

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

Volume 30, Part I

12 June 2011

92nd ANNUAL MEETING
including the
7th WORLD CONGRESS on MUMMY STUDIES
PROGRAM with ABSTRACTS



**University of San Diego
San Diego, California
12 – 16 June 2011**



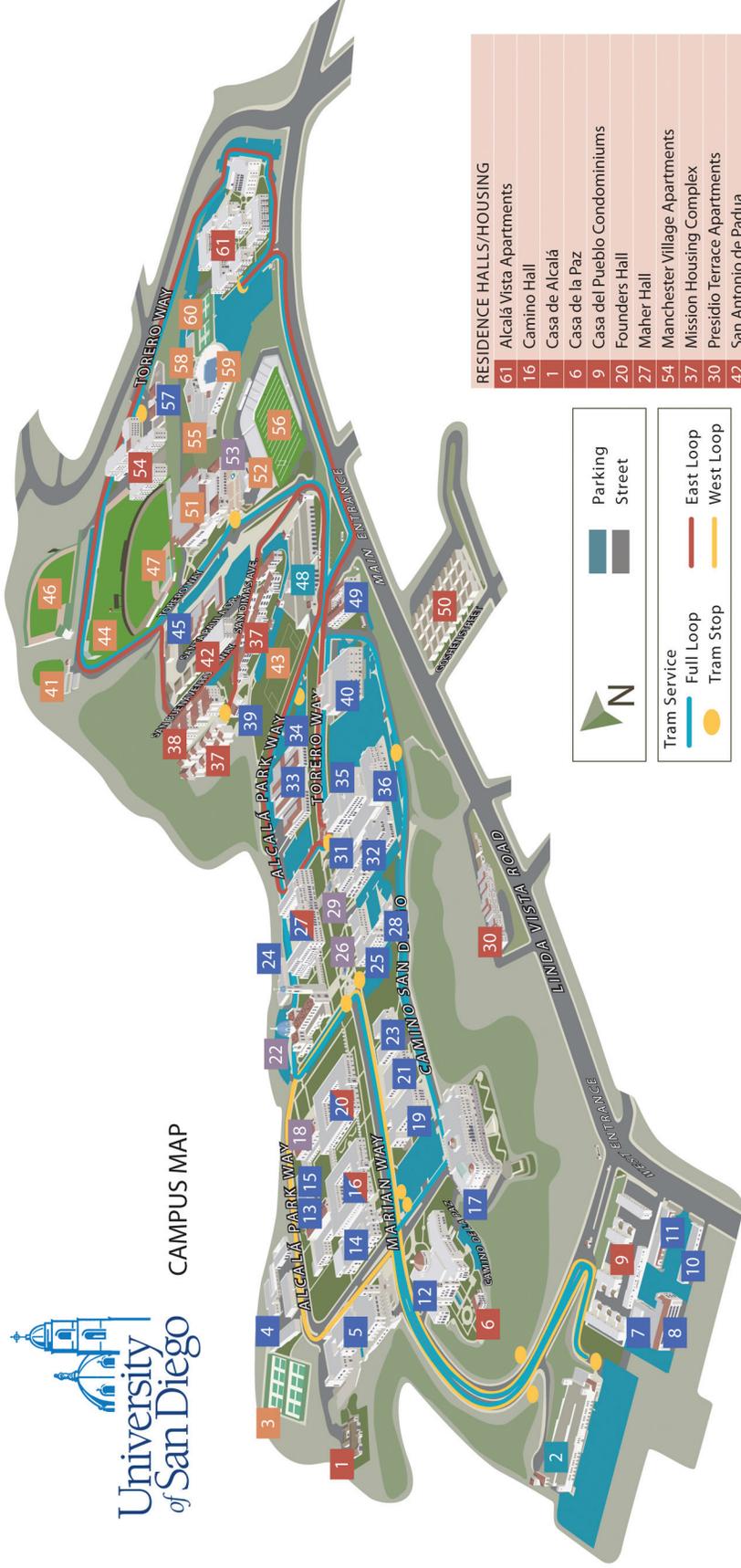
**7th World
Congress on
Mummy Studies**



ADVANCING SCIENCE, SERVING SOCIETY



CAMPUS MAP



RESIDENCE HALLS/HOUSING	
61	Alcalá Vista Apartments
16	Camino Hall
1	Casa de Alcalá
6	Casa de la Paz
9	Casa del Pueblo Condominiums
20	Founders Hall
27	MaHer Hall
54	Manchester Village Apartments
37	Mission Housing Complex
30	Presidio Terrace Apartments
42	San Antonio de Padua
38	San Buenaventura
50	University Terrace Apartments

CHURCHES/PLAZAS	
18	Founders Chapel
22	The Immaculata
26	Colachis Plaza
29	Plaza de San Diego
53	Eagan Plaza

ON CAMPUS DINING	
5	Bert's Bistro
12	La Paloma
33	La Gran Terraza
34	Pavilion Dining/Tu Mercado
50	ATM/Concessions
27	Aromas
38	Missions Café

N

Parking
 Street

Tram Service
 Full Loop
 East Loop
 West Loop
 Tram Stop

ATHLETIC FACILITIES	
47	Cunningham Baseball Field
60	East Tennis Courts
52	Field House
51	Jenny Craig Pavilion
44	Manchester Valley Field
59	Pool
46	Softball Field
55	Sports Center
41	Sports Field
56	Torero Stadium
43	Valley Field
58	Weight Room
3	West Tennis Court

PARKING STRUCTURES	
48	Mission Parking
2	West Marian Way Parking

ACADEMIC/ADMINISTRATIVE FACILITIES	
7	Alcalá Park West - Coronado
8	Alcalá Park West - Barcelona
10	Alcalá Park West - Ávila
11	Alcalá Park West - Durango
16	Camino Hall
14	Copley Library
49	Degheri Alumni Center
4	Facilities Management Complex
20	Founders Hall
31	Guadalupe Hall
23	Hahn School of Nursing and Health Science
33	Hahn University Center
25	Hughes Administration Center
12	Joan B. Kroc Institute for Peace & Justice
36	Loma Hall and Bookstore
27	MaHer Hall
21	Manchester Executive Conference Center
57	Manchester Child Development Center
39	Mission Crossroads
5	Mother Rosalie Hill Hall
19	Olin Hall
40	Pardee Legal Research Center
24	Procurement, Copy and Graphics
28	Public Safety, Parking Services and Visitor Info
15	Sacred Heart Hall
32	Serra Hall
17	Shiley Center for Science and Technology
45	St. Francis Center for Priestly Formation
13	Student Health Center
34	Student Life Pavilion
35	Warren Hall

PROCEEDINGS
of the
Annual Meeting
of the
AAAS, PACIFIC DIVISION

Volume 30, Part I

12 June 2011

PROGRAM with ABSTRACTS

**92nd Annual Meeting of the Pacific Division of the
American Association for the Advancement of Science**

including the

7th World Congress on Mummy Studies

***University of San Diego
San Diego, California
12 – 16 June 2011***

*Contents accurate as of 23 May 2011.
Times and/or locations of events may change.
Please refer to the “Changes” flyer for updated information.*



CONTENTS

92nd ANNUAL MEETING of the AAAS, PACIFIC DIVISION PROGRAM with ABSTRACTS

GENERAL INFORMATION

Policies.....	4
Governance.....	5
Greeting from Dr. Alissa Arp, President, AAAS Pacific Division.....	6
Sections Sponsoring Sessions at the Annual Meeting.....	7
University of San Diego and San Diego.....	9
Registration.....	11
Campus Housing.....	9
Local Hotels and Motels.....	10
Travel to the Meeting.....	10
On-campus Parking.....	11
Registration Center.....	11
Messages.....	13
Breaks.....	13
Meeting Rooms, Computers, and PowerPoint Presentations.....	12
Student Presentation Award Competition.....	12
Special Events and Public Lectures.....	12
Field Trips.....	14
Workshops.....	16
Program at a Glance.....	19

GENERAL SESSIONS

Opening Greetings, 7 th World Congress on Mummy Studies.....	19
Sunday Poetry Reading.....	19
Sunday Evening Plenary Lecture.....	19
Sunday Evening Reception.....	24
Monday Noon Public Lecture.....	19
Monday Evening Plenary Lecture.....	19
Monday Evening Reception.....	19
Tuesday Noon Public Lecture.....	20
Annual Banquet, including the Announcement of Student Awards and the Pacific Division Presidential Lecture.....	20
Business Meeting of the Council of the Pacific Division.....	20
Wednesday Noon Public Lecture.....	20
Museum of Man Field Trip and Reception.....	20

TECHNICAL SESSIONS

I. Symposia

Sunday, 12 June

^{WCMS} Applied Ethics of Mummy Research.....	26
---	----

Monday, 13 June

The Forensic Science of Clinical Mental Health Counseling: The Theresa Lewis Case.....	23
7 th Annual Symposium on Advances in Materials Science and Nanotechnology.....	23
Quantum Retrocausation: Theory and Experiment, Part I.....	24
Don't Sign Your Life Away: Author's Rights, Scientific Publishing, Digital Repositories, and the Case for Open Access.....	24
Panama Canal Expansion.....	25
New Humanities and Science Convergences: New Languages for New Realities: Literature, Poetry, and Hypertext.....	26

Tuesday, 14 June

^{WCMS} Human Leishmaniasis in Mummified Remains: From Icono-graphical Sources to Modern Day Techniques.....	27
Geophysical Turbulence.....	27
Antarctic Ice Is Nice.....	28
Quantum Retrocausation: Theory and Experiment, Part II.....	29
The Second Law of Thermodynamics: Status and Challenges, Part I.....	30
^{WCMS} Technical Studies on the Head of an Egyptian Child Mummy.....	30
Music and the Sciences: Synergies Among Musical Arts, Math, Science, and Engineering.....	31
Science Education and Civic Engagement.....	32
^{WCMS} Human Experimental Mummification.....	32
Fragile X Syndrome: Advances In Our Understanding of a Common Cause of Retardation and Autism.....	33
^{WCMS} Mummy Research in the Electronic Age.....	34
^{WCMS} aDNA and Associated Biomolecules.....	34

^{WCMS}Denotes a program of the 7th World Congress on Mummy Studies

<i>Wednesday, 15 June</i>	
^{WCMS} Princess Takabuti – Analysis, Interpretation, and Visualization	35
United States and World Fairs	35
Pathways to Science: Promoting Inquiry-Based Learning Beyond the Classroom	36
^{WCMS} Facial Analysis and Depiction of Preserved Remains	37
The Second Law of Thermodynamics: Status and Challenges, Part II	37
^{WCMS} The Rio Muerto Project: Mummies of the Tiwanaku Culture from Moquegua, Perú	38
Osteoimmunology: Fundamental, Clinical and Translational Implications in Temporomandibular Disorders	38
^{WCMS} State-of-the-Art Ancient Mummy Research	39
 The Changing Role of the Research University in K–12 Science Education	40

<i>Thursday, 16 June</i>	
^{WCMS} Mexican Mummy Studies	41
^{WCMS} Studies on an Old Kingdom Mummy	41
^{WCMS} Heart Disease and Atherosclerosis in Ancient Egyptian Mummies	42
^{WCMS} Mummies as Cultural Heritage	42
^{WCMS} A Multidisciplinary Collaboration for Tissue Analyses: The Case of Kwäday Dän Ts'inci	43
^{WCMS} Hair in Archaeology	43

II. Workshops

<i>Monday, 13 June</i>	
Finding Information in Open Access Journals	45

<i>Wednesday, 15 June</i>	
Vitamin D	45

<i>Thursday, 16 June</i>	
Field and Advanced Paleoimaging	46
Artefact Annotation – Developing an Ontology to Help Mine Datasets	46

III. Contributed Oral Paper Sessions

<i>Sunday, 12 June</i>	
World Congress on Mummy Studies, Session I	47

<i>Monday, 13 June</i>	
World Congress on Mummy Studies, Session II	48
Joint Session of AAASPD Sections of Education Anthropology and Archaeology	50

Joint Session of AAASPD Sections of Ecology, Organismal Biology, and Environmental Sciences Earth Sciences	50
Joint Session of AAASPD Sections of Health Sciences Engineering, Technology, and Applied Sciences Computer and Information Sciences	51

<i>Tuesday, 14 June</i>	
Joint Session of Pacific Division Sections Chemistry and Biochemistry Cell and Molecular Biology	52
Joint Session of Pacific Division Sections History and Philosophy of Science General and Interdisciplinary Studies	52
Joint Session of Pacific Division Sections Psychology Social, Economic and Political Sciences Engineering, Technology and Applied Sciences	53

<i>Thursday, 16 June</i>	
World Congress on Mummy Studies, Session III	54

IV. Contributed Posters

Poster Session Instructions	55
-----------------------------------	----

<i>Sunday, 12 June</i>	
Poster Session I: World Congress on Mummy Studies	55

<i>Monday, 13 June</i>	
Poster Session II: AAAS, Pacific Division	58

ABSTRACTS	61
------------------------	----

INDEX OF NAMES	155
-----------------------------	-----

MAPS

University of San Diego	Inside Front Cover
Joan B. Kroc Institute for Peace and Justice	Inside Back Cover

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.

Video and/or audio taping of any session or parts thereof for commercial purposes is not permitted without prior approval from the speakers, organizers and AAAS, Pacific Division.

The AAAS, Pacific Division is not responsible for the accuracy of advertising information in these *Proceedings*. Advertising information contained herein is provided by the participating advertisers and does not constitute endorsement by the AAAS, Pacific Division.

Abstracts and summaries published in these *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. Discourtesy 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 12 of these *Proceedings*.

Planning Committee for the 92nd Annual Meeting

Program Chairs at the University of San Diego

For the general program:

Frank Jacobitz, University of San Diego

Anne A. Sturz, University of San Diego

For the 7th World Congress on Mummy Studies:

Alana Cordy-Collins, University of San Diego

Rose Tyson, San Diego, CA

Program Organizers:

Alan L. Bain, Retired, Smithsonian Institution Archives

Steve Bachofer, Saint Mary's College California

Andre Barkhordarian, U California, Los Angeles

Ronald Beckett, Quinnipiac University

Amy Besnoy, University of San Diego

Raffaella Bianucci, University of Turin

Bob Brier, Long Island University

John Cannell, Vitamin D Institute

Robert L. Chianese, Cal State University Northridge

Francesco Chiappelli, U California, Los Angeles

Philip Collins, U California Irvine

Gerald Conologue, Quinnipiac University

Alana Cordy-Collins, University of San Diego

John Cworkowski, U California, San Diego

Halina Duraj, University of San Diego

Harinda Joseph S. Fernando, U Notre Dame

Veronica Galván, University of San Diego

Crystal Goldman, San Jose State University

Paul S. Goldstein, U California, San Diego

Paul Heckman, U California, Davis

Frank G. Jacobitz, University of San Diego

Ronn Johnson, University of San Diego

Ronald S. Kaufmann, University of San Diego

Ilan Leboroio, Instituto Nacional de Antropologia e Historia

Pearl Ly, Cal State University San Marcos

Niels Lynnerup, University of Copenhagen

Carl A. Maida, U California, Los Angeles

Josephina Mansilla, Instituto Nacional de Antropologia e Historia

María Victoria Monsalve, U British Columbia

Andreas G. Nerlich Institute for Pathology, München, Germany

Christina Papageorgopoulou, University of Zürich

Anita Petty, Digital Operations, Albuquerque, NM

Panos Photinos, Southern Oregon University

Dario Piombino-Mascali, Institute for the Mummies and the Iceman, Bolzano

Marvin Rowe, Texas A&M University

Frank Rühli, University of Zürich

Kai Schneider, Université de Provence

Sherry Seethaler, U California, San Diego

Thomas F. Schubert, University of San Diego

Amy Shachter, Santa Clara University

Daniel P. Sheehan, University of San Diego

Dong Hoon Shin, Seoul National University

Mark Spigelman, University College, London

Steve Staninger, University of San Diego

Anne A. Sturz, University of San Diego

Randall C. Thompson, University of Missouri

Rose Tyson, San Diego, California

Peter W. Vanderlish, The Scripps Research Institute

Ani Velo, University of San Diego

Caroline Wilkinson, University of Dundee

Jocelyn Williams, Trent University

Andrew S. Wilson, University of Bradford

S.J. Wolfe, American Antiquarian Society

Albert Zink, European Academy of Bolzano

Officers of AAAS

2011 – 2012

Chairman of the Board: *Alice S. Huang*, California Institute of Technology

President: *Nina V. Fedoroff*, U.S. Department of State

President-elect: *William Press*, University of Texas, Austin

Treasurer: *David E. Shaw*, D.E. Shaw Research

Chief Executive Officer: *Alan I. Leshner*, AAAS, Washington, D.C.

Officers of the Pacific Division

2010 – 2011

President: *Alissa Arp*, Southern Oregon University

President-elect: *Robert Chianese*, California State University, Northridge (retired)

Past President: *John E. Hafernik*, San Francisco State University

Executive Director: *Roger G. Christianson*, Southern Oregon University

Executive Committee of the

Pacific Division

2010 – 2011

Alissa Arp, Southern Oregon University

Robert L. Chianese, California State University, Northridge (retired)

Robert L. Christiansen, U.S. Geological Survey, Menlo Park, CA (retired)

Roger G. Christianson, Southern Oregon University

Terrence Gosliner, California Academy of Sciences

John Hafernik, San Francisco State University

Frank Jacobitz, University of San Diego

Matthew J. James, Sonoma State University

Léo F. Laporte, University of California, Santa Cruz (emeritus)

Owen M. McDougal, Boise State University

D. Jeffrey Meldrum, Idaho State University, Pocatello

Counselor, non-voting:

Alan E. Leviton, California Academy of Sciences

AAAS Liaison to the Pacific Division

Gretchen Seiler, AAAS, Washington, DC

Council of the Pacific Division

2010 – 2011

Alissa Arp, Southern Oregon University

William B.N. Berry, University of California, Berkeley

John J. Carroll, University of California, Davis (retired)

Robert L. Chianese, California State University, Northridge (retired)

Francesco Chiappelli, University of California, Los Angeles

H.K. Choi, California State University, Dominguez Hills

Robert L. Christiansen, U.S. Geological Survey, Menlo Park, CA (retired)

Roger G. Christianson, Southern Oregon University

Stephen Frost, University of Oregon

Armando J. Galindo, Pebble Beach, CA

Terrence Gosliner, California Academy of Sciences

John Hafernik, San Francisco State University

Frank Jacobitz, University of San Diego

Matthew J. James, Sonoma State University

Cheryl L. Jorcyk, Boise State University

Léo Laporte, University of California, Santa Cruz (emeritus)

Alan E. Leviton, California Academy of Sciences

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

Carl A. Maida, University of California, Los Angeles

Owen M. McDougal, Boise State University

Donald J. McGraw, Ephraim, UT

D. Jeffrey Meldrum, Idaho State University, Pocatello

J. Kenneth Nishita, California State University Monterey Bay

Panos Photinos, Southern Oregon University

Rouel S. Roque, Touro University Nevada

Anne A. Sturz, University of San Diego

Kimberly D. Tanner, San Francisco State University

Richard W. Van Buskirk, Pacific University

Jay Vavra, High Tech High, San Diego, CA



June 12, 2011

Welcome to the 92nd Annual Meeting of the Pacific Division of the AAAS, hosted by the University of San Diego. This year's meeting theme of "Examining the Past – Exploring the Present – Enabling the Future" is particularly appropriate for our setting, as we rapidly approach the 100th anniversary of the Division's annual meetings and in light of the fact that San Diego was the site for the first annual meeting of the Pacific Division in 1916.

Program highlights include the usual robust range of scientific topics from nanotechnology to Antarctic ice, and we are extremely pleased to welcome the World Congress on Mummy Studies, whose members are making their seventh triennial conclave a part of our Pacific Division annual meeting. Additionally, we continue our discussions of inquiry-based learning beyond the classroom, as well as the exploration of the convergence of science and the arts through relationships between music, poetry and science.

Please join in on the myriad of workshops and field trips that will highlight our time in the beautiful San Diego area. I know we all look forward to catching up with friends and colleagues, and to the stimulating interactions in store for us in the days to come.

A handwritten signature in black ink, appearing to read 'Alissa J. Arp'.

