet know if this is by programmed cell death.

**196 Ionizing Irradiation Produces a Delay in Pupation in the Hornworm, *Manduca sexta*, LOUIE RAMOS<sup>1</sup>, CLEOPA OMONDI<sup>1</sup>, ADRIAN HALME<sup>2</sup>, and MEGUMI FUSE<sup>1</sup>** (<sup>1</sup>Department of Biology, San Francisco State University, San Francisco, CA 94132; <sup>2</sup>Department of Molecular and Cell Biology, University of California, Berkeley, CA 94720; vermillionone@hotmail.com).

The imaginal discs in *Drosophila melanogaster* larvae are extremely resilient and are repaired extremely efficiently. Imaginal disc repair is facilitated by an endocrine-induced delay in pupation to accommodate repair of the damaged tissues. Damage within imaginal discs can be produced by the administration of high doses of irradiation during larval development. We have examined whether a similar delay can be induced by larval irradiation in another holometabolous insect, the hornworm *Manduca sexta*. *M. sexta* larvae are large and will be a useful model for characterizing the blood-borne factors regulating this developmental delay. We have found that irradiation of *M. sexta* larvae produces a dose-dependent delay in pupation as well as eclosion, in a manner similar to that seen in *Drosophila*. At low doses or irradiation, animals eclosed with only minor morphological abnormalities and were viable adults. At higher doses, adults showed significant abnormalities, but only occasionally were unable to eclose fully. Blood transfer experiments from damaged to control animals appeared to induce delays in pupation, but to a lesser extent than seen in the damaged larvae. We are currently characterizing this factor.

**197 Determination of the Neurotransmitter that Inhibits the CNS During Ecdysis in the Hornworm, *Manduca sexta*, LAURA MENDOZA, ROTH EA, ADRIAN CHASE, and MEGUMI FUSE** (San Francisco State University, Department of Biology, 1600 Holloway Ave., San Francisco, CA 94132; lemendoz@sfsu.edu).

Part of the neural mechanism regulating behaviors includes modulation such as inhibition. In insects, ecdysis, or the shedding

of the old cuticle, has become a model for understanding neuro-modulation. Part of the regulatory mechanism for ecdysis involves the inhibition of central nervous system neurons. While inhibition has been demonstrated in the tobacco hornworm, *Manduca sexta* (Zitnan and Adam, 2000; Fuse and Truman, 2002), putatively in the subesophageal ganglion, the neurotransmitter responsible for the inhibition has not yet been determined. Using *M. sexta*, we propose to determine if GABA can mimic inhibition of ecdysis onset. Ecdysis can be initiated prematurely, with very precise timing, by application of Ecdysis Triggering Hormone. We have confirmed the findings of previous studies, where the onset of Ecdysis Triggering Hormone-induced ecdysis occurs significantly sooner when the subesophageal ganglion is removed (removal of inhibition) by ligation *in vivo* or by dissection *in vitro*. *In vivo*, timing of onset is assessed videographically and by eye. *In vitro*, the isolated CNS is monitored by extracellular electrophysiology. We will discuss the effects of GABA agonists and antagonists in altering timing of ecdysis onset in these preparations.

**198 Characterizing Ecdysis Behaviors in the Stick Insect, ANDREW CARRIMAN and MEGUMI FUSE** (Department of Biology, San Francisco State University, San Francisco, CA 94132; andcarry@biology.sfsu.edu; andcarry@sfsu.edu).