Alissa J. Arp, Ph D
President, AAAS Pacific Division



Office of the Dean
College of Arts and Sciences
1250 Siskiyou Boulevard
Ashland, Oregon 97520-5045

T: 541.552.8173
F: 541.552.0000



Joan B. Kroc Institute for Peace and Justice

**92nd Annual Meeting
of the
Pacific Division of AAAS
including the
7th World Congress on Mummy Studies
University of San Diego
San Diego, California
12 – 16 June 2011**

GENERAL INFORMATION

**PACIFIC DIVISION SECTIONS
AND AFFILIATED SOCIETIES
SPONSORING SESSIONS AT THE
SAN DIEGO MEETING**

World Congress on Mummy Studies
Agriculture and Horticultural Sciences
Anthropology and Archaeology
Atmospheric and Oceanographic Sciences
Cell and Molecular Biology
Chemistry and Biochemistry
Computer and Information Sciences
Earth Sciences
Ecology, Organismal Biology and Environmental Sciences
Education (Science and Technology)
Engineering, Technology and Applied Sciences
General and Interdisciplinary

Health Sciences
History and Philosophy of Science
Mathematics
Oral Biology and Dental Medicine
Physics and Materials Science
Psychology
Social, Economic and Political Sciences

**UNIVERSITY OF SAN DIEGO
AND SAN DIEGO**

The University of San Diego (USD) is a Roman Catholic institution of higher learning. Presently enrolling more than 7,500 students, it is known for its commitment to teaching, the liberal arts and the formation of values and community service. The university adds depth to education by inspiring students to grow spiritually, morally and socially.

USD's 180-acre campus, Alcalá Park, sits atop a mesa overlooking San Diego's Mission Bay and the Pacific Ocean. The university campus is a community treasure, with Spanish Renaissance inspired buildings and breathtakingly beautiful landscapes, including the spot where Father Junipero Serra celebrated the first Catholic Mass in Alta California more than 230 years ago. Like California's oldest city, the university took its name from San Diego de Alcalá, a Franciscan brother from Alcalá de Henares, a monastery near Madrid, Spain. The Spanish Renaissance architecture that characterizes Spain's five-century-old University of Alcalá serves as the inspiration for all buildings on the USD campus.

Under the leadership of Mother Rosalie Hill of the Society of the Sacred Heart and Bishop Charles Francis Buddy of the Diocese of San Diego, the University of San Diego began as separate colleges for men and women. Chartered in 1949, the first classes met in 1952 and the School of Law opened its doors in 1954. By the late 1960s it became clear that both colleges would benefit from combining academic resources. In 1972 the University of San Diego became a single coeducational university.

Now governed by a board of trustees independent from the founding organizations, USD welcomes students, faculty and staff of diverse religious traditions and remains dedicated to the values originally articulated by Mother Hill and Bishop Buddy.

SAN DIEGO

With a near-perfect climate, 70 miles of beaches, and mountains and deserts just a short drive away, San Diego draws more than 26 million visitors each year. Known for its countless year-round outdoor activities, San Diego is packed with unique pursuits in the water, on the trails and in the sky. The University of San Diego is just minutes from sailing, windsurfing, kayaking and a host of other water sports. All of the city's beaches are ideal for surfing, body boarding, snorkeling or simply soaking up rays on sand warmed by the ever-present sun.

Hundreds of miles of trails and parks wind throughout San Diego County, ranging from oceanfront land to mountain pine forests, making it very easy to backpack, hike, camp or rock climb in a variety of elevations and environments. The Pacific Crest Trail, which works its way through 150 miles of San Diego backcountry in its trek from México to Canada, is designated one of America's National Scenic Trails.

San Diego has many attractions, including the world-famous San Diego Zoo and Wild Animal Park. Additionally, the 131-year-old Balboa Park is a 1,200-acre oasis in the heart of the city, complete with 15 museums, eight gardens and the acclaimed Old Globe Theatre. San Diego is also home to one of only three Olympic training centers in the nation. And its coastal waters offer an exceptional seasonal experience: a first-rate vantage point from which to witness the annual migration of gray whales from Alaskan seas to Mexican lagoons.

USD STUDENTS

Though the beach is nearby, USD is a serious academic institution. And while the campus itself is stunning, the people truly make the difference. More than 7,000 candidates vie for 1,000 freshman openings each year. The median incoming freshman holds a 3.72 GPA and an 1180 SAT score, yet each student is unique and selected on expressions of diversity, leadership, service, talent, and essential human character.

Of great significance to USD students are small class sizes; great, accessible faculty; and fantastic lab facilities. Students choose from more than 60 undergraduate and graduate degree programs in academic divisions, including the College of Arts and Sciences and the schools of Business Administration, Leadership and Education Sciences, Law, and Nursing and Health Science. The new Joan B. Kroc School of Peace Studies was inaugurated in 2007.

NATURAL SCIENCES AT USD

The natural sciences at USD include four departments: Biology, Chemistry, Physics, and Marine Science and Environmental Studies. Curricula in the sciences are centered on the belief that students learn best when theoretical concepts are combined with hands-on experience. Students in the sciences take numerous lab and field courses, which provide opportunities to learn useful techniques and participate in the scientific process. Many students carry out research and perform internships that complement their formal course work. Interdisciplinary collaborations are common among faculty and students in different departments.

These interactions are enhanced by the inclusion of all four science departments in the new Donald P. Shiley Center for Science and Technology, which opened in 2003. The Center contains classrooms, offices, and modern labs that are used for teaching as well as faculty and student research. It is equipped with state-of-the-art instrumentation and equipment, including 500 MHz and 400 MHz nuclear magnetic resonance systems, a high pressure liquid chromatography – mass spectrometer, gas chromatography – mass spectrometry instruments, atomic analyzers, a nutrient analyzer, a bomb calorimeter, and a laser particle sorter. Microscopic resources include, among the usual assortment of compound and dissecting microscopes, scanning and transmitting electron microscopes and an atomic force microscope.

Several facilities were constructed for specialized functions, including a seawater system with two 2,000 gallon tanks, environmental chambers, aquarium room, a laser laboratory, and a greenhouse with five rooms with independent climate controls. Research and teaching collections include terrestrial and marine vertebrates, marine invertebrates, insects and an herbarium. A 16-foot research vessel is available for marine science investigations.

ANNUAL MEETING

REGISTRATION

The Registration Center will be in the lobby of the Joan B. Kroc Institute for Peace and Justice building (see campus map on the inside cover of these *Proceedings*). Hours of operation are:

Saturday: 5:00 p.m. – 6:45 p.m.

Sunday: 8:00 a.m. – 5:30 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. – 4:00 p.m.

Thursday: 7:30 a.m. – 2:00 p.m.

All persons attending the meeting, except for public sessions, must be registered for the meeting and must wear their name badges at all times while participating in meeting events. Those not displaying a meeting name badge may not make scheduled presentations and may be asked to leave the meeting site.

On-site registration fees are as follows: full meeting professional, \$120; program planners, program presenters, and field trip leaders full meeting, \$85; one-day of meeting professional, \$85 [note that individuals planning to attend more than one day of the meeting must pay the full meeting fee]; K-12 teachers, community college instructors, and emeritus/retired individuals, \$60; students, unemployed, \$50; spouses/family members, \$40.

Special stipends of \$75 were given to the first twenty K-12 and community college instructors that registered in advance for the meeting and requested the stipend on their registration forms. 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 each to help defray their costs for the meeting.

About field trips: Due to limited seating in vehicles and the need to inform some destinations of the number of people arriving, pre-registration for all field trips was required. If you didn't register for a particular field trip in 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, with the exception of Field and Advanced Paleoimaging which has a \$20 fee, are available at no additional charge to meeting registrants. Some workshops have limited space and persons indicating their participation on the Advance Registration Form will have priority in attending should a workshop fill.

About refunds: Requests for refunds must have been in writing and received in the Pacific Division office no later than 19 May 2011. 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 \$15 handling fee is applied. An additional 3.5% deduction is applied to the total amount for credit card refunds.

CAMPUS HOUSING FOR MEETING REGISTRANTS

Meeting registrants staying on campus are housed in Founders and Camino Halls (#s 16 and 20 on the campus map). Founders Hall was originally built as the San Diego College of Women. For a period of time, Founders and Camino Halls were the only dorms on the USD campus. The residence rooms in these two halls are located on the second floor, offering most of the rooms views of beautifully landscaped courtyards. The rooms are typical dorm rooms, with one or two residents per room. Each resident is provided a twin bed, chest of drawers, desk and desk chair and most of the rooms have parquet flooring. Rooms have wireless internet access. Showers and restrooms are located in typical dorm fashion, down the hall. Laundry rooms and vending machines are available. A lounge with cable TV and computers is located in the hall. The University Alcohol Policy designates Founders as a no alcohol living area regardless of age or class status.

If you are an individual and would like to request double housing, we will be pleased to assign you a same gender roommate. Please be sure to note this on your housing application form.

Room/board charges: The basic housing package includes the nights of Sunday, Monday and Tuesday, 12 – 14 June. Additional nights on either side of the three night package are available, allowing one to stay on campus from Friday, 10 June until Saturday, 18 June. Each night includes an \$8 food credit to be spent on campus at any of the eateries, such as Bert's Bistro, La Paloma, La Gran Terraza, Pavilion Dining, Aromas, etc.

Cost of three night housing package (includes \$24 on-campus food credit):

Double: \$183 per person

Single: \$234

Cost of additional nights on either side of the three night package (includes \$8 on-campus food credit per night):

Double: \$61 per person per additional night

Single: \$78 per additional night

Parking for those staying on campus: The cost of parking is \$3.00 per day, and was available for purchase at the time of booking the housing package. Parking permits are for use in the two parking structures, West Marian Way Parking on the west end of campus (#2 on the campus map and closest to the dorms but with a steep hill to climb or wait for a shuttle) and Mission Parking just to the east of the central campus (#48 on the campus map and a bit further away but no hill to climb).

WHAT'S UNDER THE DOME?

SAN DIEGO MUSEUM OF MAN

The SDMoM is the region's only anthropology museum. We are located under the iconic California Tower in Balboa Park.

Begin your journey at www.museumofman.org

LOCAL HOTELS AND MOTELS

San Diego boasts many fine hotels of all qualities, many of which can be accessed for reservations through web sites such as expedia.com or hotels.com.

The three hotels listed below entered into agreements with the Pacific Division to provide meeting attendees special rates and benefits. Attendees were asked to make their reservations directly with the hotel of their choice. The hotels are listed in order of proximity to USD and not in order of any preference on the part of the Pacific Division. Note that taxes (currently 12.5%) will be added to the listed room rates.

Hampton Inn San Diego Airport/Sea World

3888 Greenwood Street, San Diego, CA
619-299-6633

hamptoninn.hilton.com/en/hp/hotels/index.jhtml;jsessionid=NNOJ3XEKQ5EGKCSGBJF222Q?cityhcn=SANGWHX

\$92 (1 to 4 persons)

Proximity to meeting: 2.2 miles

Days Hotel

543 Hotel Circle South, San Diego, CA
1-800-227-4743 or 619-297-8800

www.dayshotelhc.com

\$79 (1 to 4 persons)

Proximity to meeting: 3.3 miles

The Dana on Mission Bay

1710 W. Mission Bay Drive, San Diego, CA
1-800-445-3339 or 619-222-6440

www.thedana.com

Rate: \$129 (1 – 4 persons)

Proximity to meeting: 4.5 miles

TRAVEL TO THE UNIVERSITY OF SAN DIEGO

By Automobile from the North: Use I-5 South, exit Sea World Dr. and Tecolote Rd. Proceed left at stoplight toward Morena Blvd. Turn right onto Morena, left onto Napa, and left onto Linda Vista Rd.

• If you are coming onto campus for the meeting, turn left at the first stoplight, into USD's west entrance. Proceed past the guard booth to the left turn into the West Marian Way Parking structure, number 2 on the campus map found on the inside cover of these *Proceedings*. Trams regularly transport people to the top of the hill and the Kroc Institute for Peace and Justice (IPJ), where the Registration Center is located. Alternatively, you can walk the hill, but it could be a strenuous hike for some. To let someone off

at the top, pass the turn into the parking structure and follow the road to the second stop sign. Turn right and pull up in front of IPJ, by the La Paloma food bar. You can then retrace your route back down the hill and turn right into the parking structure.

- If you are going to your on-campus housing in Founders and Camino Halls, turn left at the first signal and follow the above directions to the top of the hill. Founders and Camino Halls are located on the left side of Marian Way, past IPJ. You can park your automobile near your assigned Hall for unloading before parking in one of the two parking structures. The parking fee is \$3.00 per day.

By automobile from the South (or the airport): Use I-5 North, exit Morena Blvd. (signs will say: Morena Blvd. use I-8 East). Stay to the right and follow the signs for Morena Blvd. Once on Morena, take the first right onto Linda Vista Rd.

- If you are coming onto campus for the meeting, turn left at the second stoplight, into USD's west entrance and follow the directions in the third paragraph above this.

- If you are going to your on-campus housing, turn left at the second signal and follow the directions in the third paragraph above this.

By Automobile from the east: Use I-8 West, exit at Morena Boulevard, turning right. Once on Morena, take the first right onto Linda Vista Rd. and follow the directions above under "By Automobile from the South."

By Air: San Diego is served by several major carriers. The airport is about a ten minute taxi ride from campus. Expect to pay about \$15.00 for the taxi fare. Alternatively, you can rent a car at the airport and follow the above directions to USD.

ON-CAMPUS PARKING

On-campus parking is available in either the West Marian Way Parking or Mission Parking. West Marian Way Parking is much closer to the Kroc Institute for Peace and Justice (KIPJ), site of the meeting, but one must walk up a steep hill to get there. USD provides regular shuttle service up the hill, stopping at KIPJ and several other campus locations. The Mission Parking is probably a twelve to fifteen minute walk from KIPJ, but considering there is no significant hill to climb, may be the better choice for parking. Cost is \$3 per day in either parking structure.

REGISTRATION CENTER

The Registration Center will be in the lobby of the Joan B. Kroc Institute for Peace and Justice building (see #12 on the campus map on the inside cover of these *Proceedings*). Hours of operation are:

Saturday: 5:00 p.m. – 6:45 p.m.

Sunday: 8:00 a.m. – 5:30 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. – 4:00 p.m.

Thursday: 7:30 a.m. – 2:00 p.m.

MESSAGES

To leave a message for a meeting registrant or to contact the AAAS, Pacific Division staff, call 541-292-1115. Please note that this line will be monitored only between the dates of 11 and 17 June. After these 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 for each session as appropriate. Refreshments will be served in the Joan B. Kroc Institute for Peace and Justice rotunda, near the Registration Center.

CAMPUS FOOD SERVICES

The USD campus has several locations where food may be purchased. The most convenient is *La Paloma*, situated in front of our meeting site, the Kroc Institute for Peace and Justice (#12 on the campus map). During summer hours, *La Paloma* provides a food cart that features sandwiches, barbecue, salads, and an assortment of beverages. Hours are 8:00 a.m. to 2:00 p.m. Monday through Friday.



Other locations you might consider:



La Gran Terraza, located on the second floor of the University Center (#33 on the campus map), includes three separate dining venues: *Grand Dining*, which offers a two to three course 'business lunch' prix fixe buffet in addition to the regular a la carte menu and for dinner a varied menu from tapas and hors d'oeuvres to upscale salads, innovative entrees and divine desserts; *O'Toole's lounge*, which provides guests with a varied, flavorful menu featuring hot and cold tapas as well as the opportunity to choose from an extensive wine list that includes vintages from across the globe or from an array of local craft beers featuring Stone Brewing Co.; and *The Terrace*, which overlooks Tecolote Canyon and Mission Bay and where one will find a casual al fresco menu featuring tapas, beer and wine, and daily specials.



Aromas Café, located adjacent to the Immaculata on the 1st level of Maher Hall (#27 on the campus map) is USD's award winning coffeehouse.

Alumni-owned Ryan Bros. Coffee is roasted fresh on site, and they also offer 21 flavors of tea, tea lattes, Italian sodas, blended drinks and gourmet baked goods.



Bert's Bistro, located at the west-end of campus in Mother Rosalie Hill Hall (#5 on the campus map) offers a Mexican menu and \$5 combos in addition to sandwiches, wraps, sushi, soup, salad bar, frozen yogurt and a full espresso and tea bar.

Pavilion Dining (#34 on the campus map) is home to an array of unique dining concepts that fuse distinct ingredients and flavors to create delicious menus in an inviting environment.



Tu Mercado (#34 on the campus map) is a natural food grocery store where visitors may find any number of treats to bring back to their rooms or snack on throughout the day.

MEETING ROOMS, COMPUTERS, AND POWERPOINT PRESENTATIONS

This year's technical sessions will meet in the Joan B. Kroc Institute for Peace and Justice (#12 on the campus map, which is on the inside cover of these *Proceedings*). All meeting rooms are equipped with LCD projectors and computers running Windows XP and Microsoft Office 2007. Only CD-ROMs and thumb/USB/flash drives may be used to load presentations onto the computers. Speakers requiring other specialized equipment such as slide or overhead projectors must have made their requests known when submitting their abstracts. If available, specialized equipment is provided. Any rental costs incurred are the responsibility of the requestor.

Should a presenter wish to use their own laptop computer for their presentation, it will be possible to connect the laptop directly to the LCD projector via a VGA port. It is the responsible of presenter doing this to make sure that they bring any needed adapters to connect their computers to the VGA cable of the LCD projector.

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. Societies often supplement these awards with their own cash prizes.

For this meeting, six Division-wide awards may be given: 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; Best Poster Award (for posters only but otherwise unrestricted); and the AAAS Robert I. Larus Travel Award, which will provide a reimbursement for travel and other meeting related expenses up to \$750 for the awardee to attend the national meeting of AAAS in Vancouver, British

Columbia, 16 – 20 February 2012 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 Division-wide awards, a student must be registered for the meeting *prior to judging*, 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). Sample evaluation forms for both oral and poster presentations are posted on the Division's meeting web page.

Students who are eligible for Awards of Excellence are invited to be the Division's guests at the annual Banquet Tuesday evening, 14 June. 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 Center to see whether any tickets are still available.

IMPORTANT NOTE: All judging for student awards ends no later than 3:00 p.m. on Tuesday, at which time the judges go into closed session to determine the winners. Students with oral presentations beyond this cut-off time were instructed to present their oral presentation also as a poster in order to be judged and in the pool of potential prize winners.

SPECIAL EVENTS AND PUBLIC LECTURES

Sunday Evening Public Plenary Lecture. 7:00 p.m. in the KIPJ Theatre. *NeuroEngineering: Evolution of Biopsychosocial Networks in Humans*, presented by Ishiro Nishimura, DDS, DMSc, DMD, FAP (School of Dentistry and Medicine, University of California Los Angeles, Los Angeles, CA).

Sunday Evening Welcome Reception. Approximately 8:00 – 9:15 p.m. Immediately following the plenary lecture, and hosted by the Pacific Division and its affiliated societies and sections, all registrants and their families are invited to enjoy the conviviality of this event on 12 June, starting about 8:00 p.m. and running to about 9:15 p.m. A selection of soft drinks, chips, pretzels and good conversation will be available. Please wear your registration badge.



Ichiro Nishimura

Courtesy, UCLA

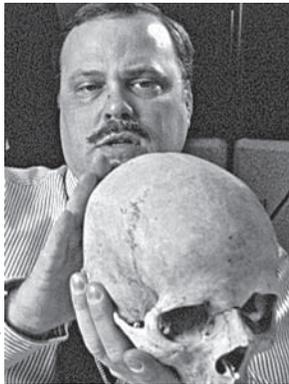
Monday Noon Public Lecture. 12:15 p.m. in the KIPJ Theatre. *Journeying Through Stressed Urban Systems* will be presented by Harindra (Joe) Fernando, Ph.D. (Civil Engineering and Geological Sciences, and Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN) will talk on tsunamis and storm surges, referring to the Indian Ocean Tsunami, Hurricane Katrina and sustainability of communities.



H.J.S. Fernando

Courtesy Arizona State University

Monday Evening Public Plenary Lecture. 7:00 p.m. in the KIPJ Theatre. David R. Hunt, Ph.D. (Physical / Forensic Anthropologist and Collections Manager, Physical Anthropology Division Department of Anthropology, National Museum of Natural History, Washington, D.C.) will present the talk, *Multi-disciplinary Approach to the Study of Human Remains*.



David R. Hunt

Courtesy himself

Monday Evening President's Reception. Approximately 8:00 – 9:15 p.m. University of San Diego Executive Vice President and Provost Dr. Julie Sullivan, will welcome conference attendees at an informal

reception hosted by USD President Dr. Mary Lyons. 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 World Congress on Mummy Studies Special Invited Lecture. 11:45 a.m. in the KIPJ Theatre. *The Lanzarote and Fuerteventura Prehispanic Population, Canary Islands, Spain*, presented by Conrado Rodríguez Martín (Instituto Canario de Bioantropología).



John J. Cannell

Courtesy Vitamin D Council

Tuesday Noon Public Lecture. 12:15 p.m. in the KIPJ Theatre. *Vitamin D*, presented by John J. Cannell, MD (Executive Director, Vitamin D Council, San Luis Obispo, CA).

Tuesday Evening Student Awards Banquet. Reception at 6:15 p.m.; dinner at 7:00 p.m. in KIPJ Rooms A – D. Tuesday evening will be an exciting time for students as

Division representatives will announce the names of student winners of sectional 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.