Circadian clocks control physiological processes to anticipate daily changes in the environment. Ecdysis, or the shedding of the cuticle, is a process common to all insects to facilitate growth and development. It is often under circadian control. Ecdysis has been best studied in holometabolous organisms, which undergo complete metamorphosis. Ecdysis in the stick insect, *Carausius morosus*, a hemimetabolous insect undergoing incomplete metamorphosis, has not been characterized. Our goal is to determine if the ecdysis neural network is conserved between hemimetabolous and holometabolous insects, by **a**) Determining whether ecdysis in the stick insect is governed by a circadian rhythm; **b**) Determining whether the same ecdysis regulatory hormones of the central nervous system (CNS) found in holometabolous insects are conserved in the stick insect; **c**) Describing ecdysis behaviors in the stick insect. *C. morosus* was stored in regulated light/dark cycles and checked twice daily for ecdysis. The expression of compounds involved in ecdysis, namely cGMP, leucokinin and eclosion hormone, were assessed in the stick insect CNS by immunohistochemistry, and compared to known expression patterns in the hornworm, *Manduca sexta*. Ecdysis behaviors were videotaped and characterized. We found that **a**) ecdysis in the stick insect occurred just before early “dawn”; **b**) only cGMP and leucokinin were apparent in the CNS of both insects, and **c**) many classic ecdysis behaviors were observed in the stick insect. A simple model such as *Carausius* may help elucidate some mechanisms of circadian control, but also aid in developing environmentally-friendly pesticides.

## HEALTH SCIENCES

**199 The Association of Personal Characteristics and Social Support Resources with the Ability to Afford Needed Dental Care, EDGAR RIVERA, DIANE VASQUEZ, ELMER BARNES, and BENJAMIN A. FREED** (University of California Los Angeles School of Dentistry, 10833 Le Conte Ave Rm. 63-007 CHS, Los Angeles, CA 90095; elmer.barnes9@yahoo.com).

In California, approximately 21% of the adult population has

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identified having an unmet dental need that they could not afford. It is known that demographics like ethnicity, education, and income play a vital role in the ability to afford dental care. Our study focuses on the social support aspects of a person and how it influences the ability to afford needed dental care. This research design is a cross-sectional study using secondary data analysis of adult surveys from the 2003 California Health Interview Survey (CHIS) data set. The study sample consisted of 10,436 adults representing 8.3 million Californians. We used bivariate and multivariate logistic regression analysis on the weighted data and constructed a variable for social support based on four items. Our analysis shows that low levels of social support were 71% more likely to have an unmet dental need that they could not afford. In addition, there is a significant association with having neighborhood attachment and being able to afford needed dental care. Comparison to non-smokers, current smokers were 73% more likely to have an unmet dental need that they could not afford. As expected, adults that are less educated, Hispanic and that are unemployed and looking for work were less likely to afford needed dental care. This study brings new ideas for social support and neighborhood attachment and the concept of affording needed dental care.

**200 Factors Associated with Severe Periodontal Bone Loss in a National Probability Sample of Diabetics and Non-Diabetics in the United States, THIEN DO, KRYSTLE HOLFORD, JIE SHEN, and HONGHU LIU** (University of California Los Angeles School of Dentistry, 10833 Le Conte Ave CHS, Rm. 63-007, Los Angeles, CA 90095-1668; thiendo07@gmail.com; keaholford@yahoo.com).

According to the National Health and Nutrition Examination Survey (NHANES) 2003-2004, there were 19 million people with diabetes. Of these, 8% had severe periodontal bone loss involving one or more teeth compared to 3% in the normal population. The objective of our study is to assess the factors that are associated with severe periodontal bone loss in a national sample of controlled and uncontrolled diabetics compared to people without diabetes. Our research design is a cross sectional analysis utilizing data sets from NHANES 2003-2004. The study sample consisted of 5,303 people, representing 214 million in the United States. Our dependent variable is severe periodontal bone loss measuring 6mm or more. Using multivariate logistic regressions with complex survey design, the weighted results showed that uncontrolled and controlled diabetics were 72% and 94% more likely to have severe bone loss than non-diabetics. Additional factors show that females were less likely; those who visited the dentist for emergency care were 61% more likely; and those who needed teeth pulled due to pain were 2.5 times more likely to have severe bone loss. Although the relationship between diabetes and periodontal disease is well known, this study provides specific information on the degree of risk of severe periodontal bone loss for both diabetics and non-diabetics. These results have important implications for programs that serve diabetics, dental and medical practitioners, and health policy makers.