The evening is planned to begin at 6:15 p.m. with a reception. Dinner service will begin about 7:00 p.m. After dinner will be the presentation of student awards, followed by the Presidential Address, *Scientific Art and Artful Science: Musings of an Arts and Sciences Dean*, presented by Dr. Alissa J. Arp (Dean, College of Arts and Sciences, Southern Oregon University and President of the Pacific Division). The evening is expected to end by about 9:30 p.m.



Alissa J. Arp

Courtesy herself

At the time of purchasing their tickets, banquet attendees were asked to choose between three entrées: Gnocchi (a vegetarian offering, made of thick, soft potato pillows that almost resemble dumplings and covered with asparagus tips, artichokes and sun dried tomatoes and a white wine sauce), Black Cod (served on a bed of borlotti bean ragout infused with thyme and preserved lemon) and Osso Bucco Milanese (cross-cut veal shank, served with vegetables and broth). All entrées are served with a baby spinach salad, fresh vegetable, Chef's choice of starch, butter and rolls, coffee, tea, iced tea and water. If you didn't already purchase a banquet ticket but would like to attend, please check with the Registration Center for ticket availability.

Students in competition for Awards of Excellence are invited to be guests of the Division for this event. *Note that if you are a student who requested a complimentary ticket, we expect you to attend the banquet. Please don't dishonor the Division's generosity in offering you this opportunity to fully participate in the meeting with minimal out-of-pocket expenses by asking for a ticket and then not showing up!*

Wednesday Morning Business Meeting of the Council of the Pacific Division. 7:00 a.m. in the KIPJ Boardroom (Room 226). The Council of the AAAS, Pacific Division will hold its annual breakfast and business meeting starting with breakfast service at 7:00 a.m. Once breakfast is served, the Council will get down to business, electing officers, Executive Committee and Council members, discussing programs for the 2012 and 2013 annual meetings, and transacting other such business as is required by the Division's By-Laws. This is an open meeting and Pacific Division members with an



Courtesy AAAS

Shirley Malcom



Courtesy herself

Sharon Levy

interest in the governance of the Division are invited to attend.

Wednesday Keynote Talk. 8:45 a.m. in KIPJ Room A, Shirley Malcom, Ph.D. (Director of Education and Human Resources Programs, AAAS, Washington, D.C.), as part of the symposium *Pathways to Science: Promoting Inquiry-Based Learning Beyond the Classroom*, will give the Keynote Talk, *The Promise of Inquiry-Based Learning Beyond the Classroom*.

Wednesday Noon Public Lecture. 12:15 p.m. in the KIPJ Theatre. *Once and Future Giants: What Ice Age Extinctions Tell Us about the Fate of Earth's Largest Animals*, Ms. Sharon Levy (Science writer, Arcata, CA). A book signing by Ms. Levy for her recent book of the same title as her talk will immediately follow the conclusion of the talk.

Wednesday Evening Reception. 6:00 p.m. at the Museum of Man, Balboa Park. Please refer to Field Trip #4 on page 15 of these *Proceedings*.

FIELD TRIPS

All field trips are open to meeting registrants and their families. At least one member of a family group must be registered for the meeting. Unregistered family members 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 a non-registrant participates in.

Due to limited space, advance registration was required for all field trips. Reservation and payment of field trip fee(s) was included on the Advance Registration Form. If you didn't pre-register for a field trip in which you would like to participate, inquire at the Registration Center to see whether any space remains.

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 19 May 2011, the registrant will receive a refund of the fee(s) paid less a \$15 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 19 May.

Sunday, 12 June

Field Trip #1: San Diego Coastal Geology and Hazards. Departs from the front of KIPJ at 10:00 a.m.; returns about 4:00 p.m. Pick up your registration materials in advance at the Registration Center. Includes transportation, field guide, and box lunch. Cost: \$70.

Organized by Elizabeth Baker Treloar and Eric Cathcart (Department of Marine and Environmental Sciences, University of San Diego, San Diego, CA), this three-quarter day field trip along the beautiful San Diego coastline will focus on the sedimentary rocks that record 65 million years of geologic events. The Rose Canyon Fault Zone, the geologic hazards of the coastal region, and the potential threat of the southern San Andreas Fault will be addressed.

The field trip will stop first at Mount Soledad in La Jolla, then progress south to Sunset Cliffs in Point Loma, and finish with a stop at scenic Cabrillo National Monument.

Weather can be cool and foggy on the coast, so plan to bring a jacket or, even better, layer your clothing. Tidepools at Cabrillo Rocks can be wet and slippery, so be sure to wear good shoes--no heels or flip flops!

Field Trip #3: Sunday, 12 June: San Diego Botanic Garden. Departs from the front of KIPJ at 9:00 a.m.; returns about 3:00 p.m. Pick up your registration materials in advance at the Registration Center. Includes transportation, box lunch, and garden map/guide. Cost: \$70.

Organized by Michael S. Mayer (Department of Biology, University of San Diego), this trip is an exploration of the San Diego Botanic Garden. Straddling a hill and 37 acres in the seaside town of Encinitas, the San Diego Botanic Garden (formerly Quail Gardens) harbors a wonderful diversity of plant communities, which are arranged thematically and geographically. Highlights include a stand of our local coastal sage scrub, old world and new world desert gardens, a bamboo collection, a subtropical fruit garden, and dozens of species of cycads and palms distributed throughout the various continentally-themed sage scrub. Newer additions to the property include the Hamilton Children's Garden, as well as numerous demonstration and interactive installations on topics such as Native Americans and native plants, and gardening for fire safety or water conservation.

We will leave the USD campus at 9:00 a.m. for the half-hour drive up the coast to Encinitas, location of The San Diego Botanic Garden. Upon arrival, we will take a guided walk around the gardens, ending with lunch (box lunches provided). After lunch there will be extra time for individual exploration before we leave the gardens at 2:30 p.m. for our trip back to campus.

Be sure to wear comfortable walking shoes and bring along a jacket in case of cooler weather, as Encinitas is on the coast.

Wednesday, 15 June

Field Trip #4: *Museum of Man.* Departs from the front of KIPJ at 5:30 p.m.; returns about 9:30 p.m. Includes transportation, entry to the Museum of Man, and reception. Cost: \$15.

Sponsored by the Museum of Man in Balboa Park, this field trip includes a reception and a special viewing of a new exhibit – Modern Day Mummy: The Art and Science of Mummification. The exhibit features Mumab, a modern day mummy preserved using ancient Egyptian techniques. Mumab is on permanent loan to the Museum of Man from the University of Maryland.

Thursday, 16 June

Field Trip #2: *Come See the Wonders of the Fairs: A Walking Tour.* Departs from the front of KIPJ at 9:30 a.m.; returns about 3:30 p.m. Limited to 27 participants. Includes transportation, guided tour of World's Fair remnants at Balboa Park. Cost: \$25.

Organized by Don Larson and Tammy Lau (Madden Library, California State University Fresno, Fresno, CA; tammyl@csufresno.edu), this walking tour of the remnants of San Diego's world's fairs will be a lively and entertaining "visit to the fairs," imagining them as they once were by seeing the legacies of the fairs. The tour guide will be Don Larson, a lifelong aficionado and collector on world's fairs. The well-known Donald G. Larson Collection on International Expositions and Fairs is the largest world's fair collection on the West Coast and resides at California State University Fresno.

The current Balboa Park is the site of both of San Diego's world's fairs: the 1915-16 Panama-California Exposition and the 1935-36 California Pacific International Exposition. There are dozens of features, attractions, buildings and gardens that are the remains of the two fairs, among them the Botanical Building (and beautiful lily pond), the Spreckels Organ Pavilion, the Old Cactus Garden, Spanish Village, Japanese Tea Pavilion (now a tea house restaurant), the Ford Building (now the Air and Space Museum), the House of Hospitality (now the Visitors Center), the California State Building (now the San Diego Museum of Man), the House of Pacific Relations International Cottages (with 32 cottages promoting multicultural goodwill), and the Zoro Garden (formerly a nudist colony built for the 1935 fair). Even the world-famous San Diego Zoo grew out of the fairs, with exotic animals left after the 1935 exposition ended.

After lunch at one of the numerous restaurants, cafes and snack shops in the park (on your own or as an informal group), there will be time to explore other parts of the splendid and vast Balboa Park. An optional visit to the Japanese Garden (and tea pavilion) as of the printing of these *Proceedings* costs \$4. We'll plan on meeting the shuttles at 3:10 p.m.

SAN DIEGO MUSEUM OF MAN

MODERN DAY MUMMY

The Art & Science of Mummification



Open June 11, 2011

Join us for this fascinating new exhibit, showcasing the process of mummification, how scientists study mummies, and what we can learn from them!

for our quick trip back to campus.

Due to the nature of this walking tour, be sure to wear comfortable shoes! Depending on the weather, a jacket may also be needed.

Field Trip #5: Tidepooling at Cabrillo National Monument Thursday, 16 June: 4:30 a.m. –8:15 a.m. Departs from the front of KIPJ at 4:30 a.m.; returns about 8:30 a.m. Limited to 10 participants. Includes transportation, admission fees, field guide and refreshments. Cost: \$55.

Organized by Drew M. Talley (Department of Marine Science and Environmental Studies, University of San Diego, San Diego, CA). Wake up early and make the most of your last day at the meeting in San Diego by joining us for a sunrise visit to the Cabrillo National Monument. Home to the historic Old Point Loma lighthouse and a wealth of biodiversity, Cabrillo National Monument is a protected area of 65 hectares situated on the end of the Point Loma peninsula. The early-morning field trip will be led by intertidal ecologists from USD and the National Park Service, and will include a copy of “The Life of Point Loma”, with chapters covering the marine, intertidal, and terrestrial habitats of the peninsula, as well as coffee and pastries during a post-field question and answer session with the Park Ranger. This is a rare chance to visit the Cabrillo National Monument when it is normally closed to the public!

Caution: you will be walking on slippery rocks and in shallow intertidal water. Please wear appropriate footwear and dress in layers!

Field Trip #6: Mission Bay Aquatic Center Lesson in Sailing or Kayaking Thursday, 16 June: 1:45 p.m. – 5:00 p.m. It is participants’ responsibility to arrange for their own travel to and from the Mission Bay Aquatic Center. Includes all instruction and equipment. Does not include transportation to and from the Mission Bay Aquatic Center. Cost: \$35.

Organized by Steven A. Murray (Department of Engineering, University of San Diego), this field trip provides a choice for beginners of two water sports opportunities on beautiful Mission Bay: sailing or kayaking. Each includes an hour or so of instruction, followed by on-the-water practice time.

Kayaking: 3-hour Kayak Lesson and Tour. Students will learn to kayak, then tour the coves of Mission Bay. Activities may include on-the-water kayaking games. All boats and equipment is included.

Sailing: 3-Hour Basic Sailing Lesson in 8’ single handed sabot. 1 hour classroom time with 1.5 hours on the water practice. All Equipment and instruction is included.

An area will be set up for participants to store belongings as a group, so you won’t be using the public locker room. Bring typical beach wear for the event (swim trunks or swimsuit, sandals and a beach towel) and a change of dry clothes for after the lesson. You will be wearing a wetsuit for the duration of the lesson to keep warm. Some individuals like to have a hooded sweatshirt to wear over the wetsuit if

they get out of the water early, but most just wrap themselves in their towel.

Important notes:

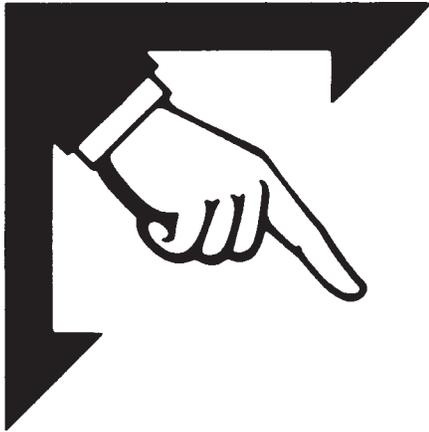
1. You will be asked to sign a liability waiver at the Mission Bay Aquatic Center (MBAC) before you can participate in either event. Failure to sign the waiver will prevent your participation. No refund of fees will be made for failure to sign the waiver. A sample copy of the waiver form will be provided to participants.

2. Transportation to and from the MBAC is the responsibility of participants. Due to the high cost for bus rentals in the San Diego area, the Pacific Division will not be providing transportation for this event. It is up to participants to arrive at the MBAC in time to take care of the required paperwork before the beginning of the sessions at 2:00 p.m. We suggest you plan to arrive at least 15 minutes early, no later than 1:45 p.m. Directions to the MBAC will be provided to participants.

WORKSHOPS

Workshops are available to all meeting registrants without additional fees with the exception of Field and Advanced Paleoimaging, for which there is a \$20 fee. As with all of the technical program for this meeting, all workshop participants must be registered for the meeting. In order to help workshop developers in their planning, pre-registrants were asked to indicate their interest in attending each workshop. Some workshops have limited room. In case a workshop fills, those who pre-registered for the workshop will be given preference in attendance.

Descriptions of all workshops may be found starting on page 45 of these *Proceedings*.



Future Meetings

Pacific Division Annual Meetings

2012.....24 – 27 June in Boise, Idaho

co-located with the Snake River Section of the American Chemical Society at the Boise Convention Center and co-sponsored by Boise State University.

The following venues are in negotiation, so keep your fingers crossed!

2013.....late June in Las Vegas, Nevada

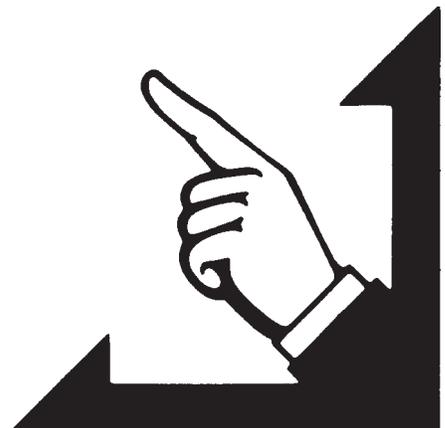
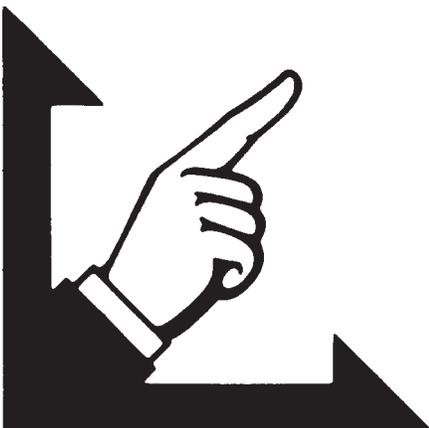
2014.....late June in Riverside, California

AAAS National Meetings

2012.....16 – 20 Feb. in Vancouver, B.C.

2013.....14 – 18 Feb. in Boston, Massachusetts

2014.....13 – 17 Feb. in Chicago, Illinois



PROGRAM AT A GLANCE

SUNDAY – 12 JUNE	MONDAY – 13 JUNE	TUESDAY – 14 JUNE	WEDNESDAY – 15 JUNE	THURSDAY – 16 JUNE
<p>FIELD TRIP San Diego Botanic Garden <i>Bus departs from in front of KIPJ</i> 9:00 AM – 3:00 PM</p>	<p>CONTRIBUTED PAPERS World Congress on Mummy Studies Session II KIPJ Theatre 8:00 AM – 5:00 PM</p>	<p>SYMPOSIUM Human Leishmaniasis in Mummified Remains... KIPJ Theatre 8:00 AM – 10:00 AM</p>	<p>BUSINESS MEETING Business Meeting of the Council the Pacific Division KIPJ 226 7:00 AM – 10:00 AM</p>	<p>FIELD TRIP Tidepooling at Cabrillo National Monument <i>Bus departs from in front of KIPJ</i> 4:30 AM – 8:30 AM</p>
<p>FIELD TRIP San Diego Coastal Geology and Hazards <i>Bus departs from in front of KIPJ</i> 10:00 AM – 4:00 PM</p>	<p>SYMPOSIUM The Forensic Science of Clinical Mental Health Counseling... KIPJ Room E 8:00 AM – 5:15 PM</p>	<p>SYMPOSIUM Geophysical Turbulence KIPJ Room E 8:10 AM – 4:40 PM</p>	<p>SYMPOSIUM Princess Takabuti – Analysis, Interpretation, and Visualization KIPJ Theatre 8:00 AM – 9:15 AM</p>	<p>SYMPOSIUM Mexican Mummy Studies KIPJ Theatre 8:00 AM – 10:15 AM</p>
<p>OPENING GREETINGS 7th WORLD CONGRESS ON MUMMY STUDIES KIPJ Theatre 10:00 AM</p>	<p>SYMPOSIUM Advances in Materials Science and Nanotechnology KIPJ Room 215 8:25 AM – 10:00 AM</p>	<p>SYMPOSIUM Antarctic Ice Is Nice KIPJ Room H 8:20 AM – NOON</p>	<p>WORKSHOP Vitamin D KIPJ Rooms E and F 8:00 AM – NOON</p>	<p>WORKSHOP Field and Advanced Paleomaging Museum of Man <i>Bus departs from in front of KIPJ</i> 8:15 AM – 12:15 PM</p>
<p>SYMPOSIUM Applied Ethics of Mummy Research KIPJ Theatre 10:15 AM – NOON</p>	<p>CONTRIBUTED PAPERS Education Anthropology and Archaeology KIPJ Room 220 8:40 AM – Noon</p>	<p>CONTRIBUTED PAPERS Chemistry and Biochemistry Cell and Molecular Biology KIPJ Room I 8:20 AM – NOON</p>	<p>SYMPOSIUM United States and World Fairs KIPJ Room B 8:30 AM – 5:45 PM</p>	<p>FIELD TRIP Come See the Wonders of the Fairs: A Walking Tour <i>Bus departs from in front of KIPJ</i> 9:30 AM – 3:30 PM</p>
	<p>CONTRIBUTED PAPERS Ecology, Organismal Biology, and Environmental Sciences Earth Sciences KIPJ Room 218 8:40 AM – 11:40 AM</p>	<p>CONTRIBUTED PAPERS History & Philosophy of Science General & Interdisciplinary Studies KIPJ Room G 8:20 AM – NOON</p>	<p>SYMPOSIUM Pathways to Science: Inquiry-Based Learning Beyond the Classroom KIPJ Room A 8:30 AM – NOON</p>	<p>SYMPOSIUM Studies on an Old Kingdom Mummy KIPJ Theatre 10:30 AM – 11:30 AM</p>
	<p>SYMPOSIUM Quantum Retrocausation: Theory and Experiment, Part I KIPJ Rooms A and B 8:45 AM – 4:45 PM</p>	<p>SYMPOSIUM Quantum Retrocausation: Theory and Experiment, Part II KIPJ Rooms A and B 8:45 AM – 4:15 PM</p>	<p>SYMPOSIUM Facial Analysis and Depiction of Preserved Remains KIPJ Theatre 9:15 AM – 11:00 AM</p>	<p>SYMPOSIUM Heart Disease and Atherosclerosis in Ancient Egyptian Mummies KIPJ Theatre 11:30 AM – 12:30 PM</p>
	<p>SYMPOSIUM Don't Sign Your Life Away... KIPJ Room 217 9:00 AM – 3:20 PM</p>	<p>SYMPOSIUM Second Law of Thermodynamics: Status and Challenges, Part I KIPJ Rooms C and D 8:45 AM – 4:15 PM</p>	<p>SYMPOSIUM Second Law of Thermodynamics: Status and Challenges, Part II KIPJ Rooms C and D 9:30 AM – 3:00 PM</p>	<p>CONTRIBUTED PAPERS World Congress on Mummy Studies Session III KIPJ Rooms A and B 11:30 AM – 12:30 PM</p>
	<p>CONTRIBUTED PAPERS Engineering, Tech., & App. Sciences Computer & Information Sciences KIPJ 219 10:00 AM – 11:40 AM</p>	<p>SYMPOSIUM Technical Studies on the Head of an Egyptian Child Mummy KIPJ Theatre 10:30 AM – NOON</p>	<p>SYMPOSIUM Rio Muerto Project: Mummies of the Tiwanaku Culture from Moquegua, Perú KIPJ Theatre 11:00 AM – NOON</p>	
	<p>NOON PUBLIC LECTURE "Journeying Through Stressed Urban Systems" KIPJ Theatre 12:15 PM</p>	<p>NOON PUBLIC LECTURE "Vitamin D" KIPJ Theatre 12:15 PM</p>	<p>NOON PUBLIC LECTURE "Once and Future Giants: What Ice Age Extincts Tell Us about the Fate of Earth's Largest Animals" KIPJ Theatre 12:15 PM</p>	
<p>CONTRIBUTED PAPERS World Congress on Mummy Studies Session I KIPJ Theatre 1:30 PM – 5:00 PM</p>	<p>PROGRAMS CONTINUING from MORNING WCMS CONTRIBUTED PAPERS SYMP: Forensic Sci of Clinical... SYMP: Quantum Retrocausation SYMP: Don't Sign Your Life Away...</p>	<p>PROGRAMS CONTINUING from MORNING SYMP: Geophysical Turbulence SYMP: Quantum Retrocausation SYMP: 2nd Law Thermodynamics</p>	<p>PROGRAMS CONTINUING from MORNING SYMP: United States and World Fairs SYMP: 2nd Law Thermodynamics</p>	<p>SYMPOSIUM Mummies as Cultural Heritage KIPJ Theatre 1:30 PM – 3:15 PM</p>
<p>POETRY READING Poetry and Science Garden of the Sea Patio (behind KIPJ) 4:00 PM – 5:30 PM</p>	<p>POSTER SESSION AAAS, Pacific Division KIPJ Rooms C and D Noon – 5:00 p.m.</p>	<p>SYMPOSIUM Music and the Sciences: Synergies Among Musical Arts, Math, Science, and Engineering KIPJ Room F 1:15 PM – 5:10 PM</p>	<p>SYMPOSIUM Osteoimmunology: Fundamental, Clinical and Translational Implications in Temporomandibular Disorders KIPJ Room G 1:15 PM – 3:00 PM</p>	<p>FIELD TRIP Lesson in Sailing or Kayaking Mission Bay Aquatic Center 1:45 PM – 5:00 PM</p>
<p>POSTER SESSION World Congress on Mummy Studies KIPJ Rooms C and D 5:30 PM – 6:30 PM</p>	<p>SYMPOSIUM Panama Canal Expansion KIPJ Room H 1:30 PM – 5:30 PM</p>	<p>SYMPOSIUM Science Education and Civic Engagement KIPJ Room G 1:15 PM – 5:00 PM</p>	<p>SYMPOSIUM State-of-the-Art Mummy Research KIPJ Theatre 1:30 PM – 5:15 PM</p>	<p>SYMPOSIUM A Multidisciplinary Collaboration for Tissue Analyses: The Case of Kwäday Dän Ts'ínchi KIPJ Theatre 3:30 PM – 4:15 PM</p>
	<p>SYMPOSIUM New Languages for New Realities: Literature, Poetry, and Hypertext KIPJ Room F 1:30 PM – 5:00 PM</p>	<p>SYMPOSIUM Human Experimental Mummification KIPJ Theatre 1:30 PM – 4:15 PM</p>	<p>SYMPOSIUM The Changing Role of the Research University in K-12 Science Education KIPJ Room A 2:00 PM – 4:50 PM</p>	<p>SYMPOSIUM Hair in Archaeology KIPJ Theatre 4:30 PM – 6:15 PM</p>
	<p>WORKSHOP Finding Information in Open Access Journals Loma Hall Room 307 3:45 PM – 4:45 PM</p>	<p>SYMPOSIUM Fragile X Syndrome: Advances In Our Understanding of a Common Cause of Retardation and Autism KIPJ Room H 1:30 PM – 5:00 PM</p>		<p>CLOSING CONVOCATION, ANNOUNCEMENTS, and RECEPTION 7th World Congress on Mummy Studies KIPJ Theatre 6:30 PM</p>
		<p>CONTRIBUTED PAPERS Psychology Soc., Econ., and Pol. Sciences Engineering, Tech., and Appl. Sci. KIPJ 214 1:40 PM – 4:20 PM</p>		
		<p>STUDENT AWARD JUDGES MEETING KIPJ Green Room 3:00 PM</p>		
		<p>SYMPOSIUM Mummy Research in the Electronic Age KIPJ Theatre 4:15 PM – 5:00 PM</p>		
<p>EVENING PLENARY LECTURE "NeuroEngineering: Evolution of Biopsychosocial Networks in Humans" KIPJ Theatre 7:00 PM</p>	<p>EVENING PLENARY LECTURE "Multi-disciplinary Approach to the Study of Human Remains" KIPJ Theatre 7:00 PM</p>	<p>SYMPOSIUM aDNA and Associated Biomolecules KIPJ Theatre 5:15 PM – 6:30 PM</p>		
<p>DIVISION RECEPTION TBA 8:00 PM</p>	<p>USD PRESIDENT'S RECEPTION TBA 8:00 PM</p>	<p>RECEPTION and STUDENT AWARDS BANQUET KIPJ 6:15 PM</p>	<p>FIELD TRIP/RECEPTION Museum of Man Balboa Park <i>Bus departs from in front of KIPJ</i> 5:30 PM – 9:30 PM</p>	
<p>STUDENT AWARDS JUDGES ORGANIZATIONAL MEETING KIPJ ROOM A 9:00 PM</p>		<p>PACIFIC DIVISION PRESIDENT'S ADDRESS "Scientific Art and Artful Science: Musings of an Arts and Sciences Dean" KIPJ Rooms A – D APPROX 8:30 PM</p>		