**201 Vitamin D Deficiency and Bisphosphonate Effects on Bone, BRIELLE McDANIEL<sup>1</sup>, MICHAELA SCOTT<sup>1</sup>, AKISHIGE HOKUGO<sup>2</sup>, and ICHIRO NISHIMURA<sup>2</sup>** (<sup>1</sup>Howard Hughes Medical Institute Pre-College Science Program, University of California Los Angeles School of Dentistry and <sup>2</sup>The Weintraub Center for Reconstructive Biotechnology, University of California Los Angeles School of Dentistry, Box 951668, Los Angeles, CA 90095; brie\_c05@yahoo.com; michaelascott09@aol.com).

Osteoporosis, which causes bones to become more susceptible to fracture, is treated with bisphosphonates to slow down or stop the process of bone resorption. Studies have shown that an extreme side effect of this drug causes the death of the jawbone (Osteonecrosis of the Jaw (ONJ)). This study was performed to demonstrate the effects of bisphosphonates on bones with osteoporosis. Twelve rat femurs were harvested from 4 different groups- vitamin D deficient, bisphosphonate-treated, vitamin D deficient and bisphosphonate-treated, and control groups. These bones were scanned using a micro-computed tomography (MicroCT) for a magnified view of the spaces between trabecular bone. Through a series of serum chemistry by enzyme-linked immunosorbent assays (ELISA) tests, the amount of bone resorption was also considered and recorded. Results show that Vitamin D deficient bones resembled those of bones of patients with osteoporosis and were very porous whereas bones injected with bisphosphonates were extremely thick and dense with much trabecular bone. Bones that were Vitamin D deficient and bisphosphonate treated were denser than those of the control. The serum chemistry of the Vitamin D deficient group indicated highest osteoclast activity, whereas Bisphosphonate and Vitamin D deficient-Bisphosphonate groups indicated low osteoclast activity. Also, the most bone resorption occurred in vitamin D deficient bones whereas the least occurred in bones injected with bisphosphonates. These experiments demonstrated that bones already suffering from osteoporosis became denser than those that did not originally contain the disease. Also, they have allowed the advancement of finding a cure for and prevention of ONJ.

**202 Effect of Altering Apparent Viscosity and Elastic Modulus of Tracheal Mucus and Positioning on Displacement of Mucus during Simulated Cough in Patients with a Wide Range of Respiratory Diseases, ANPALAKI J. RAGAVAN<sup>1</sup>, CAHIT A. EVRENSEL<sup>1,2</sup>, and PETER KRUMPE<sup>1,3</sup>** (<sup>1</sup>Graduate Program of Biomedical Engineering, University of Nevada, Reno, NV 89557; <sup>2</sup>Department of Mechanical Engineering, University of Nevada, Reno, NV 89557; <sup>3</sup>School of Medicine, University of Nevada, Reno, NV 89557; ragavan@unr.edu).

The effect of altering apparent viscosity ( $\eta'$ ) and elastic modulus ( $G'$ ) of simulated human tracheal mucus on mucus displacement during simulated cough was investigated in a "D" shaped rigid model human trachea placed at two discrete (0°, 30°) vertical angles. Simulated mucus at two  $\eta'$  values ( $0.3 \pm 0.03$  Pascal second(PaS) and  $1.7 \pm 0.14$  PaS) with  $G'$  in the range between 1 Pascal (Pa) and 90Pa were prepared through mixing Locust Bean Gum (LBG), Sodium Tetra Borate (Borax), food starch and sucrose at varying proportions to represent sputum of patients with mild and severe lung pathology (asthma, chronic bronchitis, COPD, CF). Aliquots of 0.3ml of mucus samples were placed inside the model human tracheal and cough events were generated through a computer controlled solenoid valve, differential pressure transducer and amplifier assembly. The  $\eta'$  and  $G'$  of mucus samples were measured in the laboratory using a Cone and Plate Rheometer (AR 1500, TA Instr.). Displacement of all mucus aliquots during cough at cough velocities in the range between 5m/s and 30m/s were measured.

The interactive effect of the three factors ( $\eta'$ ,  $G'$ , tracheal angle) were significant ( $p < 0.0001$  through ANCOVA,  $n=546$ ). Mean mucus displacements were significantly larger ( $p < 0.0001$ ) at lower  $\eta'$  equal to  $0.3 \pm 0.03$  PaS compared to at  $1.7 \pm 0.14$  PaS at same  $G'$ , angle and velocity. Displacement increased with  $G'$  up to 56 Pa and decreased thereafter at both angles. Displacements at same cough

velocities were significantly larger at 30-degree tracheal angle compared to at 0-degree angle for both  $\eta'$  at all G' values.

**203 Estrogen Signaling Modulates Cisplatin Resistance in the Treatment of Human Non-Small Cell Lung Cancer Cells, AMIT-KUMAR PATEL, DIANA C. MARQUEZ-GARBAN, and RICHARD J. PIETRAS** (University of California Los Angeles Department of Medicine, Division of Hematology-Oncology, 10833 Le Conte Ave., 11-934 Factor Bldg., Los Angeles, CA 90095; amitdineshp@ucla.edu).

Lung cancer is the most common cause of cancer mortality in male and female patients in the US. Non-small cell lung cancer (NSCLC) accounts for more than 80% of lung cancers. Standard chemotherapy for patients with advanced disease is a cisplatin-based treatment. However, a major drawback of this therapy is development of drug resistance leading to cancer progression and reduced patient survival. The cytotoxic mode of cisplatin action is mediated by its interaction with DNA to form adducts that activate signaling pathways for cell death (apoptosis). DNA damage-mediated apoptotic signals, however, can be blocked in NSCLC, and emerging data suggest that estrogens play a role in this process. To understand how estrogens modulate cisplatin resistance *in vitro*, we used two models of NSCLC, A549 and H23 cells, that proliferate in response to estradiol-17 $\beta$  (E2), express estrogen receptors and aromatase (enzyme that produces estrogens locally). Cisplatin reduces cell proliferation and enhances apoptosis in NSCLC cells when given alone or in combination with aromatase inhibitors that block E2 production. This antitumor effect is reduced when cells are in the presence of estrogens. Using gel electrophoresis and Western immunoblot analysis of excision repair cross-complementing-1 (ERCC1) protein (plays a key role in repair of cisplatin-induced DNA damage), we find that ERCC1 levels are significantly increased in the presence of estrogen, thereby suggesting a potential mechanism for estrogen-induced cisplatin resistance. A new strategy to block NSCLC growth may be use of cisplatin with simultaneous suppression of estrogen signaling (using aromatase inhibitors).

**204 The Relationship of Calcium Concentration on *Blastomyces dermatitidis* Yeast Cell Growth and Antibody Detection with Cell Lysate Antigens, JAMES B. SMITH, ROSS DECHANT, and GENE M. SCALARONE** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007; scalgene@isu.edu).

The dimorphic fungus *Blastomyces dermatitidis* is the primary agent in the systemic fungal disease blastomycosis, a condition that is frequently overlooked and undiagnosed in clinical laboratories. Yeast phase cells express cell wall proteins in a calcium binding motif that are implicated as the components that induce or inhibit an immunological response to *B. dermatitidis*. The growth of the fungus is impaired at low calcium levels and it has been suggested that *B. dermatitidis* may possess mechanisms that allow for acquiring exogenous calcium in the host and contribute to the pathogenesis of this disease. The purpose of this study was to determine the effect of variable calcium concentrations (calcium chloride; 0.15-0.75 g/L) in growth media and the expression of the antigenic components subsequently produced from the yeast cells. The relationship of the variable calcium concentrations in the yeast cell growth media and the ability of the yeast phase lysates, prepared from four different isolates of *B. dermatitidis*, to detect antibodies in serum specimens