GENERAL SESSIONS

Sunday, 12 June 2011

OPENING GREETINGS

7th World Congress on Mummy Studies

KIPJ Theatre

Sunday

10:00 a.m.

CONRADO RODRÍGUEZ MARTÍN, MD (Director of the Museum of Archaeology of Tenerife, Canary Islands, President of the Committee for the study of the Gaunche mummies, Vice-President of the Paleopathology group in Spain, instrumental in the organization of the 6th World Congress on Mummy Studies held in Lanzarote, Canary Islands in 2007, and co-author of the Cambridge Encyclopedia of Human Paleopathology (with Authur C. Aufderheide, M.D.) will open the 7th World Congress on Mummy Studies with greetings.

The World Congress on Mummy Studies program continues on page 22 of these Proceedings.

POETRY SCIENCE READINGS*

Garden of the Sea

(behind KIPJ)

Sunday

4:00 p.m.

EVENING PUBLIC PLENARY LECTURE*

KIPJ Theatre

Sunday

7:00 p.m.

1 *NeuroEngineering: Evolution of Biopsychosocial Networks in Humans*, **ISHIRO NISHIMURA, DDS, DMSc, DMD, FAP** (School of Dentistry and Medicine, University of California Los Angeles, Los Angeles, CA).

WELCOME RECEPTION

KIPJ Rotunda

Sunday

8:00 p.m.

Sponsored by the Pacific Division, this informal reception features soft drinks, pretzels, and chips. It begins immediately following the conclusion of the evening public plenary lecture and continues until about 9:15 p.m. All registrants and their families are invited to enjoy the conviviality of this event. Please wear your registration badge.

STUDENT AWARDS JUDGES ORGANIZATIONAL MEETING

KIPJ Room A

Sunday

9:00 p.m.

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

Monday, 13 June 2011

NOON PUBLIC LECTURE*

KIPJ Theatre

Monday

12:15 p.m. - 1:00 p.m.

2 *Journeying Through Stressed Urban Systems*, **H.J.S. FERNANDO, PhD** (Environmental Fluid Dynamics Laboratories, Departments of Civil Engineering and Geological Sciences and Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN).

EVENING PUBLIC PLENARY LECTURE*

KIPJ Theatre

Monday

7:00 p.m.

3 *Multi-disciplinary Approach to the Study of Human Remains*, **DAVID R. HUNT** (National Museum of Natural History, Washington, D.C.).

USD PRESIDENT'S RECEPTION

Garden of the Sea

(behind KIPJ)

Monday

8:00 p.m.

University of San Diego President Dr. Mary Lyons will host an informal reception following Dr. Hunt'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.

Tuesday, 14 June 2011

**WORLD CONGRESS ON MUMMY STUDIES
SPECIAL INVITED LECTURE**

KIPJ Theatre
Tuesday
11:45 a.m.

4 *The Lanzarote and Fuerteventura Prehispanic Population, Canary Islands, Spain*, **CONRADO RODRÍGUEZ MARTÍN**¹*, **PABLO ATOCHE**², and **ANGELES RAMÍREZ**² (¹Instituto Canario de Bioantropología (OAMC-Cabildo de Tenerife); ²Universidad de Las Palmas de Gran Canaria).

NOON PUBLIC LECTURE*

KIPJ Theatre
Tuesday
12:15 p.m.

5 *Vitamin D*, **JOHN J. CANNELL, MD** (Executive Director, Vitamin D Council, San Luis Obispo, CA).

**STUDENT AWARDS JUDGES MEETING
KIPJ SOUTH GREEN ROOM**

Tuesday
3:00 p.m.

**RECEPTION AND STUDENT
AWARDS BANQUET**

Joan B. Kroc Institute for Peace and Justice
Tuesday
6:15 p.m.

Beginning at 6:15 p.m., a hosted reception will feature a cash bar of beer and wine, and soft drinks and juices. Dinner will be served around 7:00 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 also to let the servers know your choice of entrée. Tickets to the banquet cost \$40 and needed to be purchased in advance. Students in competition for Awards of Excellence were invited to attend the banquet as guests of the Division by requesting 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 to see if any tickets remain. Following dinner will be the announcement of the winners of the 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. Alissa Arp (Southern Oregon University, Ashland, OR) will give the Presidential Address, *Scientific Art and Artful Science: Musings of an Arts and Sciences Dean*. The evening is expected to end by about 9:30 p.m.

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

Wednesday, 15 June 2011

**MEETING OF THE COUNCIL
OF THE PACIFIC DIVISION**

KIPJ Board Room (Room 226)
Wednesday
7:00 a.m. - 10:00 a.m.

The Council of the AAAS, Pacific Division will hold its annual breakfast business meeting starting at 7:00 a.m. in the KIPJ Boardroom (Room 226). The Council will elect officers, discuss programs for the 2012 and 2013 annual meetings, and transact such other business as is required by the Division's By-laws.

NOON PUBLIC LECTURE*

KIPJ Theatre
Wednesday
12:15 p.m.

6 *Once and Future Giants: What Ice Age Extinctions Tell Us about the Fate of Earth's Largest Animals*, **SHARON LEVY** (Science writer, Arcata, CA). A book signing for Ms. Levy's new book, from which this talk got its name, will follow immediately upon the completion of her lecture.

MUSEUM of MAN RECEPTION

Museum of Man, Balboa Park
Wednesday
6:00 p.m.

This field trip (#4) departs from the front of KIPJ at 5:30 p.m.; returns about 9:30 p.m. The \$15 fee includes transportation, entry to the Museum of Man, and reception.

Sponsored by the Museum of Man in Balboa Park, this evening at the Museum of Man includes a reception and a special viewing of a new exhibit – Modern Day Mummy: The Art and Science of Mummification. The exhibit features Mumab, a modern day mummy preserved using ancient Egyptian techniques. Mumab is on permanent loan to the Museum of Man from the University of Maryland.

Thursday, 16 June 2011

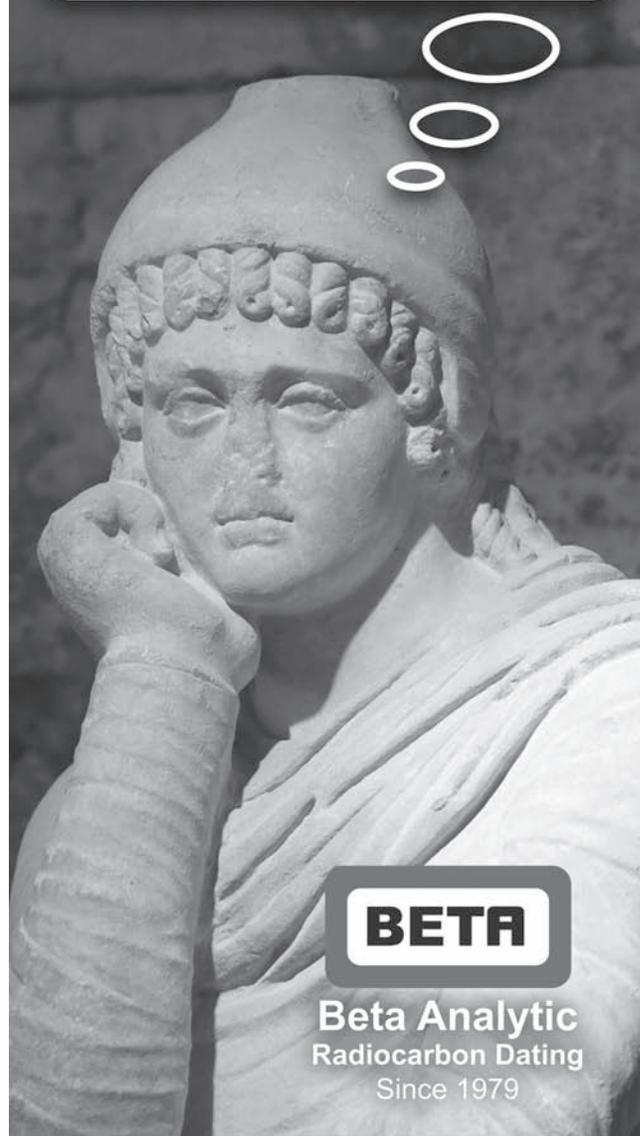
**CLOSING CONVOCATION,
ANNOUNCEMENTS,
and RECEPTION**
7th World Congress on Mummy Studies
KIPJ Theatre
Thursday
6:30 p.m.

GUIDO LOMBARDI (Laboratory of Paleopathology, Lima, Peru)
*Invitation to the 4th Meeting of Paleopathology in South America
(PAMINSA IV), 2 – 5 November 2011, Lima, Peru.*

SHEILA MENDONÇA DE SOUZA (National School of Public Health, FIOCRUZ, Rio de Janeiro, Brazil) and **CLAUDIA RODRIGUES-CARVALHO** (National Museum, Rio de Janeiro, Brazil) *Announcement of the 8th World Congress on Mummy Studies, 2013 in Rio de Janeiro, Brazil.*

JANE BUIKSTRA (Center for Bioarchaeological Research, Arizona State University, Tempe, Arizona, USA) *Announcement of the launching of the Journal of Paleopathology.*

**Radiocarbon Dating
shouldn't take ages**



BETA

Beta Analytic
Radiocarbon Dating
Since 1979

- Results in as little as 2-3 days
- ISO 17025-accredited measurements
- Outstanding customer service

Australia Brazil China
India Japan UK USA

Visit www.radiocarbon.com for details

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

Sunday, 12 June 2011

Applied Ethics of Ancient Mummy Research

KIPJ Theatre

Sunday

10:00 a.m. – Noon

Organizers: *Niels Lynnerup* (University of Copenhagen, Denmark) and *Frank Rühli* (University of Zürich, Switzerland, Head of the Swiss Mummy Project).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium includes presentations on the ethical considerations of mummy research and display from diverse viewpoints. The historical and theoretical backgrounds are covered, and an ethical framework will be proposed.

Session Co-chairs: *Neils Lynnerup* and *Frank Rühli*

10:15 7 *Introduction to Applied Ethics of Ancient Mummy Research*, **FRANK J. RÜHLI*** and **NIELS LYNNERUP**² (¹University of Zürich, Switzerland; ²University of Copenhagen, Denmark).

10:30 8 *Theoretical and Historical Background*, **BETTINA M. KREISSL LONFAT**¹, **NIELS LYNNERUP**², and **FRANK J. RÜHLI*** (¹University of Zürich, Switzerland; ²University of Copenhagen, Denmark).

10:45 9 *Stakeholder Theory for Ancient Mummy Research*, **INA KAUFMANN*** and **FRANK J. RÜHLI** (University of Zürich, Switzerland).

11:00 10 *Who Decides What: Ethical Committees, Local Population, Politicians, Lawyers, or Scientists?* **NIELS LYNNERUP*** and **LISE HARVIG** (University of Copenhagen, Denmark).

11:15 11 *Death on Display: Lived Life and a Good Story, Ethical Considerations when Displaying Mummies for a New Museum*, **PAULINE ASINGH** (Moesgaard Museum, Aarhus, Denmark).

11:30 11a *An Historical Perspective on the Display of Egypt's Royal Mummies*, **SALIMA IKRAM** (American University in Cairo, New Cairo, Egypt; salimaikram@gmail.com).

11:45 12 *Proposal for an Ethical Framework for Ancient Mummy Research*, **FRANK J. RÜHLI***, **BETTINA M. KREISSL LONFAT**¹, **INA KAUFMANN**¹, and **NIELS LYNNERUP**² (¹University of Zürich, Switzerland; ²University of Copenhagen, Denmark).

The World Congress on Mummy Studies program continues on page 47 of these Proceedings.

Monday, 13 June 2011

***The Forensic Science of Clinical
Mental Health Counseling:
The Theresa Lewis Case***

KIPJ Room E
Monday
8:00 a.m. – 5:15 p.m.

Organizer: *Ronn Johnson* (University of San Diego, San Diego, CA).

Sponsored by the Pacific Division section on Psychology.

Death penalty cases often contain mental health mitigating factors. CACREP is a counseling organization that accredits clinical mental health training programs. Among the CACREP standards are assessment, diagnosis, ethics, psychopathology, and forensic issues. Theresa Lewis was a death penalty case where the aforementioned forensic mental health factors were relevant. Lewis was the 12th woman to be executed in the United States since capital punishment was reinstated in 1976. She was convicted and sentenced to death in a murder for hire incident, with the two male co-conspirators receiving life sentences. The Theresa Lewis case is significant for two clinical mental health reasons. First, it provides a forensic mental health framework for the science-based application of various clinical tools. Second, there is an opportunity for examining the extent to which these mental health tools meet Daubert standards.

This symposium includes a number of paper presentations that examine forensic mental health issues related to the Theresa Lewis case. Papers are presented in two's followed immediately by a "counter viewpoint" facilitated by discussants that have been recruited in advance.

Session Chair: *Ronn Johnson*

8:00 **13** *Overview and Wrap-up Questions for Forensic Mental Health in Death Penalty Cases*, **RONN JOHNSON** (University of San Diego, San Diego, CA).

8:45 **14** *Opposing Forensic Mental Health Reports in Death Penalty Cases*, **ERICA J. BESSEN***, **BRIANNA J. BOWMAN***, and **RONN JOHNSON** (University of San Diego, San Diego, CA).

9:30 **15** *IQ as a Mitigating Factor in Death Penalty Cases*, **KRISTIN M. DASCANIO*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

10:15 **BREAK**

10:30 **16** *Dependent Personality Disorder as a Mitigating Factor in Death Penalty Cases*, **ERICA J. BESSEN*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

11:15 **17** *Forensic Mental Health Issues in Domestic Violence*, **SHARLAINE BROCKHOFF*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

12:00 **LUNCH**

1:15 **18** *Forensic Mental Health Cultural and Ethical Considerations in Death Penalty Cases*, **KRISTEN N. GREIDER*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

2:00 **19** *Behavioral Disorders or Mental Impairment not Contained in the DSM-IV-TR: Clinical and Forensic Implications*, **HEIDI BECKENBACH*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

2:45 **BREAK**

3:00 **20** *Clinical Mental Health Issues in Death Penalty Cases*, **KRISTEN N. GREIDER*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

3:45 **21** *Identifying, Securing, Organizing and Reviewing Mental Health Data in Death Penalty Cases*, **KELSEY R. CAMPION*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

4:30 **22** *Care of the Mental Health Professional in Death Penalty Cases*, **NICHOLAS F. O'MADDEN*** and **RONN JOHNSON** (University of San Diego, San Diego, CA).

***7th Annual Symposium on Advances
in Materials Science and Nanotechnology***

KIPJ Room 215

Monday
8:25 a.m. – 10:00 a.m.

Organizers: *Panos Photinos* (Department of Chemistry, Physics, Materials Science and Engineering, Southern Oregon University, Ashland, OR) and *Philip Collins* (Department of Physics and Astronomy, University of California Irvine, Irvine, CA).

Sponsored by the Pacific Division section on Physics and Materials Science.

Session Chair: *Panos Photinos*

8:25 *Opening Comments*

8:30 **23** *Single Molecule Lysozyme Dynamics Monitored by an Electronic Circuit*, **PATRICK C. SIMS***, **YONGKI CHOI**, **STEVEN R. HUNT**, **ISSA MOODY**, **BRAD L. CORSO**, **GREGORY A. WEISS**, and **PHILIP G. COLLINS** (University of California at Irvine, Irvine, CA).

8:45 **24** *Scanning Gate Spectroscopy and Its Application to Carbon Nanotube Defects*, **ELLIOT J. FULLER***, **STEVEN R. HUNT**, **BRAD L. CORSO**, and **PHILIP G. COLLINS** (University of California at Irvine, Irvine, CA).

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

- 9:00 25** *Experimental Measurements of Endogenous Electric Fields in MEMS Devices: Toward a Second Law Challenge*, **DANIEL P. SHEEHAN** (University of San Diego, San Diego, CA).
- 9:15 26** *Experimental Challenge to the Second Law of Thermodynamics in High-Temperature, Gas-Surface Reactions*, **DANIEL P. SHEEHAN, D.J. MALLIN, and J.T. GARAMELLA** (University of San Diego, San Diego, CA).
- 9:30 27** *Aspects of Quantization in Nucleation: The Bubble*, **K.M. GALDAMEZ** (Tufts University, Medford, MA).
- 9:45 28** *Rheological Measurements in the Isotropic, Nematic and Lamellar Phase of the Cesium Pentadecafluorooctanoate/H₂O System*, **PANOS PHOTINOS** (Southern Oregon University, Ashland, OR).

and Pitfalls, **KEN WHARTON** (San Jose State University, San Jose, CA).