from immunized rabbits or infected dogs was determined using the enzyme-linked immunosorbent assay (ELISA). Mean absorbance values ranged from 0.556 to 1.641 (rabbit sera) and from 0.433 to 1.569 (dog sera) when the calcium concentrations in the yeast cell growth media ranges from 0.15 to 0.75 g/L respectively. The results reveal that media calcium concentrations may have a significant impact on *B. dermatitidis* antibody detection and may even offer insight into future therapeutic intervention in blastomycosis.

**205 Comparative Studies on  $\alpha$ -(1,3)- glucan in *Blastomyces dermatitidis* Yeast Lysate Antigens and the Use of the Lysates for the Detection of Antibodies, MANDIRA MANANDHAR and GENE M. SCALARONE** (Department of Biological Sciences, Idaho State University, Pocatello, ID 83209-8007; scalgene@isu.edu).

The polysaccharide alpha 1-3 glucan is a cell wall constituent associated with the pathogenesis of most respiratory fungal organisms. *Blastomyces dermatitidis*, the systemic fungal organism that causes blastomycosis in humans and animals, contains alpha 1-3 glucan as a surface component of the yeast cells and has been implicated as a virulence factor in the disease. The purpose of this present study was to evaluate the relationship between the amount of alpha 1-3 glucan in yeast phase lysate reagents prepared from various isolates of *B. dermatitidis* and the ability of these lysates to detect antibody in serum specimens from rabbits immunized with lysate antigens or whole killed yeast cells. A monoclonal antibody was used to detect alpha 1-3 glucan in 15 yeast lysate preparations using an enzyme-linked immunosorbent assay (ELISA). An ELISA was also used to detect antibody in the rabbit sera with the lysate antigens. An inverse relationship was evidenced when the alpha 1-3 glucan mean absorbance values, ranging from 0.218 to 0.550, were compared to the antibody detection mean values which ranged from 1.137 to 0.829. The data indicate that the yeast lysate antigenic reagents with the least amount of alpha 1-3 glucan were the most efficacious with regard to antibody detection. Studies are continuing to further elucidate this relationship for possible immuno-diagnostic applications.

## ECOLOGY, ORGANISMAL BIOLOGY and ENVIRONMENTAL SCIENCES

**206 A Study of the Changes in Composition of Native vs. Non-native Plant Density in Oregon Coastal Clatsup Prairie under Species Specific Management Conditions, DEREK NAEGELI and MEGHANN CARTER** (Environmental Science, Pacific University, 2043 College Way, Forest Grove, OR 97116, USA; MTrunner@pacificu.edu).

The decline of Oregon's native grasses is detrimental to the health of the coastal prairie ecosystem. On the Oregon Military Department's Camp Rilea training facility near Warrenton, Oregon, the grasslands include many native grasses as well as many introduced grasses that threaten to out-compete the natives. The low growing habitat and patchy nature of native grasses creates niches that can be occupied by native forbs. When non-native species are introduced into this system, they have no natural check and tend to form dense monocultures with much lower species diversity. The management at Camp Rilea consists of mowing the earlier-seeding invasive species to cut off their seed heads in order to inhibit recruitment. The goal is to reduce the density of invasive plants and allow native plants to resume their dominant role. This study

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compares the effect of different intensities of management on the composition of the grasslands. The grass is mowed three times yearly and trampled by the researchers once yearly to determine the effect of disturbance on native and non-native species. The data is collected using a point-intercept method to determine community composition. By comparing the results of one year to the next, artificial methods of disturbance such a mowing and trampling can be evaluated for their ability to influence the proportion of native to non-native species in this remnant coastal prairie system.

**207 Effect of Host on *Symbiodinium* Gene Expression, ERIKA DIAZ-ALMEYDA, SHINICHI SUNAGAWA, CHRISTIAN VOOLSTRA, COLLIN CLOSEK, and MONICA MEDINA** (School of Natural Sciences, University of California, Merced, CA 95344; ediaz-almeyda@ucmerced.edu).

Health of coral reefs, the most diverse marine ecosystem, depends on the functional symbiosis between cnidarian hosts and symbiotic dinoflagellates. These dinoflagellates belong to the diverse genus *Symbiodinium* and reside in the endodermal cells of the host. While the coral host provides inorganic nutrients to the symbionts, the dinoflagellates pass some of their photosynthetic products to the host. While a number of studies have investigated the effect that the symbiont has on the coral host (e.g. enhanced calcification, etc.), the effect that the host might have on the metabolism of the symbiont is unknown. In this study we use *Aiptasia pallida* as a model to investigate the effect of the host on *Symbiodinium* gene expression. By infecting aposymbiotic anemones with different strains of *Symbiodinium* and using microarrays, the gene expression related to carbohydrate or energy metabolism on *Symbiodinium* living inside and outside *Aiptasia pallida* was analyzed. This is the first report that uses microarray technology to assay transcriptome changes in the symbiont and will be helpful to understand the molecular and cellular mechanisms involved in cnidarian-dinoflagellate symbioses.

**208 Pattern of Symbiont Distribution in Two Intertidal Isopods (*Ligia pallasii* and *L. occidentalis*) along the Eastern Pacific, RENATE EBERL, MATTHEW COHN, and DONALD R. STRONG** (University of California Davis, Department of Evolution and Ecology, One Shields Avenue, Davis, CA 95616; reberl@ucdavis.edu).

Symbiotic associations provide ecological opportunities as metabolic capability acquired from a microbial symbiont can allow hosts to expand their distribution and occupy formerly unoccupied niches. The marine intertidal zone likely represents the kind of environmental gradient across which the first terrestrial invertebrates evolved. Studies of microbial associations of intertidal isopods in the primitive genus *Ligia*. (Oniscidea, Isopoda, Crustacea) can serve as models to understand rules that govern the formation of nutritional symbioses as more advanced Oniscidean isopods - previously found to house symbionts in their hepatopancreas - have evolved a true terrestrial existence.

*Ligia pallasii* and *Ligia occidentalis* co-occur at different heights of the intertidal zone along the Eastern Pacific with a large geographic zone of range overlap from Southern Oregon to Monterey Bay, California. In both host species Fluorescent-in-situ-hybridization with EUB I-III revealed bacterial symbionts in the hepatopancreas, with two different morphologies - moderately to strongly curved rods and cocci (*L. pallasii*), and cocci (*L. pallasii* and *L. occidentalis*). Phylotypic diversity in 16S rRNA clone

libraries of hepatopancreas homogenate was greater in *L. pallasii* (5 bacterial classes) that lives higher in the intertidal than in *L. occidentalis* (Mollicutes only). Populations of *Ligia spp.* along the Eastern Pacific were screened with the primer pair (S372/1492r) specific for Mollicutes for the presence of symbionts. Both host species screened positive in all populations despite distinct regional lineages in each host species as evidenced from sequencing a host mitochondrial gene.