- 9:30 30** *Delayed Choice Experiments, the Arrow of Time, and Quantum Measurement*, **L.S. SCHULMAN** (Clarkson University, Potsdam, New York, USA).

10:15 BREAK

- 10:30 31** *Precision Measurements and Weak Values*, **ANDREW N. JORDAN** (University of Rochester, Rochester, NY).

- 11:15 32** *The Retrocausal Nature of Quantum Measurement Revealed by Partial and Weak Measurements*, **AVSHALOM C. ELITZUR** (*Iyar*, The Israeli Institute for Advanced Research).

12:00 LUNCH

- 1:30 33** *The Broken Symmetry of Time*, **RUTH E. KASTNER** (University of Maryland, College Park, MD).

- 2:15 34** *Mechanism of the Quantum Speed-up*, **GIUSEPPE CASTAGNOLI** (Elsag Bailey, Pieve Ligure, Italy).

3:00 BREAK

- 3:15 35** *Cyclical Cosmology on a Mobius Strip*, **MICHAEL IBISON** (Institute for Advanced Studies at Austin, Austin, TX).

- 4:00 36** *Understanding Retrocausality – and Losing a Wager*, **RICHARD SHOUP** (Boundary Institute, San Jose, CA).

- 4:45 36a** *Pre and post-selection, weak measurements and the flow of time in quantum mechanics*, **JEFF TOLLAKSEN** (Chapman University, One University Drive, Orange, CA).

*Program continues on Tuesday at 8:45 a.m.
Please refer to page 29 in these Proceedings.*

***Quantum Retrocausation:
Theory and Experiment, Part I***

KIPJ Rooms A and B

Monday

8:45 a.m. – 4:45 p.m.

*Program continues on Tuesday at 8:45 a.m.
(refer to page 29 of these Proceedings)*

Organizer: *Daniel P. Sheehan* (Department of Physics, University of San Diego, San Diego, CA).

Sponsored by the Pacific Division section on Physics and Materials Science.

Causation – the notion that earlier events affect later ones but not vice versa – undergirds our experience of reality and physical law. Although it is predicated on the forward unidirectionality of time, in fact, most physical laws are time symmetric; that is, they formally and equally admit both time-forward and time-reverse solutions. Time-reverse solutions would allow the future to influence the past, i.e., reverse (or retro-) causation. Why time-forward solutions are preferentially observed in nature remains an unresolved problem in physics.

Laboratory evidence for reverse causation is intriguing but scarce; meanwhile, theoretical models for these results have not yet made deep enough connections with mainstream physics. Even the most basic physical constraints – e.g., whether reverse causation is best explained by energy transfers or simply by correlations without information exchange – remain open questions.

This symposium will explore recent experiments, theory, and philosophical issues connected with retrocausation. In particular, it is hoped that this meeting will help generate comprehensive theoretical models by which experimental results can be understood, and stimulate new experiments and collaborations by which the underlying physics may be more clearly exposed.

Session Chair: *Garret Moddel* (University of Colorado, Boulder, CO)

- 8:45 29** *Constructing Retrocausal Models: Decision Points*

***Don't Sign Your Life Away:
Author's Rights, Scientific Publishing, Digital
Repositories, and the Case for Open Access***

KIPJ Room 217

Monday

9:00 a.m. – 3:20 p.m.

Organizers: *Amy Besnoy* (Science Librarian/Copley Library, University of San Diego, San Diego, CA), *Crystal Goldman* (Academic Liaison Librarian, Dr. Martin Luther King, Jr. Library, San Jose

State University, San Jose, CA), *Pearl Ly* (Natural Sciences Librarian, Kellogg Library, California State University San Marcos, San Marcos, CA), and *Steven Staninger* (Business Librarian/Copley Library, University of San Diego, San Diego, CA).

Sponsored by the Pacific Division section on General and Interdisciplinary Studies.

This symposium and its accompanying workshop will focus on author's rights, the legal background on copyright, the broad field of scientific publishing, and the benefits of open access to alleviate costs. Digital repositories will be discussed as a way for the academy to reclaim the ownership and dissemination of intellectual property. For information on the accompanying workshop, please turn to page 45 of these *Proceedings*.

Session Chair: *Amy Besnoy*

9:00 *Introductory Comments*

9:05 **37** *Bibliometric Information Services for Computing, Interpreting and Reporting Research Productivity and Impact Indicators Using Cited Reference Enhanced Databases – Some Caveats for Librarians*, **PETER JACSO** (University of Hawaii, Honolulu, HI).

9:25 **38** *Bibliometric Analysis of the Production of Graduate Nursing Students: 2002-2009*, **VALERIA E. MOLteni** (San Jose State University, San José, CA).

9:45 **39** *HighWire's Role in the Scholarly Publication Process*, **BONNIE ZAVON** (Public Relations, HighWire Press, Stanford University, Palo Alto, CA).

10:15 **BREAK**

Session Chair: *Crystal Goldman*

10:30 **40** *Retaining Authors' Rights: Long-term Protection in Adopting New Habits for a Flexible Scholarly Future*, **JULIA GELFAND** (University of California Irvine, Irvine, CA).

10:50 **41** *How Faculty in Higher Education Understand Copyright: A Multidisciplinary Study of Research and Teaching Universities and Community Colleges*, **PATRICK NEWELL** (California State University Fresno Fresno, CA).

11:10 **42** *The Role of Librarians in the Protection of Author's Rights and Copyright*, **IFEOMA ANN OLUWASEMILORE*** and **NGOZI BLESSING UKACHI** (University of Lagos, Lagos, Nigeria).

11:30 **LUNCH**

Session Chair: *Pearl Ly*

1:15 **43** *Communicating Science in the Future*, **PHILIP BOURNE** (Editor in Chief, PLoS Comp. Biol. and University of California San Diego, San Diego, CA).

1:45 **44** *Helping Users Find Versions of Record in the Scholarly Literature*, **CAROL ANNE MEYER** (CrossRef, Lynfield, MA).

2:05 **BREAK**

2:20 **45** *Maximizing the Potential Impact of Digital Repositories*, **CRYSTAL GOLDMAN** (San Jose State University, San Jose, CA).

2:40 **46** *Building a Local Environmental Repository*, **STEPHEN STRATTON*** and **MELISSA MINDS VANDEBURGT*** (California State University Channel Islands, Camarillo, CA).

3:00 **47** *Building a Global Virtual Herbarium – From the Collection Book to the Computer Screen*, **LARRY SCHMIDT** (University of Wyoming, Laramie, WY).

3:20 **BREAK**

3:45 Workshop: *Finding Information in Open Access Journals*. Please turn to page 45 of these *Proceedings* for information about this workshop.

Panama Canal Expansion

KIPJ Room H

Monday

1:30 p.m. – 5:30 p.m.

Organizer: *Anne A. Sturz* (Department of Marine Science and Environmental Studies, University of San Diego, San Diego CA).

Program sponsored by the Pacific Division sections on Earth Sciences, General and Interdisciplinary Studies, and Sociology, Economics, and Political Sciences.

The Panama Canal is a cornerstone of the global transportation system, connecting the Atlantic Ocean to the Pacific Ocean across the Isthmus of Panama. The original canal was completed and opened for shipping in 1914. Thirteen to fourteen thousand vessels use the Canal every year. Commercial transportation through the Canal represents approximately 5% of the world trade. The Canal has a work force of approximately nine thousand employees and operates 24 hours a day, 365 days a year. The Panama Canal Authority is undertaking construction of new locks, new water reutilization basins, plus widening and deepening existing navigational

channels. Anticipated completion of the Panama Canal Expansion is in 2014, marking the 100th anniversary of Canal operations. Speakers contributing to this symposium will discuss the history, geological parameters and sociological implications of the Canal.

Session Chair: *Anne A. Sturz*

- 1:30** *Introductory Comments*, **ANNE A. STURZ**
- 1:40** **48** *General Overview of the History of the Panama Canal*, **J. DAVID ROGERS** (Missouri University of Science and Technology, Rolla, MO).
- 2:10** **49** *The History of the Panama Canal: An Imperial/Latin American Counterpoint*, **MARÍA BÁRBARA ZEPEDA CORTÉS** (University of California San Diego, La Jolla, CA).
- 2:40** **50** *Sociological Aspects of the Panama Canal*, **THOMAS REIFER** (University of San Diego, San Diego, CA).
- 3:10** **BREAK**
- 3:30** **51** *Landslides of the Panama Canal*, **J. DAVID ROGERS** (Missouri University of Science and Technology, Rolla, MO).
- 4:00** **52** *General Overview of the Panama Canal Expansion Project*, **ELDON GATH** (Earth Consultants International, Santa Ana, CA).
- 4:30** **53** *Tectonic Geomorphic and Paleoseismic Investigations of the Pedro Miguel Fault for the Panama Canal Expansion Project*, **ELDON GATH** (Earth Consultants International, Santa Ana, CA).
- 5:00** **54** *Historical Earthquake Activity in Central Panama*, **TANIA GONZALEZ** (Earth Consultants International, Inc., Santa Ana, CA).

New Humanities and Science Convergences:

***New Languages for New Realities:
Literature, Poetry, and Hypertext***

KIPJ Room F

Monday

1:30 p.m. – 5:00 p.m.

Program Organizers: *Robert Louis Chianese* (California State University, Northridge), *Halina Duraj* (University of San Diego), and *Carl A. Maida* (University of California, Los Angeles).

Sponsored by the Pacific Division section on General and Interdisciplinary Studies.

Session Chairs: *Halina Duraj* and *Robert Louis Chianese*

- 1:30** *Welcome and Introductions*
- 1:40** **55** *Whither Hypertext? Electronic Literature and the Literary Canon*, **HUGH BURKHART** (University of San Diego, San Diego, CA).
- 2:10** **56** *Exploring the Labyrinth: Typography and Reader Engagement in House of Leaves*, **ALISON PEARL** (University of Utah, Salt Lake City, UT).
- 2:40** **57** *The [] Project: How Hypermedia Can Reshape the Critical Essay*, **ROBERT GLICK** (University of Utah, Salt Lake City, UT).
- 3:10** **BREAK**
- 3:30** **58** *Ethnopoetics and Ethnography of the Oral Tradition*, **CARL A. MAIDA** (University of California, Los Angeles, CA).
- 4:00** **59** *Poetry, Science, and Ecological Language: the Description of Birds*, **ROBERT LOUIS CHIANESE** (California State University Northridge, Northridge, CA).
- 4:30** *Wrap-up and Additional Questions*

Tuesday, 14 June 2011

Human Leishmaniasis in Mummified Remains: From Iconographical Sources to Modern Day Techniques

KIPJ Theatre
Tuesday
8:00 a.m. – 10:00 a.m.

Organizers: *Andreas G. Nerlich* (Institute for Pathology, Klinikum München-Bogenhausen, München, Germany) and *Raffaella Bianucci* (Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Italy).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium includes an overview of the current microbiology of present-day leishmaniasis as both a local and systemic disease dependent on the parasite strain. Molecular investigations on modern strains will provide first clues as to the origin and potential evolution of the pathogens. The symposium includes presentations on the most recent findings of Old and New World leishmaniasis in mummies and skeletonized human remains, shedding light on the distribution and strain differences during antiquity.

Session Co-chairs: *Andreas G. Nerlich* and *Raffaella Bianucci*

- 8:00 60** *Introduction to Human Leishmaniasis in Mummified Remains: From Iconographical Sources to Modern Day Techniques*, **ANDREAS G. NERLICH^{1*}** and **RAFFAELLA BIANUCCI^{2,3,4}** (¹Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ²University of Turin, Turin, Italy; ³University of Marseilles, Marseilles, France; ⁴University of Pisa, Italy).
- 8:15 61** *Molecular Phylogeny, Taxonomy, and Evolution of Leishmania*, **GABRIELE SCHOENIAN** (Charité University Medicine Berlin, Berlin, Germany).
- 8:30 62** *The Unresolved Origins of Leishmaniasis: a Phylogenetic Perspective*, **KELLY M. HARKINS** (Arizona State University, Tempe, AZ).
- 8:45 63** *Evolutionary Origin of Phlebotominae (Diptera: Psychodidae) Based on Fossil Evidence and Potential Evolution of Host-Leishmania Interactions in the Old and the New World*, **REGINALDO PEÇANHA BRAZIL^{1*}** and **JOSÉ D. ANDRADE FILHO²** (¹Instituto Oswaldo Cruz/FIOCRUZ, Rio de Janeiro, Brazil; ²Centro de Pesquisas René Rachou/FIOCRUZ, Belo Horizonte, Brazil).
- 9:00 64** *Iconography of Mochica Leishmaniasis in Ancient Peru*, **ALFREDO ALTAMIRANO** (San Marcos University, Lima, Perú).
- 9:15 65** *Review of Paleopathology of Leishmaniasis in South*

America, **ALFREDO ALTAMIRANO** (San Marcos University, Lima, Perú).

- 9:30 66** *Molecular Identification of Visceral Leishmaniasis in Ancient Egyptian and Nubian Tissue Samples*, **ANDREAS G. NERLICH^{1*}**, **MARK SPIGELMAN^{2,3}**, **BETTINA SCHRAUT¹**, **CHARLES L. GREENBLATT²**, **ALBERT ZINK^{1,4}**, and **HELEN D. DONOGHUE⁵** (¹Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ²The Hebrew University Jerusalem, Israel; ³University College, University of London, England; ⁴EURAC Bolzano, Italy; ⁵University College London, London, UK).
- 9:45 67** *First Evidence of Leishmania infantum/Mycobacterium tuberculosis Co-infection from Renaissance Europe*, **RAFFAELLA BIANUCCI^{1,2,9*}**, **ANDREAS G. NERLICH³**, **ABIGAIL BOUWMAN⁴**, **CHARLOTTE ROBERTS⁴**, **GABRIELE SCHOENIAN⁵**, **ANNA TRISCIUOGGIO⁶**, **CARSTEN M. PUSCH⁷**, **MARKUS BALL⁷**, **BEATRICE BACHMEIER⁸**, **EZIO FERROGLIO⁶**, **VALENTINA GIUFFRÀ⁹**, **SANDRA LOESCH^{3,10}**, and **GINO FORNACIARI⁹** (¹University of Turin, Turin, Italy; ²University of Marseilles, Marseilles, France; ³Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ⁴University of Durham, United Kingdom; ⁵Charité Universitätsmedizin, Berlin, Germany; ⁶University of Turin, Italy; ⁷University of Tübingen, Germany; ⁸University of Munich, Germany; ⁹University of Pisa, Italy; ¹⁰University of Bern, Switzerland).

The World Congress on Mummy Studies program continues on page 30 of these Proceedings.

Geophysical Turbulence

KIPJ Room E
Tuesday
8:10 a.m. – 4:40 p.m.

Organizers: *Frank G. Jacobitz* (Mechanical Engineering Program, University of San Diego, San Diego, CA), *Harinda Joseph S. Fernando* (Department of Civil Engineering and Geological Sciences, University of Notre Dame, Notre Dame, IN), and *Kai Schneider* (Laboratoire de Mécanique, Modélisation et Procédés Propres, Université de Provence, Marseille, France).

Sponsored by the Pacific Division section on Engineering, Technology and Applied Sciences.

Turbulent motion in the geophysical environment is important for transport and mixing processes of natural and anthropogenic quantities, including momentum, heat, nutrients, or pollutants. In turn, velocity shear, density stratification, and system rotation present in the geophysical system affect properties of the turbulent motion. This symposium invites participants from a variety of backgrounds and employing various techniques to share their insights into the dynamics of turbulence.

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

Session Chair: *Frank G. Jacobitz*

8:10 *Introductory Comments*, **FRANK G. JACOBITZ**

8:15 **68** INVITED PRESENTATION: *Turbulent Rotating Convection*, **HERMAN CLERCX** (Eindhoven University of Technology, Eindhoven, The Netherlands).

9:00 **69** *Numerical Simulations of Stratified and Rotating Turbulence using Feature Extraction*, **ERIC AROBONE*** and **SUTANU SARKAR** (University of California San Diego, La Jolla, CA).

9:25 **70** *Interactions of Building Flows and Influence of Tall Buildings on Ground Level Concentration*, **HANSHENG PAN***, **MARKO PRINCEVAC**, and **CHRISTIAN BARTOLOME** (University of California Riverside, Riverside, CA).

9:50 **BREAK**

10:20 **71** *An Application of a Simple Free Convection Model to the Fire Flickering Phenomenon*, **TREVOR MAYNARD*** and **MARKO PRINCEVAC** (University of California Riverside, Riverside, CA).

10:45 **72** *Laboratory Measurements and Sensitivity Modeling of the Thermodynamic and Droplet Characteristics of Superfog*, **CHRISTIAN BARTOLOME^{1*}**, **MARKO PRINCEVAC¹**, **AKULA VENKATRAM¹**, **SHANKAR MAHALINGAM²**, **DAVID R. WEISE³**, **GARY ACHTEMEIER⁴**, **HENRY VU¹**, and **GUILLERMO AGUILAR¹** (¹University of California Riverside, Riverside, CA; ²University of Alabama, Huntsville, AL; ³PSW Research Station, USDA Forest Service, Riverside, CA; ⁴Southern Research Station, USDA Forest Service, Athens, GA).

11:10 **73** *Development of the Urban Nocturnal Boundary Layer*, **SAM POURNAZERI***, **MARKO PRINCEVAC**, **AKULA VENKATRAM**, **SI TAN**, and **NICO SCHULTE** (University of California Riverside, Riverside, CA).

11:35 **74** *Systematic Modeling of the Effects of Sound Barriers on the Dispersion From Roadways*, **BRANDN GAZZOLO***, **SAM POURNAZERI**, and **MARKO PRINCEVAC** (University of California Riverside, Riverside, CA).

12:00 **LUNCH**

1:30 **75** *Rise of Buoyant Emissions from Low Level Sources in Urban Areas*, **MARKO PRINCEVAC***, **SAM POURNAZERI**, and **AKULA VENKATRAM** (University of California Riverside, Riverside, CA).

1:55 **76** *Scale-dependent and Directional Statistics in Anisotropic Turbulence using Wavelets*, **KAI SCHNEIDER^{1*}**,

WOUTER BOS², **MARIE FARGE³**, **FRANK JACOBITZ⁴**, **YUKIO KANDEA⁵**, **LUKAS LIECHTENSTEIN⁶**, **NAOYA OKAMOTO⁵**, and **KATSUNORI YOSHIMATSU⁵** (¹Université de Provence, Marseille, France; ²Ecole Centrale Lyon, France; ³Ecole Normale Supérieure, Paris, France; ⁴University of San Diego, San Diego, CA, USA; ⁵Nagoya University, Japan; ⁶Aix-Marseille University, Marseille, France).

2:20 **77** *On Helical Properties of Homogeneous Turbulence*, **FRANK G JACOBITZ^{1*}**, **KAI SCHNEIDER²**, **WOUTER J.T. BOS³**, and **MARIE FARGE⁴** (¹University of San Diego, San Diego, CA; ²Aix-Marseille University, Marseille, France; ³Ecole Centrale de Lyon - Université de Lyon, Ecully, France; ⁴Ecole Normale Supérieure, Paris, France).

2:45 **78** *Turbulence in the Near Wake of Strongly Stratified Flow Around a Sphere*, **KYLE A. BRUCKER***, **THOMAS T. O'SHEA**, **JAMES W. ROTTMAN**, and **DOUGLAS G. DOMMERMUTH** (Science Applications International Corporation, San Diego, CA).

3:10 **BREAK**

3:30 **79** *Evening Transition in Complex Terrain*, **H.J.S. FERNANDO¹**, **L. LEO²**, **S. DISABATINO²**, and **A. DALLMAN¹** (¹University of Notre Dame, Notre Dame, IN; ²Università del Salento, Lecce, Italy).

3:55 **80** INVITED PRESENTATION: *What is Geophysical Turbulence and Which Way Does it Cascade?* **CARL H. GIBSON** (University of California San Diego, La Jolla, CA).

Antarctic Ice Is Nice

KIPJ Room H
Tuesday
8:20 a.m. – Noon

Organizers: *Ronald S. Kaufmann* and *Anne A. Sturz* (Marine Science and Environmental Studies Department, University of San Diego, San Diego CA).

Program sponsored by the Pacific Division section on Atmospheric and Oceanographic Sciences.