**209 Modeling the Impacts of Climate Change on San Francisco Bay-Delta Wetlands and Links to Pelagic Food Webs, V.T. PARKER<sup>1</sup>, J.C. CALLAWAY<sup>2</sup>, E.R. HERBERT<sup>1</sup>, L.M. SCHILE<sup>3</sup>, V.T. VREDENBURG<sup>1</sup>, M.C. VASEY<sup>1,4</sup>, E.L. BORGNISS<sup>2</sup>, N.M. KELLY<sup>3</sup>, and D.M. TALLEY<sup>5</sup>** (<sup>1</sup>Department of Biology, San Francisco State University, 1600 Holloway Ave., San Francisco, CA 94110; herberte@sfsu.edu; <sup>2</sup>Department of Environmental Science, University of San Francisco, 2130 Fulton Street, San Francisco, CA 94117-1080; <sup>3</sup>Department of Environmental Science and Policy Management, University of California Berkeley, 137 Mulford Hall #3114, Berkeley, CA 94720; <sup>4</sup>Department of Environmental Studies, University of California Santa Cruz, 1156 High St., Santa Cruz, CA 95064; <sup>5</sup>Department of Marine Science and Environmental Studies, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110).

San Francisco Bay-Delta wetlands are predicted to experience substantial shifts in salinity and inundation over the next century. Summer salinities will increase due to reduced freshwater flows, increased saltwater intrusion due to sea-level rise, and increased summer temperatures. Inundation rates will increase as sea-level rise outpaces marsh accretion. While these shifts are predicted in estuaries around the country, the impacts will differ significantly between temperate systems and the mediterranean-type climate system found in the SF Bay-Delta. We have initiated a multi-year study that evaluates the predicted effects of climate change on marsh dynamics, investigating plant species distributions, decomposition and productivity, sediment accretion, and food web dynamics across the estuary. Freshwater marshes have higher rates of both diversity and productivity (>60 species, 2440 g m<sup>-2</sup> y<sup>-1</sup>) than brackish (24-50 species, 900-1400 g m<sup>-2</sup> y<sup>-1</sup>) or salt marshes (10-17 species, 270-700 g m<sup>-2</sup> y<sup>-1</sup>) but sites also show specific inter-site variability in diversity and productivity that is strongly correlated with inundation and salinity gradients within a single site. Initial measurements of sediment accretion and plant decomposition rates suggest differences in the importance of mineral versus organic matter contributions to marsh accretion. Preliminary  $\Delta^{15}\text{N}$  and  $\Delta^{13}\text{C}$  stable isotope data suggest a dependence of resident fishes on the productivity of specific assemblages within marshes, indicating that pelagic consumers will be impacted by changes in marsh plant communities in response to changes in salinity and inundation.

**210 The Presidio Bee Biodiversity Survey, CHRISTOPHER QUOCK and JESSICA VAN DEN BERG** (Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; cdquock@mindspring.com).

This project builds on earlier studies of arthropod diversity in the Presidio of San Francisco. Questions addressed include: 1. Do restored sites increase in bee diversity and change in species composition over time? 2. How do natural environmental factors affect yearly and site-to- site patterns of bee diversity and abundance? 3. Can additional sampling increase the number of bee species known

from the Presidio? To address these questions, bees were sampled at four locations within the Presidio for one year. Transects were laid out at Thompson Reach, Lobos Sand Dunes, Baker Beach, and the World War II Memorial site. Study sites overlapped those of the previous bee survey. Of particular interest were sites, such as Thompson Reach, where dramatic environmental changes have taken place due to habitat restoration. Bees were sampled using transects lined with blue, yellow and white pan traps from late morning to mid-afternoon for one day per month. In line with the previous study, a high degree of native bee species richness was found in the Presidio. The presence of additional species/morpho-species not represented in the past survey indicates an even higher level of bee diversity within this urban park. Additionally, absence of some taxa found in the previous study suggests that the Presidio bee fauna experiences considerable yearly variation in composition and abundance.

**211 Altered Host Nutrient Consumption and Utilization Determines Parasite Success, S. N. THOMPSON and R. A. REDAK** (Department of Entomology, University of California, Riverside, CA 92521; nelsont@ucr.edu).