This symposium includes an examination of Antarctic ice and associated ecosystems. The impact of global warming on polar regions has been the subject of considerable recent research. In particular, warming in West Antarctica and the Antarctic Peninsula has been correlated with retreating glaciers, resulting in significant loss of ice mass over the past decade (Rignot et al., 2008). Antarctic glaciers have been accelerating (Pritchard and Vaughan, 2007), changing the dynamics of the continental ice sheet. In addition, ice shelves around the Antarctic continent have been breaking up, with

increased occurrences of large icebergs originating from ice shelves in the Ross, Bellingshausen and Weddell Seas (e.g. Scambos et al, 2000; Bindshadler and Rignot, 2001; Ballantyne, 2002; Long et al., 2002). Changing ice cover and the increased production of icebergs can affect physical and biological processes on the Antarctic continent and in the Southern Ocean. Speakers contributing to this symposium will discuss distribution of Antarctic glaciers, subglacial lakes, sea ice, currents affecting ice transport, effects of icebergs on water column structure and biological communities in the Southern Ocean.

Program Co-chairs: *Anne A. Sturz* and *Ronald S. Kaufmann*.

8:20 *Opening Remarks* ANNE A. STURZ and RONALD S. KAUFMANN

8:30 **81** *Elevation Changes on Antarctica's Ice Shelves*, **FERNANDO S. PAOLO**^{1*}, **HELEN A. FRICKER**¹, and **LAURIE PADMAN**² (¹Scripps Institution of Oceanography, La Jolla, CA; ²Earth and Space Research, Corvallis, OR).

9:00 **82** *Cooling, Dilution and Mixing of Ocean Water by Free-drifting Icebergs in the Weddell Sea*, **JOHN HELLY** (University of California San Diego, La Jolla, CA).

9:30 **83** *Subsurface Melting of a Free-Floating Antarctic Iceberg*, **GORDON R. STEPHENSON, JR.***, **JANET SPRINTALL**, **SARAH T. GILLE**, **MARIA VERNET**, **JOHN J. HELLY**, and **RONALD S. KAUFMANN** (Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA).

10:00 BREAK

10:30 **84** *From Enigmatic Extremophile Environment to a Window on the Workings of a Water System: Antarctica's Subglacial Lakes and Waterways*, **SASHA CARTER** (Scripps Institution of Oceanography, La Jolla, CA).

11:00 **85** *The Effect of Free-Drifting Icebergs on the Physiology of Antarctic Krill, Euphausia superba, in the Southern Ocean*, **DANIELLE N. GARCIA***, **RONALD S. KAUFMANN**, and **MARY SUE LOWERY** (University of San Diego, San Diego, CA).

11:30 **86** *Composition and Structure of Macrozooplankton and Micronekton Communities in the Vicinity of Free-Drifting Icebergs in the Southern Ocean*, **RONALD S. KAUFMANN**^{1*}, **ROB E. SHERLOCK**², **STEPHANIE L. BUSH**³, **KAREN J. OSBORN**⁴, **DANIELLE N. GARCIA**¹, **KIM R. REISENBICHLER**², **MARY S. LOWERY**¹, **BRUCE H. ROBISON**², and **KENNETH L. SMITH, JR.**² (¹University of San Diego, San Diego, CA; ²Monterey Bay Aquarium Research Institute, Moss Landing, CA; ³University of Rhode Island, Kingston, RI; ⁴University of California Santa Cruz, Santa Cruz, CA).

Quantum Retrocausation: Theory and Experiment, Part II

KIPJ Rooms A and B

Tuesday

8:45 a.m. – 4:15 p.m.

This program is continuing from Monday. Please refer to page 24 in these Proceedings for the program description.

Session Chair: *Michael Ibson*

8:45 **87** *Experimental Evidence for Anomalous Retroactive Influences on Human Cognition and Affect*, **DARYL J. BEM** (Cornell University, Ithaca, NY).

9:30 **88** *Retrocausal Effects as a Consequence of Orthodox Quantum Mechanics Refined to Accommodate The Principle of Sufficient Reason*, **HENRY P. STAPP** (Lawrence Berkeley National Laboratory, Berkeley, CA).

10:15 BREAK

10:30 **89** *Laboratory Demonstration of Retrocausation in a Digital System*, **GARRET MODDEL**^{1*}, **ZIXU ZHU**¹, and **ADAM M. CURRY**² (¹University of Colorado, Boulder, CO; ²Psyleron, Inc., Princeton, NJ).

11:15 **90** *Electrocortical Evidence for Retrocausation*, **DEAN RADIN**^{1*}, **CASSANDRA VIETEN**¹, **LEENA MICHEL**¹, and **ARNAUD DELORME**² (¹Institute of Noetic Sciences, Petaluma, CA; ²University of California San Diego, La Jolla, CA).

12:00 LUNCH

1:00 **91** *Retrocausation, Consistency, and the Bilking Paradox*, **YORK DOBYNS** (Princeton University, Princeton, NJ).

1:45 **92** *Toward a Classical Thermodynamic Model for Pre-cognition*, **EDWIN C. MAY** (Laboratories for Fundamental Research, Palo Alto, CA).

2:30 BREAK

2:45 **93** *Causality is Inconsistent with Quantum Field Theory*, **FRED ALAN WOLF** (Have Brains / Will Travel: a Global Quantum Physics Educational Company, San Francisco CA).

3:30 **94** *Retroactive Event Determination and Its Relativistic Roots*, **SKY E. NELSON** (Santa Rosa, CA).

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

***The Second Law of Thermodynamics:
Status and Challenges, Part I***

KIPJ Rooms C and D

Tuesday

8:45 a.m. – 4:15 p.m.

*Program continues on Wednesday at 8:15 a.m.
(refer to page 37 of these Proceedings)*

Organizer: *Daniel P. Sheehan* (Department of Physics, University of San Diego, San Diego, CA).

Sponsored by the Pacific Division section on Physics and Materials Science.

The second law of thermodynamics is considered one of the central principles of science, engineering and technology. Since its discovery 185 years ago, no counter-example has been recognized by the scientific community, and its status is generally considered absolute. During the last two decades, however, it has come under unprecedented scrutiny by research groups worldwide, as evidenced by the more than two dozen distinct challenges advanced against it in over 60 articles. Several of these challenges have moved into laboratory testing.

In this symposium, the current experimental and theoretical status of second law will be examined. Topics will include nonequilibrium systems, Maxwell's demon, decoherence, and the thermodynamic arrow of time. Emphasis will be given to current and proposed experiments addressing questions of second law universality. It is hoped this meeting will generate new theoretical models by which emerging experimental results can be understood, and stimulate new experiments and collaborations by which the underlying physics of the second law may be more fully exposed.

Session Chair: *Harvey Leff* (California State Polytechnic University)

8:45 95 *Second Law Violation for Non-Ergodic Interactions*, **L. S. SCHULMAN** (Clarkson University, Potsdam, New York, USA).

9:30 96 *Reduced Statistical Fluctuations for an Object in a Partitioned Environment*, **E. DELRE**^{1,2}, **P. DIPORTO**³, **S. DI SABATINO**¹, and **B. CROSIGNANI**^{3*} (¹University of L'Aquila, L'Aquila, Italy; ²University of Rome "La Sapienza", Rome, Italy; ³California Institute of Technology, Pasadena CA).

10:15 BREAK

10:30 97 *A Thermodynamic Time-Arrow for Single Particle Interactions?* **AVSHALOM C. ELITZUR**^{1*}, **ELIAHU COHEN**², and **PAZ BENIAMINI**³ (¹Iyar, The Israeli Institute for Advanced Research; ²Tel-Aviv University; ³Hebrew University of Jerusalem, Israel).

11:15 98 *The Repelling Bose String*, **J.B. McGUIRE** (Florida Atlantic University, Boca Raton FL).

12:00 LUNCH

1:00 99 *The Quantum Solar Cell: Using Quantum Thermodynamics to Mitigate Recombination and Enhance Efficiency*, **KONSTANTIN E. DORFMAN**^{*}, **MARLAN O. SCULLY**, and **ANATOLY A. SVISZINSKY** (Texas A&M University, College Station, TX and Princeton University, Princeton, NJ).

1:45 100 *Experimental Challenge to the Second Law of Thermodynamics in High-Temperature, Gas-Surface Reactions*, **D.P. SHEEHAN**^{*}, **D.J. MALLIN**, and **J.T. GARAMELLA** (University of San Diego, San Diego, CA).

2:30 BREAK

2:45 101 *Experimental Evidence Violating Laws of Thermodynamics In Magnetostrictive Materials*, **GERALD PELLEGRINI** (Northeastern University, Boston, MA).

3:30 102 *The Proell Effect: A Macroscopic Maxwell's Demon*, **KENNETH M. RAUEN** (Lubbock, TX).

***Technical Studies on the Head of
an Egyptian Child Mummy***

KIPJ Theatre

Tuesday

10:30 a.m. – Noon.

Organizers: *Anita Petty* (Digital Operations, 3M Unitek, Albuquerque, New Mexico) and *Marvin Rowe* (Conservation Lab, Museum of New Mexico and Science Program, Texas A&M University).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium presents the results of analysis of the head of an Egyptian child mummy collected from Egypt during the 1920 Shelton Expedition. Included will be the chemical analysis of the resin on the wrapping, the radiocarbon dating by non-destructive plasma oxidation, and X-ray fluorescence of the head.

Session Chair: *Bob Brier*

10:30 103 *Digital Extraction of Surface Volumes Rendered from the CT Scans of a Late Period Egyptian Mummy*, **ANITA PETTY** (3M Unitek, Albuquerque, NM).

10:45 104 *Chemical Analysis of the Resin on Wrappings of a Late Period Egyptian Mummy*, **DAVE SEAPY**¹, **ADEL SAIED**¹, **MARVIN ROWE**^{1,2*}, and **ANITA PETTY**³ (¹Texas A&M University (Qatar campus); ²Museum of New Mexico, Santa Fe, NM; ³3M Unitek, Albuquerque, NM).

11:00 105 *Radiocarbon Dating of a Late Period Egyptian Mummy Using Plasma Oxidation*, **MARVIN ROWE^{1,2*}**, **KAREN L. STEELMAN³**, **JERRY KING⁴**, and **ANITA PETTY⁵** (¹Museum of New Mexico, Santa Fe, NM; ²Texas A&M University Qatar, Doha Qatar; ³Central Arkansas University, Conway, AR; ⁴University of Arkansas, Fayetteville, AR; ⁵3M Unitek, Albuquerque, NM).

11:15 106 *Nondestructive X-ray Fluorescence Analysis of the Head of an Egyptian Child Mummy*, **MARVIN ROWE^{1,2*}**, **ANITA PETTY³**, and **MARK MACKENZIE¹** (¹Museum of New Mexico, Santa Fe, NM; ²Texas A&M University Qatar, Doha Qatar; ³3M Unitek, Albuquerque, NM).

11:30 107 *An Analysis of Mummified Intracranial Content*, **OTTO APPENZELLER^{1*}**, **MIKE SPILDE²**, **ANITA PETTY³**, **CLIFFORD QUALLS⁴**, **GENEVIEVE PHILLIPS⁵**, **PETER APPENZELLER⁶**, and **BOB BRIER⁷** (¹NMHEMC Research Foundation, Albuquerque NM; ²University of New Mexico, Albuquerque NM; ³3M Unitek, Albuquerque, NM; ⁴University of New Mexico, Albuquerque NM; ⁵University of New Mexico, Albuquerque, NM; ⁶Tricore Laboratories, Albuquerque, NM; ⁷Long Island University, Greenvale, NY).

11:45 108 SPECIAL INVITED LECTURE: *The Lanzarote and Fuerteventura Prehispanic Population, Canary Islands, Spain*, **CONRADO RODRÍGUEZ MARTÍN**, **PABLO ATOCHE**, and **ANGELES RAMÍREZ** (¹Instituto Canario de Bioantropología (OAMC-Cabildo de Tenerife); ²Universidad de Las Palmas de Gran Canaria).

The World Congress on Mummy Studies program continues on page 32 of these Proceedings.

***Music and the Sciences:
Synergies Among Musical Arts, Math,
Science, and Engineering***

KIPJ Room F

Tuesday

1:15 p.m. – 5:10 p.m.

Organizer: *Thomas F. Schubert* (Department of Engineering, University of San Diego, San Diego, CA) and *Ani P. Velo* (Department of Mathematics and Computer Science, University of San Diego, San Diego, CA).

Sponsored by the Pacific Division section on General and Interdisciplinary Studies.

The linkage between science and music is not a new concept; throughout much of western history, science and art were each considered as philosophy. Aristotle's exploration of the physical world led him to study musical scales, modes, and harmonic relationships with the use of weights. Galileo's father was a famous musician and

Einstein played the violin.

The purpose of this symposium is to bring people artificially separated by modern academic disciplines together to re-explore the common ground shared by math, science, engineering, and music.

Session Co-chairs: *Thomas F. Schubert* and *Ani P. Velo*

1:15 *Introductory Comments*, **THOMAS F. SCHUBERT**

1:30 109 *Music, Expectation, and Information Theory*, **GARETH LOY** (San Rafael, CA).

1:55 110 *Restoration of Musical Meter from Memory: How We Represent Musical Styles?* **SARAH C. CREEL** (University of California San Diego, La Jolla, CA).

2:20 111 *A Seventeenth-Century Mathematical History of Tuning the Musical Scale*, **JOHN F. BUKOWSKI** (Juniata College, Huntingdon, PA).

2:45 112 *Generation and Analysis of Heptatonic Harmonic Scales*, **JOHN H. CHALMERS** (Scripps Institute of Oceanography, University of California San Diego, La Jolla, CA).

3:10 BREAK

3:30 113 *Temperament of Mind: Hector Berlioz and Evariste Galois*, **JEFF JOHANNES** (State University College of Arts and Sciences, Geneseo, NY).

3:55 114 *An Analytical Oboe Design*, **RONALD L. FOX*** and **E. RANDOLPH HAGER*** (Retired, General Atomics, La Jolla, CA).

4:20 115 *Using Vocal Spectroscopy to Take the Guesswork Out of Powerful Singing*, **RONALD SHAHEEN** (University of San Diego, San Diego, CA).

4:45 116 *Objective and Subjective Analyses of the Steel-String Acoustic Guitar*, **DAVID M. MALICKY** (University of San Diego, San Diego, CA).

Science Education and

Civic Engagement

KIPJ Room G

Tuesday

1:15 p.m. – 5:00 p.m.

Organizers: *Amy Shachter* (Associate Provost, Research and Academic Affairs, Santa Clara University, Santa Clara, CA) and *Steve Bachofer* (Department of Chemistry, Saint Mary's College, Moraga, CA).

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

This symposium will provide examples of courses that link science education and civic engagement. Included will be examples of courses designed to improve science education by helping to develop and strengthen efforts that teach through complex social issues to the basic science necessary to comprehend and intelligently act on them. Courses that foster student engagement in the community to create a greater sense of place and responsibility will also be highlighted.

Session Chair: *Amy Shachter*

1:15 117 *What are the Benefits of Taking the Lab Outside?* **STEVEN BACHOFER** (Saint Mary's College of California, Moraga, CA).

1:45 118 *Using Course-Specific Student Course Evaluations to Drive Learning-Centered Teaching*, **STEPHEN CARROLL^{1*}** and **MELISSA GANUS²** (¹Santa Clara University, Santa Clara, CA; ²Seattle Community Colleges, Seattle, WA).

2:15 119 *Preservice Science Teachers Think About Science and Teaching*, **CAROLYN VIVIANO** (Loyola Marymount University, Los Angeles, CA).

2:45 120 *Community Guest Speakers Show Forensics Students How to Become More Involved in Preventing Campus Crimes*, **VIRGINIA R. CARSON** (Chapman University, Orange, CA).

3:15 BREAK

3:30 121 *Science Education in Rural America: SENCER Related Learning Outcomes and Attitudes in Chemistry Courses for Non-majors*, **GREGORY S. VAN DOREN¹** and **LAWRENCE K. DUFFY^{2*}** (¹White Earth Tribal and Community College, Mahanomen, MN; ²University of Alaska Fairbanks, Fairbanks, AK).

4:00 122 *Metacognitive Learning: Enhancing Performance by Teaching Students HOW to Learn*, **STEPHEN CARROLL^{1*}** and **MELISSA GANUS²**, (¹Santa Clara University, Santa Clara, CA; ²Seattle Community Colleges, Seattle, WA).

4:30 123 *Applying the Innovation Diffusion Model to Science Education Reform: What can SENCER and Other Reform Efforts Learn?* **AMY SHACHTER** (Santa Clara University, Santa Clara, CA).

Human Experimental Mummification

KIPJ Theatre

Tuesday

1:30 p.m. – 4:15 p.m.

Organizers: *Frank J. Rühli* (Institute of Anatomy, University of Zürich, Switzerland, Head of the Swiss Mummy Project) and *Christina Papageorgopoulou* (Research Assistant, Institute of Anatomy, University of Zürich).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

Artificial mummification methods have been developed in many parts of the world with that of the Ancient Egyptians being among the most successful. Nevertheless, little effort has been made to explore this process on an experimental basis. This symposium aims to present the results of a large project which tried experimentally to reconstruct the ancient Egyptian mummification method by applying evidence-based diagnostic criteria and state-of-the-art methodology, and to bring researchers together who have conducted similar experiments on animal and human tissues.

Session Co-chairs: *Frank J. Rühli* and *Christina Papageorgopoulou*

1:30 124 *Introduction: Human Experimental Mummification*, **FRANK J. RÜHLI^{*}** and **CHRISTINA PAPAGEORGOPOULOU** (University of Zürich, Zürich, Switzerland).

1:45 125 *Human Mummification: The Experimental Approach*, **BOB BRIER** (Long Island University, Greenvale, NY).

2:00 126 *Post-mortem Alterations of Mummified Human Tissue under Experimental Setting*, **CHRISTINA PAPAGEORGOPOULOU^{*}**, **NATALLIA SHVED**, and **FRANK J. RÜHLI** (University of Zürich, Zürich, Switzerland).

2:15 127 *Modeling Ancient Egyptian Mummification Method Using Evidence Based Methodology: Histological Analysis*, **CHRISTINA PAPAGEORGOPOULOU^{*}**, **NATALLIA SHVED**, **JOHANN WANEK**, **GIOVANNI COLACCICO**, and **FRANK J. RÜHLI** (University of Zürich, Zürich, Switzerland).

2:30 128 *Modeling Ancient Egyptian Mummification Methods Using Evidence Based Methodology: MRI, CT Analysis*, **STEPHANIE PANZER¹**, **JOHANN WANEK²**, **CHRISTINA PAPAGEORGOPOULOU²**, **NATALLIA SHVED²**, **GIOVANNI COLACCICO²**, and **FRANK J. RÜHLI^{2*}** (¹Berufsgenossenschaftliche Unfallklinik Murnau, Murnau am Staffelsee, Germany; ²University of Zürich, Zürich, Switzerland).

2:45 129 *Swiss Mummy Project: Experimental Human Tissue Mummification and Post-mortem DNA Degradation*, **NATALIA SHVED, CHRISTINA PAPAGEORGIOU, KATJA PAULSEN, CORDULA HAAS, and FRANK J. RÜHLI** (University of Zürich, Zürich, Switzerland).

3:00 BREAK

3:30 130 *Experimental Human Ice Mummification for Conservation and Taphonomic Studies*, **E. EGARTER VIGL¹, ANGELA GRAEFEN^{2*}, MARCO SAMADDELLI², FRANK MAIXNER², ASTRID GRUMER², and ALBERT ZINK²** (¹General Hospital Bolzano, Italy; ²EURAC - Institute for Mummies and the Iceman, Bolzano, Italy).

3:45 131 *Experimental Archaeology for the Interpretation of Taphonomy Related to Bog Bodies: Lessons Learned from Two Projects Undertaken a Decade Apart*, **HEATHER GILL-FRERKING^{1*} and COLLEEN HEALEY²** (¹Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany; ²Independent Conservator, Ottawa, Canada).

4:00 132 *Sheep and Cats and Cows, Oh My!: Experimental Mummification*, **SALIMA IKRAM** (American University in Cairo, New Cairo, Egypt).

The World Congress on Mummy Studies program continues on page 34 of these Proceedings.

Fragile X Syndrome: Advances In Our Understanding of a Common Cause of Retardation and Autism

KIPJ Rooms H and I

Tuesday, 1:30 p.m. – 5:00 p.m.

Organizers: *Veronica V. Galván* (Department of Psychological Sciences, University of San Diego, San Diego, CA) and *Peter W. Vanderklish* (Department of Neurobiology, The Scripps Research Institute, La Jolla, CA).

Sponsored by the Pacific Division section on Health Sciences.

Fragile X syndrome is the most common inherited form of mental retardation and the leading known cause of Autism. Many affected individuals also suffer from anxiety, attention deficit, hyperactivity, obsessive-compulsive disorders, developmental seizures and subtle physical symptoms. These wide ranging symptoms are caused by the silencing of a single gene, denoted *Fmr1*. In unaffected individuals, this gene is active and produces a protein (FMRP) that regulates the de novo synthesis of hundreds of other proteins at synapses. Intensive, multidisciplinary studies of FMRP and synaptic dysfunctions that arise from its absence in Fragile X syndrome have provided exciting insights

into the neural basis of this syndrome that may also apply to other causes of Autism. These efforts have led to candidate therapies while also advancing our basic understanding of the mechanisms that control neuronal excitability and synaptic plasticity. This symposium will provide a forum for scientists, teachers, students, and interested lay public to hear both an introduction to Fragile X from parents of affected children and a series of talks from scientists that will present some of the latest research in the field. Scientific topics will include the molecular basis of synaptic dysfunction in Fragile X syndrome, alterations in synaptic plasticity and aggregate neural activity, and potential therapeutic strategies. Further information and resources will be made available by the FRAXA Research Foundation, an organization founded by parents that funds Fragile X research and has been instrumental in advancing the field by supporting scientists to find a cure.

Session Chair: *Veronica Galván*

1:30 133 *The Journey So Far*, **CINDY de GRUCHY** (Co-founder, The Fragile X Center of San Diego, San Diego, CA).

2:00 134 *Translating Fragile X*, **PETER W. VANDERKLISH^{1*}, JOHN B. FARNUM¹, JULIE PILOTTE¹, and VERONICA GALVÁN²** (¹The Scripps Research Institute, La Jolla, CA; ²University of San Diego, San Diego, CA).

2:30 135 **OSWALD STEWARD* et al.** (University of California, Irvine, CA).

3:00 BREAK

Session Chair: *Peter Vanderklish*

3:20 136 *Defective GABAergic Neurotransmission and Pharmacological Rescue of Neuronal Hyperexcitability in the Amygdala in a Mouse Model of Fragile X Syndrome*, **MOLLY M. HUNTSMAN^{1*}, JOSE LUIS OLMOS-SERRANO¹, SCOTT M. PALUSZKIEWICZ^{1,2}, BRANDON S. MARTIN^{1,2}, WALTER E. KAUFMANN³, and JOSHUA G. CORBIN¹** (¹Children's National Medical Center, Washington DC, USA; ²Georgetown University School of Medicine, Washington, DC; ³Johns Hopkins, University School of Medicine, Baltimore MD).

3:50 137 *Impairments in the Pathways that Regulate the Spine Actin Cytoskeleton in a Mouse Model of Fragile X*, **JULIE C. LAUTERBORN*, GARY LYNCH, and CHRISTINE M. GALL** (University of California at Irvine, Irvine, CA).

4:20 138 *Long-lasting Effects of Minocycline on Behavior in Neonatal and Adult Fragile X Mice*, **IRYNA M. ETHELL^{1*}, LORRAINE DANSIE¹, KELLY PHOMMAHAXAY¹, SARAH ROTSCHAFER², KHALEEL RAZAK², and DOUGLAS W. ETHELL³** (^{1,2}University of California Riverside, Riverside, CA; ³Western University of Health Sciences, Pomona, CA).

4:50 *Open Discussion*

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

Mummy Research in the Electronic Age

KIPJ Theatre
 Tuesday
 4:15 p.m. – 5:00 p.m.

Organizers: *S. J. Wolfe* (American Antiquarian Society, Worcester, MA) and *Jasmine Day* (The University of Western Australia, Perth, Australia).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium covers the recent digitization of many 19th century periodicals that have revealed a flood of mummy fiction, including poetry, plays, and novels.

Session Chair and Commentator: *David A. Rawson* (Worcester Polytechnic Institute, Worcester, MA)

- 4:15 **139** *Introduction: The New Age of Research: Digitization and Electronic Access*, **DAVID A. RAWSON** (Worcester Polytechnic Institute, Worcester, MA).
- 4:30 **140** *The Mythology of Mummy Paper: Deconstructing an Urban Legend*, **S. J. WOLFE** (American Antiquarian Society, Worcester, MA).
- 4:45 **141** *The Mummy Speaks: An Interdisciplinary Study of the Mummy in Literature, Theatre and Politics*, **JASMINE DAY** (The University of Western Australia, Perth, Australia).

aDNA and Associated Biomolecules

KIPJ Theatre
 Tuesday
 5:15 p.m. – 6:30 p.m.

Organizers: *Mark Spigelman* (Windeyer Institute of Medical Sciences, University College, London, UK, and The Kuvin Centre, Hebrew University, Jerusalem, Israel) and *Dong Hoon Shin* (Department of Anatomy, Seoul National University College of Medicine, Seoul, Korea, and Dankook University, Choeran, Korea).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium will discuss how aDNA and associated biomolecules form an important and growing part of research associated with mummy studies and how they contribute to a better understanding of the life and death of people that were mummified. As this research is potentially destructive, the symposium will show how to biopsy mummies using minimally destructive/intrusive methodology as well as trying to establish baselines and protocols on how/what to sample.

Session Co-Chairs: *Mark Spigelman* and *Dong Hoon Shin*

- 5:15 **142** *Ancient DNA and Parasites from Korean Mummies*, **DONG HOON SHIN^{1*}**, **MYEUNG JU KIM²**, **YI-SUK KIM³**, **CHANG SEOK OH¹**, and **MIN SEO⁴** (¹Seoul National University College of Medicine, Seoul, Korea; ²Dankook University, College of Medicine, Choeran, Korea; ³Ewha Womans University School of Medicine, Seoul, Korea; ⁴Dankook University College of Medicine, Cheonan, Korea).
- 5:30 **143** *Mummy Response to Pathogens*, **GILA KAHILA BAR-GAL^{1*}**, **ANAT LICHTER-PELED¹**, and **MARK SPIGELMAN²** (¹The Hebrew University of Jerusalem, Rehovot, Israel; ²University College London, London, UK and The Hebrew University of Jerusalem, Jerusalem Israel).
- 5:45 **144** *Analysis of Ancient Mummy DNA – Problems and Perspectives*, **ALBERT ZINK^{*}**, **ANGELA GRAEFEN**, **CHRISTIAN MITTERER**, and **FRANK MAIXNER** (EURAC – Institute for Mummies and the Iceman, Bolzano, Italy).
- 6:00 **145** *Progress Report on the Progress of Scientific Studies of Three Large Mummy Collections: Results and Prospects*, **MARK SPIGELMAN** (University College London, London, UK and The Hebrew University of Jerusalem, Jerusalem, Israel).
- 6:15 **146** *Panel Discussion on the Importance of aDNA and Biomolecules in the Study of Ancient Mummies*, **MARK SPIGELMAN^{1*}** and **DONG HOON SHIN^{2*}** (¹University College London, London, UK and Hebrew University of Jerusalem, Jerusalem, Israel; ²Seoul National University College of Medicine, Seoul, Korea and Dankook University, Choeran, Korea).

Wednesday, 15 June 2011

***Princess Takabuti – Analysis,
Interpretation, and Visualization***

KIPJ Theatre
Wednesday
8:00 a.m. – 9:15 a.m.

Organizer: *Caroline Wilkinson* (Centre for Anatomy and Human Identification, College of Life Sciences, University of Dundee, Dundee, Scotland).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium relates the study of “Princess” Takabuti, an Egyptian mummy from the Ulster Museum in Belfast, Ireland. This was the first mummy to be displayed in Ireland (1835) and has been the highlight of the Ulster’s Egyptian collection. In 2008, the mummy was taken to the University of Manchester where Rosalie David and a team of scientists analyzed the mummy for evidence of disease, diet, lifestyle, lifespan, status, and religious practices. Caroline Wilkinson from the University of Dundee created a 3-D reconstruction of the mummy’s face. See *Facial Analysis and Depiction of Preserved Remains* on page 37 for a continuation of this topic.

Session Chair: *Caroline Wilkinson*

- 8:00** **147** *Introduction to the Takabuti Project*, **JENEFER COCKITT*** and **A.R. DAVID** (University of Manchester, Manchester, UK).
- 8:15** **148** *The Mummy of the Ancient Egyptian Noblewoman, Takabuti of Thebes*, **WINIFRED GLOVER** (Ulster Museum, Belfast, Northern Ireland, UK).
- 8:30** **149** *Imagine Takabuti: Radiology and Osteology*, **JUDITH E. ADAMS^{1*}** and **EILEEN M. MURPHY²** (¹The Royal Infirmary, Manchester, UK; ²Queen’s University Belfast, Belfast Northern Ireland, UK).
- 8:45** **150** *Reconstruction of the Face of Princess Takabuti*, **CAROLINE WILKINSON**, **SARAH SHRIMPTON**, and **JANICE P. AITKEN** (University of Dundee, Dundee, Scotland).
- 9:00** **151** *Show Me the Mummy – the Face of Takabuti*, **CAROLINE WILKINSON** (University of Dundee, Dundee, Scotland).

The World Congress on Mummy Studies program continues on page 37 of these Proceedings.

United States and World Fairs

KIPJ, Room B
Wednesday
8:30 a.m. – 5:45 p.m.

Organizer: *Alan L. Bain* (Emeritus Certified Archivist; Volunteer, National Anthropological Archives; Retired Archivist, Smithsonian Institution Archives).

Program sponsored by the Pacific Division section on Anthropology and Archaeology.

World fairs are good fun and food. But, that is not all. Fairs are complex events that contain multiple ideas and meanings to the directors and managers, business community, the audience, participants, exhibitors and government administrators. They reflect themes of technological and industrial advance, empire and colony, racism and research, self-image, respect and independence. This symposium covers a wide-range of topics and fairs documenting Asia and Asian American communities represented at the fairs, the reasons for the collections of ethnological material and other artifacts and what happened to them, Californians response to the Panama-Pacific Exposition, mummies on display, how Native Americans were represented and how the Japanese depicted the Ainu. Anthropologists, historians and archivists will participate at this symposium. In addition to the above, there will be a discussion on the use of archives to document fairs, the information they contain, and the continuous need to acquire additional records and special collections.

Session Chair: *Robert W. Rydell*

- 8:30** *Opening Comments*, **ROBERT W. RYDELL** (Montana State University, Bozeman, MT).
- 8:45** **152** *Writing the History of World’s Fairs*, **JAMES G. GILBERT** (Distinguished University Professor Emeritus, University of Maryland, College Park, MD).
- 9:15** **153** *Asian Americans and Asian Nations at U. S. World Fairs, 1876-1915*, **BENNET BRONSON** (Chinese in Northwest America Research Committee, Bainbridge Island, WA).
- 9:45** *Question and Answer Period*
- 10:00** **BREAK**
- 10:20** **154** *Living ‘Cliff Dwellers’ at the 1893 World’s Columbian Exposition: An Enduring Metaphor of a 21st Century Indigenous People*, **LARS KRUTAK** (National Museum of Natural History, Washington, DC).
- 10:50** **155** *A Publicly Ethereal Manifestation: Chicago, Anthropology, and the World’s Columbian Exposition*, **STEPHEN E. NASH** (Denver Museum of Nature and Science, Denver, CO).

11:10 *Question and Answer Period*

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

11:25 LUNCH

1:00 156 *Mummies in Context: Displays of Human Remains at World's Fairs in the United States*, **SAMUEL REDMAN** (University of California, Berkeley, CA).

1:30 157 *Platform for Immigration Battles: Chinese Americans at World Fairs before 1920*, **CHUIMEI HO** (Chinese in Northwest America Research Committee, Bainbridge Island, WA).

2:00 158 *Documenting the New Colony through its Objects: The Smithsonian's Philippine Collections from the early 20th Century International Fairs*, **PATRICIA O. AFABLE** (Smithsonian Institution, National Museum of Natural History, Washington, DC).

2:30 *Question and Answer Period*

2:45 BREAK

3:05 159 *Performers, Interpreters, and the Showman Onstage and Offstage at the Pay Streak's 'Igorrote Village'*, **DEANA WEIBEL¹** and **PATRICIA O. AFABLE²** (¹Grand Valley State University, Allendale MI; ²Smithsonian Institution, National Museum of Natural History, Washington, DC).

4:05 160 *Defining a Californian: Visions of California at the Panama-Pacific International Exposition*, **ABIGAIL MARKWYN** (Carroll University, Waukesha, WI).

4:35 161 *The Legacy of an Ainu Activist, Kayano Shigeru: His Lifelong Efforts to Save Ainu Heritage*, **YOSHIKO YAMAMOTO** (San Francisco State University, San Francisco, CA).

5:05 162 *World's Fairs as Special Collections*, **TAMMY LAU** (California State University Fresno, Fresno, CA).

5:25 *Question and Answer Period*

***Pathways to Science: Promoting
Inquiry-Based Learning Beyond the Classroom***

KIPJ Room A
Wednesday
8:30 a.m. – Noon

Organizers: *Carl A. Maida* (University of California, Los Angeles) and *Paul Heckman* (University of California, Davis).

Sponsored by the Education Section and the Education Committee of the AAAS, Pacific Division.

This session will combine didactic, experiential, and reflective

activities – essential elements in Inquiry-Based Learning – to engage audience members, including K-14 teachers and informal science educators, and presenters in a *professional learning community* experience. The intent is to provide an opportunity for collaborative inquiry and the learning related to STEM (Science, Technology, Engineering and Mathematics) in *out-of-school-time settings*. While increasing numbers of students start college with plans to major in the STEM fields, their completion rates are lagging, especially among under-represented minorities. Generating and sustaining interest in a scientific career will require engaging students in STEM learning activities outside of the classroom, such as collaborating with their peers on group projects in after-school programs and science clubs. This workshop will consider ways to increase students' scientific literacy through involvement in project-based learning – that is also inquiry-based – in after-school programs and in experiential, community-based learning activities, including mentored internships, with the objectives of: 1) increasing knowledge of science; 2) improving the sense of self-efficacy; and 3) promoting basic, applied, and clinical sciences as career choices. Panelists will discuss current issues and future trends in out-of-classroom science education, including STEM after-school programs, pre-college science enrichment and “pipeline” programs, university-community partnerships, STEM scientist educational outreach and mentoring activities, Informal STEM education, “National Lab Day,” “living classrooms,” scientific literacy, and “citizen science” initiatives. The session will also consider the ways high school seniors and college students, together, can serve as *science ambassadors* and role models to engage their peers in out-of-classroom activities that enhance an understanding, appreciation, and perhaps a passion for science and scientific inquiry.

Following the symposium and lunch (on your own) will be an informal field trip to the San Diego campus of High Tech High. High Tech High began in 2000 as a single charter high school launched by a coalition of San Diego business leaders and educators. It has evolved into an integrated network of schools spanning grades K-12, housing a comprehensive teacher certification program and a new, innovative Graduate School of Education. The Gary and Jerrin Ann Jacobs High Tech High is the original High Tech High school. Founded in the fall of 2000, the school is located at HTH Village in San Diego and serves approximately 535 students in grades 9-12. High Tech High now operates eleven schools in San Diego County: two elementary schools, four middle schools, and five high schools. All of these schools serve a diverse, lottery-selected student population; all embody the High Tech High design principles of personalization, adult world connection, common intellectual mission, and teacher as designer. Participants in this symposium are invited to join in this unique opportunity to see how this innovative school functions. Additional details will be announced in the session.

8:30 *Welcome*, **PAUL HECKMAN** and **CARL MAIDA**

8:35 KEYNOTE ADDRESS: *The Promise of Inquiry-Based Learning Beyond the Classroom*, **SHIRLEY MALCOM** (AAAS, Washington, D.C.).

9:00 *Panel: Styles of Inquiry-Based Learning in Out-of-School Time Environments*

Introductory Remarks:

JEFF DAVIS (University of California, Davis)

Moderator:

PAUL HECKMAN (University of California, Davis)

Panelists:

WILLIAM B.N. BERRY (University of California, Berkeley)

PAUL BUNJE (University of California, Los Angeles)

MARVIN MARCUS (University of California, Los Angeles)

KIMBERLY TANNER (San Francisco State University)

10:00 *Workshop: Promoting Student Inquiry-Based Learning and Development of STEM Activities Outside the Classroom*

Breakout Sessions with Audience and Panelists

11:00 *Synthesis Panel: Reflections on Inquiry-Based Learning in Out-of-School Time Environments*

Introductory Remarks:

PAUL HECKMAN (University of California, Davis)

Moderator:

CARL MAIDA (University of California, Los Angeles)

Panelists:

ANDEE PRESS-DAWSON (University of California, Davis)

JOHNNIE SAVOY (College Bound, Los Angeles)

STU SEMIGRAN (EduCare Foundation)

JAY VAVRA (High Tech High, San Diego)

12:00 LUNCH

1:00 *Informal Field Trip to High Tech High, San Diego (optional)*

***Facial Analysis and
Depiction of Preserved Remains***

KIPJ Theatre

Wednesday

9:15 a.m. – 11:00 a.m.

Organizer: *Caroline Wilkinson* (Centre for Anatomy and Human Identification, College of Life Sciences, University of Dundee, Dundee, Scotland).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This is the second part of a double symposium (see *Princess Takabuti – Analysis, Interpretation, and Visualization* on page 35 for the first part) which explores techniques by various researchers on the visualization of a wide range of subjects from the possible skull of Cleopatra's sister, a shrunken head from South American, and a bog body from Ireland, to a mummified anatomical child specimen.

Session Chair: *Caroline Wilkinson*

9:15 **163** *The Craniofacial Analysis of the Possible Skull of Arsinoe, Sister of Cleopatra*, **CHRISTOPHER RYNN^{1*}**, **CAROLINE WILKINSON¹**, **FABIAN KANZ²**, and

JANICE P. AITKEN¹ (¹University of Dundee, Dundee, Scotland, UK; ²Medical University of Vienna, Austria).

9:30 **164** *Facial Analysis of a Tsantsa: A Shrunken Head from the Shuar Tribes of South America*, **TOBIAS HOULTON** (University of Dundee, Scotland).

9:45 **165** *The Texturing of a Facial Depiction of Clonycavan Man – A Bog Body from Ireland*, **JANICE P. AITKEN***, **CAROLINE WILKINSON**, and **C. D. EROLIN** (University of Dundee, Dundee, Scotland).

10:00 BREAK

10:30 **166** *Body Snatchers – The Analysis of a Mummified Human Child as an Anatomical Specimen*, **CAROLINE WILKINSON**, **SUE BLACK**, **XANTHE MALLET**, and **WOLFRAM MEIER-AUGENSTEIN** (University of Dundee, Dundee, Scotland).

10:45 **167** *Historical/Archaeological Digital Forensic Facial Reconstruction from CT Scans*, **JOSHUA HARKER** (Chicago, IL).

The World Congress on Mummy Studies program continues on page 38 of these Proceedings.

***The Second Law of Thermodynamics:
Status and Challenges, Part II***

KIPJ Rooms C and D

Wednesday

9:30 a.m. – 3:00 p.m.

This program is continuing from Tuesday. Please see page 30 in these Proceedings for the program description.

Session Chair: *Andrew Rex* (University of Puget Sound)

9:30 **168** *Relaxation Phenomena in the Adiabatic Phase Transition of Type I Superconductor Particles*, **PETER D. KEEFE** (University of Detroit Mercy, Eastpointe, MI).

10:15 BREAK

10:30 **169** *The Production of Electricity Out of a Heat Bath*, **RODERICH W. GRAEFF** (Private Scholar, Koenigsfeld, Germany and Ithaca, NY).

11:15 **170** *On Entropy in Eulerian Thermodynamics*, **CHRISTIAN FRONSDAL** and **ABHISHEK PATHAK*** (University of California Los Angeles, Los Angeles, CA).

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

12:00 LUNCH

- 1:30 171** *A Generalized Second Law for Heterogeneously Coupled Energy Systems that Exhibit Equilibrium Temperature Differentials and Comments on Time Reversibility and Entropy*, **CHRISTOPHER G. JESUDASON** (University of Malaya, Kuala Lumpur, Malaysia).
- 2:15 172** *Revisiting The Second Law of Energy Degradation and Entropy Generation: From Sadi Carnot's Ingenious Reasoning to Holistic Generalization*, **MILIVOJE M. KOSTIC** (Northern Illinois University, DeKalb, IL).

***The Rio Muerto Project:
Mummies of the Tiwanaku Culture
from Moquegua, Perú***
KIPJ Theatre
Wednesday
11:00 a.m. – noon

Organizer: *Paul S. Goldstein* (University of California San Diego, La Jolla, CA).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium outlines the bioarcheological study of one of the best-preserved Tiwanaku sites (AD 500-1000) in Peru. The high degree of preservation of the human and cultural remains has allowed the study of paleodiet, gender, and status-based differences, through body preparation, cranial deformation, textile evidence, carbon and nitrogen isotope data, and mortuary architecture.

Session Chair: *Paul S. Goldstein*

- 11:00 173** *The Rio Muerto Project 2006-2010: Mummy Preparation, Mortuary Practice, and Social Identity in the Tiwanaku State (AD 500-1000)*, **PAUL S. GOLDSTEIN^{1*}**, **ULRIKE M. GREEN¹**, **ALICIA BOSWELL¹**, **SARAH BAITZEL¹**, and **PATRICIA PALACIOS²** (¹University of California San Diego, La Jolla, CA; ²Museo Contisuyo, Plaza de Armas, Moquegua, Peru).