Larvae of the insect *Manduca sexta* L. were parasitized by the gregarious hymenopteran *Cotesia congregata* (Say) and reared on chemically-defined artificial diets having variable macronutrient (protein:carbohydrate) balance and included both protein-biased and carbohydrate-biased diets. Diet and nutrient consumption were affected by nutrient balance but the responses of normal unparasitized and parasitized insects were different. Normal larvae displayed a non-linear relationship between protein and carbohydrate consumption while the relationship for parasitized larvae was linear. Normal larvae grew best on protein-biased diets although efficiency of nitrogen conversion was greatest on carbohydrate-biased diets. Parasitism generally reduced growth, but parasitized larvae displayed uniform growth across all diets and nitrogen conversion was greatest on diets having intermediate nutrient ratios. Nitrogen conversion by parasitized larvae was greatest on diets having intermediate nutrient ratios. Parasite biomass was positively correlated with host protein consumption. These results, when considered together with those of our other investigations, indicate that parasitism influences host nutrient consumption in a manner that achieves uniform host growth under diverse nutritional regimes, thus constraining blood nutrient concentrations within limits suitable for parasite growth and development.

**212 Diversity on the California Academy of Sciences' Green Roof, JESSICA VAN DEN BERG** (Department of Biology, San Francisco State University, Entomology Lab, San Francisco, CA 94132; jvanden@sfsu.edu).

I am conducting a comprehensive survey of arthropod diversity on the California Academy of Sciences' green roof. The sampling regime includes pitfall and pan traps and is performed monthly for one year, June 2008 to May 2009. DNA barcoding and digital macro photography will be used to assign individual arthropods to morphospecies to provide an accurate number of total arthropod species. I will use a variety of statistical methods to identify seasonal and temporal patterns in arthropod composition and density and the rate of colonization from the surrounding park. I predict that the arthropod diversity will be positively correlated with plant species diversity. I also predict that the various microhabitats on the roof will support different arthropod assemblages. This database

will serve as a baseline to detect changes in insect assemblages as the roof matures over time. In addition, the results of this research will help fill a void in green roof knowledge and hopefully influence future green roof designs in regards to enhancing urban ecosystems.

**213 Phylogenetic Analysis of Relationships within *Phacelia* (Boraginaceae) Inferred from Chloroplast Sequence Data, GENEVIEVE K. WALDEN and ROBERT PATTERSON** (San Francisco State University, Department of Biology, 1600 Holloway Avenue, San Francisco, CA 94132; gkwalden@sfsu.edu).

*Phacelia* Juss., the largest genus of Boraginaceae: Hydrophyllidoideae comprises 200 species, with a range throughout N. America and part of temperate S. America. The genus consists of perennials, biennials, and annual herbs. Species differences have traditionally been based on morphological and cytological characters; however, the genus is taxonomically complex and can be difficult to identify (Gillett 1955, Constance 1963). The last comprehensive revision of the Hydrophyllaceae was completed by Brand (1913), whose recognition of three tribes and 18 genera has been the basis for subsequent revisional work in the genus. Constance's classification system (1963), based largely on chromosome numbers and pollen morphology (Chuang and Constance 1982), offers a partial yet testable taxonomic structure. Molecular systematic studies in *Phacelia* (Dempcy 1996, Ganong 2002, Gilbert et al. 2005, Hansen 2005, Garrison 2007) have focused on relationships within particular species groups and not the entire genus. Collectively these researchers have analyzed 80 (~40%) taxa using nrITS. In contrast, Ferguson (1998) conducted a study of generic relationships within the expanded and paraphyletic Boraginaceae using *ndhF*, and included 19 species of *Phacelia* (Ferguson 1998). Our current research is the first attempt to infer infrageneric relationships across the entire genus *Phacelia* using chloroplast *ndhF* and *trnC-trnD* as molecular markers. In addition to resolving a wider spectrum of species relationships in the genus, we intend to address the phylogenetic integrity of previously recognized groups of various rank. Additionally, the molecular-based phylogeny will allow a future reexamination of the evolutionary history of morphological and cytological characters in *Phacelia*.

## NOTES

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