- 11:15 174** *Dress, Death, and Identity in Moquegua Tiwanaku: Textile Evidence from the Rio Muerto Mummies, Moquegua, Peru*, **ELIZABETH M. PLUNGER*** and **PAUL S. GOLDSTEIN** (University of California San Diego, La Jolla, CA).

- 11:30 175** *Unwrapping Tiwanaku Diet: Carbon and Nitrogen Isotope Data from the Mummies of Rio Muerto, Moquegua, Peru*, **ANDREW D. SOMERVILLE***, **PAUL S. GOLDSTEIN**, **SARAH I. BAITZEL**, **MARGARET J. SCHOENINGER**, **SARAH RAUBENHEIMER**, and **LINDA YZURDIGA** (University of California San Diego, La Jolla, CA).

- 11:45 176** *Labor, Gender, and Identity: Bioarchaeological Activity Patterns in Mummified and Skeletonized Individuals from the Tiwanaku State (AD 500-1000)*, **SARA K. BECKER** (University of North Carolina Chapel Hill, Chapel Hill, NC).

*The World Congress on Mummy Studies program
continues on page 39 of these Proceedings.*

***Osteoimmunology: Fundamental,
Clinical and Translational Implications
in Temporomandibular Disorders***

KIPJ Room G
Wednesday
1:15 p.m. – 3:00 p.m.

Organizers: *Andre Barkhordarian* and *Francesco Chiappelli* (UCLA School of Dentistry, Los Angeles, CA).

Program sponsored by the Pacific Division section on Oral Biology and Dental Medicine.

Osteoimmunology refers to the regulating interplay, interaction, and (or) interconnectivity between bone and immune biology. The interplay begins when bone provides the microenvironment that is critical for the development of the hematopoietic stem cells from which all cells of the mammalian immune system derive, and they in turn produce various immunoregulatory cytokines that influence the fate of bone cells. Besides sharing signaling molecules, bone and immune cells have a common site of origin. They influence each other not only after maturation and activation, but also at the formation stage as apparent in the role of osteoblasts in the establishment of hematopoietic stem cell niches and their maintenance in bone marrow. Abnormalities in immune system cause skeletal damages that eventually lead to osteoimmunopathologies such as Temporomandibular disorders and dysfunctions (TMD/TMJ). Temporomandibular disorders are conditions that affect masticatory muscles, the mandibular joints, and other associated structures. Various inflammatory mediators and cytokines influence the pathogenic mechanisms involving interactions between immune cells and bone. Temporomandibular disorders whether they are internal derangements or a mal-relationship of the mandible to the cranial base have a systemic/neurologic component. The compression or irritation of the Auriculotemporal nerve at a sub-threshold level may lead to neurologic disorders such as Cervical Dystonia and Parkinson's. When the TMJ is treated, decrease or cessation of the symptomatology is observed. In this symposium we will explore local and systemic implications that are associated with TMD/TMJ.

Session Chair: *Francesco Chiappelli*

- 1:15 Welcoming Comments**

- 1:20 177** *Fundamental Osteoimmunology: From Stem Cells to Bone-immune Metabolism*, **ANDRE BARKHORDARIAN*** and **FRANCESCO CHIAPPELLI**, (University of California Los Angeles, Los Angeles, CA).

- 1:45 178 Psychoneuroendocrine-osteimmunology and Temporomandibular Disorders**, **FRANCESCO CHIAPPELLI*** and **ANDRE BARKHORDARIAN** (University of California Los Angeles, Los Angeles, CA).
- 2:10 179 Systemic Correlates of Temporomandibular Joint Disorders**, **GARY DEMERJIAN** (Burbank, CA).
- 2:35 180 Osteimmunology I: Integrating Fundamental Osteoimmunology Research in Clinical Practice**, **JAY SISON** (Los Angeles, CA).

State-of-the-Art Ancient Mummy Research

KIPJ Theatre
Wednesday
1:30 p.m. – 5:15 p.m.

Organizers: *Frank J. Rühli* (Institute of Anatomy, University of Zürich, Switzerland, Head of the Swiss Mummy Project), *Albert Zink* (Head of the EURAC Institute for Mummies and the Iceman, European Academy of Bolzano/Bozen, Italy) and *Niels Lynnerup* (Department of Forensic Medicine, Laboratory of Biological Anthropology, University of Copenhagen, Denmark).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

Ancient mummies have been examined for centuries. The enormous ongoing advance of examination modalities allows researchers to expand their studies. The aim of this symposium is to review the current “gold-standard” for scientific studies of ancient mummies and to predict future developments, both in terms of examination standards as well as possible “high-end” single case methodologies. Presentations range from high-resolution imaging and histology to coprolites and stable isotopes.

Session Co-Chairs: *Frank J. Rühli*, *Albert Zink*, and *Niels Lynnerup*

- 1:30 181 Introduction to State-of-the-Art Ancient Mummy Research**, **FRANK J. RÜHLI***, **ALBERT ZINK²**, and **NIELS LYNNERUP³** (¹University of Zürich, Switzerland; ²EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ³University of Copenhagen, Denmark).
- 1:45 182 Macroscopic Investigation of Mummies**, **SALIMA IKRAM** (American University in Cairo, New Cairo, Egypt).
- 2:00 183 CT and MR Imaging of Ancient Mummies**, **FRANK J. RÜHLI*** and **NIELS LYNNERUP²** (¹University of Zürich, Switzerland; ²University of Copenhagen, Denmark).
- 2:15 184 State-of-the-Art of High Resolution Imaging of Ancient Mummified Tissue**, **FRANK J. RÜHLI*** and **JOHANN WANEK** (University of Zürich, Switzerland).

- 2:30 185 3D-Analyses and 3D-Visualisations**, **NIELS LYNNERUP** (University of Copenhagen, Denmark).

- 2:45 186 Histological Investigation of Human Mummified Remains – Potential and Drawbacks of the Analysis of Ancient Soft Tissue Material**, **FRANK MAIXNER^{1*}**, **ASTRID GRUMER¹**, **BARBARA PICHLER¹**, **DARIO PIOMBINO-MASCALI¹**, **FRANZ SCHROFFENEGGER²**, **EDUARD EGARTER VIGL²**, and **ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²General Hospital Bolzano, Italy).

3:00 BREAK

- 3:30 187 Molecular Investigations of Microbial Communities in Mummified Human Remains**, **FRANK MAIXNER^{1*}**, **THOMAS RATTEL²**, **GAUDELUPE PINAR³**, **KATJA STERFLINGER-GLEIXNER³**, **DARIO PIOMBINO-MASCALI¹**, **GIOVANNA CIPOLLINI¹**, and **ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²University of Vienna, Austria; ³University of National Resources and Applied Life Sciences, Vienna, Austria).

- 3:45 188 State-of-the-Art Ancient Mummy Research: Coprolites**, **KARL J. REINHARD** (University of Nebraska, Lincoln, NE).

- 4:00 189 Preservation of Human Mummified Remains**, **ALBERT ZINK^{1*}**, **MARCO SAMADELLI¹**, **DARIO PIOMBINO-MASCALI¹**, and **EDUARD EGARTER VIGL²** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²General Hospital Bolzano, Italy).

- 4:15 190 Dental Studies**, **ROGER SEILER*** and **FRANK J. RÜHLI** (University of Zürich, Switzerland).

- 4:30 191 Advancing the Stable Isotopic Analysis of Mummies: Some Suggested Future Directions**, **CHRISTINE D. WHITE*** and **FRED J. LONGSTAFFE** (The University of Western Ontario, Canada).

- 4:45 192 Using Rapid Prototyping in Mummy Studies – Bridging Science and Public Presentation**, **HEATHER GILL-FRERKING*** and **WILFRIED ROSENDAHL** (The German Mummy Project, Reiss-Engelhorn Museums, Mannheim, Germany).

- 5:00 193 Next Generation Sequencing Technology in Mummy Studies: The Genome of the Tyrolean Iceman**, **ANGELA GRAEFEN^{1*}**, **ANDREAS KELLER²**, **MARKUS BALL³**, **MARK MATZAS⁴**, **VALESCA BOISGUERIN⁴**, **FRANK MAIXNER¹**, **PETRA LEIDINGER²**, **ANDRE FRANKE⁵**, **JENS MAYER²**, **RABAB KHAIRAT³**, **JESSICA SPANGLER⁶**, **STEPHEN McLAUGHLIN⁶**, **MINITA SHAH⁶**, **CLARENCE LEE⁶**, **TIMOTHY HARKINS⁶**, **ALEXANDER SARTORI⁶**, **JAN HAAS⁷**, **HUGO KATUS⁷**, **BENJAMIN MEDER⁷**, **NIKOLAUS BLIN³**,

ECKART MEESE², CARSTEN PUSCH³, MARCO SAMADELLI¹, EDUARD EGARTER VIGL⁸, and ALBERT ZINK¹ (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²Saarland University, Homburg, Saar, Germany; ³University of Tübingen, Germany; ⁴Febit Biomed GMBH, Heidelberg, Germany; ⁵Christian-Albrechts-University Kiel, Germany; ⁶Lifetech/Applied Biosystems, Beverly, MA, Foster City, CA; ⁷University of Heidelberg, Heidelberg, Germany; ⁸General Hospital Bolzano, Italy).

The World Congress on Mummy Studies program continues on page 41 of these Proceedings.

The Changing Role of the Research University in K–12 Science Education

KIPJ Room A
Wednesday
2:00 p.m. – 4:50 p.m.

Organizers: *Sherry Seethaler* (Staff Director of California Teach, Division of Physical Sciences, University of California San Diego, La Jolla, CA) and *John Czworkowski* (Lecturer, PSOE, Department of Chemistry and Biochemistry, University of California San Diego, La Jolla, CA).

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

Concerns about America's future science and technology competitiveness in the global economy are changing the role of the nation's research universities in K-12 science education. The National Academies' report, *Rising Above the Gathering Storm*, recommended three actions to improve K-12 STEM education: 1) Attract more of America's brightest students to the teaching profession; 2) Strengthen the skills of the nation's current K-12 teachers; and 3) Enlarge the pipeline of students prepared to pursue STEM degrees. This symposium reveals how four research universities broke down intra-institutional barriers (between science and education departments) and inter-institutional barriers (between universities and K-12 schools) to address these aspects of precollege science education. University of Arizona's Science Teacher Preparation Program, University of California, San Diego's California Teach, and University of California Berkeley's Cal Teach and Summer Research Institute exemplify ways to bridge the traditional gap between undergraduate science curricula and education credential programs to develop future teachers' pedagogical content knowledge. Project PASS at the University of Nevada, Las Vegas uses a professional learning community to strengthen the skills of current teachers through a collaborative partnership between a university and a large urban school district. Another strategy is the creation of University-led charter schools, such as the University of California, San Diego's Preuss School, that provide rigorous college preparatory courses for diverse, low-income, first-generation college students. The panel will explore these programs, institutional changes that made them possible, how early dissonance was overcome, implementation, impact, and unexpected effects that continue to engage research universities in science education.

Session Chair: *Sherry Seethaler*

2:00 *Introduction*, **SHERRY SEETHALER** (University of California San Diego, La Jolla, CA)

2:10 **194** *UC Berkeley's Response to The Gathering Storm: Cal Teach and M&A Berkeley*, **NICOLE NUNES**, (University of California Berkeley, Berkeley, CA).

2:35 **195** *Content-Intensive Courses in UC San Diego's Science Education Minor: Preliminary Results on Their Effects on Pre-Service Science Teachers*, **JOHN CZWORKOWSKI** (University of California San Diego, La Jolla, CA).

3:00 **BREAK**

3:15 **196** *Growing a Culture for Science Education in the University of Arizona's College of Science*, **DEBRA TOMANEK** (University of Arizona, Tucson, AZ).

3:40 **197** *Leveraging a Collaborative Partnership to Achieve High Quality Professional Development for Science Teachers*, **KENT J. CRIPPEN** (University of Nevada, Las Vegas, NV).

4:05 **198** *More Than Outreach: Starting a Charter School on a Research University Campus*, **BARBARA SAWREY** (University of California San Diego, La Jolla, CA).

4:30 *Questions and Discussion (synthesis of common themes and lessons learned)*

Thursday, 16 June 2011

Mexican Mummy Studies

KIPJ Theatre

Thursday

8:00 a.m. – 10:15 a.m.

Organizers: *Josefina Mansilla* and *Ilán Leboeiro* (Instituto Nacional de Antropología e Historia (INAH), México).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

Researchers from México will cover the latest research on Mexican mummies in this symposium.

Session Co-chairs: *Josefina Mansilla* and *Ilán Leboeiro*

8:00 **199** *Incidents in the Sierra Tarahumara*, **ENRIQUE CHACÓN SORIA** (Centro INAH Chihuahua, Centro, Chihuahua, CP).

8:15 **200** *The “Why” of the Mortuary Context of Mexican Mummies*, **ILÁN LEBOREIRO*** and **JOSEFINA MANSILLA** (Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F.).

8:30 **201** *Brief Overview about the Mexican Mummies*, **JOSEFINA MANSILLA*** and **ILÁN LEBOREIRO** (Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F.).

8:45 **202** *México’s Most Ancient Mummy: Tm-c-247 at Romero’s Cave*, **JOSEFINA MANSILLA*** and **ILÁN LEBOREIRO** (Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F.).

9:00 **203** *Ancient DNA from Mummified Tissue in México: A Case Study for the Early Colonization of the Americas*, **CRISTINA VALDIOSERA^{1*}**, **COLIN SMITH¹**, **MORTEN RASMUSSEN¹**, **VICTOR MORENO¹**, **ESKE WILLERLEV¹**, **ILÁN LEBOREIRO²**, and **JOSEFINA MANSILLA²** (¹Center for GeoGenetics, Geologiske Museum, Copenhagen K, Denmark; ²Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México D.F.).

9:15 **204** *Traditions of the Ancient Northern Mexican Desert: Fur-wrapped and Flexed Positioned Mummies of Infant Cadavers*, **LETICIA GONZALEZ^{1*}**, **JOSEFINA MANSILLA²**, **SANDRA POMPA³**, **MARCO ANTONIO RODRIGUEZ²**, and **ILÁN LEBOREIRO²** (¹Museo Regional de La Laguna, Bosque Venustiano Carranza s/n, Torreón, Coahuila, C.P.; ²Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México, D.F.; ³Universidad Nacional Autónoma de México, Ciudad Universitaria, C.P. 04510, México D.F.; ⁴Universidad Nacional Autónoma de México, Ciudad Universitaria, C.P. 04510, México, D.F.).

9:30 **205** *Characterization of Mummy Hair at Nanometric Level Through Atomic Force Microscopy*, **CARMEN PIJOAN^{1*}**,

PEDRO BOSCH², **CARLOS FLORES²**, **JOSEFINA MANSILLA¹**, **ILÁN LEBOREIRO¹**, and **MARÍA TERESA MENENDEZ-TABOADA³** (¹Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México, D.F.; ²Universidad Nacional Autónoma de México, Ciudad Universitaria, C.P. 04510, México D.F.; ³Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030 México, D.F.).

9:45 **206** *Trace Elements in Ancient Tarahumara Mummy Hair*, **MARÍA TERESA MENENDEZ-TABOADA** (Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030, México, D.F.).

10:00 **207** *Analysis of the Genetic and Historical Context of Two Prehispanic Mummies from México: Phylogeography as an Approach to Complement the Understanding of Past Populations*, **ANA SERRANO*** and **MARIEL DURÁN** (Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030 México, D.F.).

Studies on an Old Kingdom Mummy

KIPJ Theatre

Thursday

10:30 a.m. – 11:30 a.m.

Organizer: *Bob Brier* (Long Island University, Greenvale, NY).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

The Carlos Museum at Emory University in Atlanta, Georgia has recently displayed a rare Old Kingdom mummy, giving researchers the opportunity to explore aspects of its preservation. The history of the mummy, its analysis and conservation are presented.

Session Chair: *Bob Brier*

10:30 **208** *Introduction: Studies on an Old Kingdom Mummy*, **BOB BRIER** (Long Island University, Greenvale, NY).

10:45 **209** *A History of the Oldest Egyptian Mummy in the Americas*, **PETER LACOVARA¹** and **BOB BRIER^{2*}** (¹Michael C. Carlos Museum, Atlanta, GA; ²Long Island University, Greenvale, NY).

11:00 **210** *Interpreting the Life of the Carlos Museum’s Old Kingdom Mummy*, **MONIQUE OSIGBEME***, **CHENERE PIERCE RAMSEY**, **MALU TANSEY**, **JOSHUA ROBINSON**, **JOHN KINGSTON**, and **ARRI EISEN** (Emory University, Atlanta, GA).

11:15 **211** *Project Update on the Conservation Treatment of the Carlos Museum’s Old Kingdom Mummy*, **MIMI LEVEQUE^{1*}** and **RENÉE STEIN²** (¹Peabody Essex Museum and Archaea Technica Conservation; ²Michael C. Carlos Museum, Emory University, Atlanta, GA).

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

***Heart Disease and Atherosclerosis
in Ancient Egyptian Mummies***

KIPJ Theatre

Thursday

11:30 a.m. – 12:30 p.m.

Organizer: *Randall C. Thompson* (The Mid America Heart Institute, University of Missouri, Kansas City, MO).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium presents a comparison of cardiovascular disease from 52 Egyptian Mummies with studies of atherosclerosis in the preindustrial world. The work of the HORUS Study group and its “Hunt for Atherosclerosis” is outlined.

Session Chair: *Janet M. Monge* (University of Pennsylvania Museum)

11:30 212 *Introduction: An Overview of the HORUS Study*, **RANDALL C. THOMPSON** (University of Missouri, Kansas City, MO).

11:45 213 *The HORUS Study – The Hunt for Atherosclerosis*, **L. SAMUEL WANN** (The Wisconsin Heart Hospital, Milwaukee, WI).

12:00 214 *Comparative Studies of Atherosclerosis in Communities in the Preindustrial World*, **CALEB E. FINCH** (University of Southern California, Los Angeles, CA).

12:15 215 *Demonstration of Cardiovascular Disease on CT Scans in Egyptian Mummies – Examples from 52 Mummies*, **RANDALL C. THOMPSON** (University of Missouri, Kansas City, MO).

Concurrent Session

Contributed Papers, Session III

KIPJ Rooms A and B

Thursday

11:30 a.m. – 12:30 p.m.

Please refer to page 54 in these Proceedings for complete details of this session.

11:30 320 *Development of a Nubian Pathological Ontology*, **RYAN METCALFE** (University of Manchester, Manchester, UK).

11:45 321 *Re-thinking Burial Dates at a Graeco-Roman Cemetery (Fag el Gamous, Fayoum, Egypt)*, **DAVID M. WHITCHURCH*** and **R. PAUL EVANS** (Brigham Young University, Provo, UT).

12:00 322 *The Alleged Bog Body or the Identification of a South*

American Mummy via Multi-element Isotope Analyses, **SANDRA LOESCH¹**, **CHRISTINE LEHN²**, **ULRICH STRUCK³**, **PETER HORN⁴**, **STEFAN HÖLZL⁴**, **OLIVER PESCHEL²**, **ANDREAS NERLICH⁵**, and **BRIGITTE HAAS-GEBHARD⁶** (¹Bern University, Bern, Switzerland; ²University of Munich, Munich, Germany; ³Humboldt University of Berlin, Berlin, Germany; ⁴Bavarian State Collection of Palaeontology and Geology, Munich, Germany; ⁵Municipal Clinic Bogenhausen, Munich, Germany; ⁶Bavarian State Archaeological Collection and Museum, Munich, Germany).

12:15 323 *Hand-Schueller-Christian's Disease in an Ancient Egyptian Mummy; X-ray, CT and MR Analysis*, **MISLAV CAVKA^{1,2}**, **GORDANA IVANAC^{1,2}**, **LEJLA AGANOVIC^{3*}**, **GERT REITER⁴**, **SONIA NIELLES-VALLESPIN⁵**, **PETER SPEIER⁵**, **IVOR JANKOVIC⁶**, **IGOR URANIC⁷**, and **BORIS BRKLJACIC^{1,2}** (¹University Department for Diagnostic and Interventional Radiology in University Hospital “Dubrava”, Zagreb, Croatia; ²University of Zagreb Medical School, Zagreb, Croatia; ³University of California San Diego, San Diego, CA; ⁴Siemens AG Healthcare, Erlangen, Germany; ⁵Siemens AG Healthcare, Graz, Austria; ⁶Institute for Anthropological Research, Zagreb, Croatia; ⁷Archeological Museum Zagreb, Zagreb, Croatia).

Mummies as Cultural Heritage

KIPJ Theatre

Thursday

1:30 p.m. – 3:15 p.m.

Organizers: *Dario Piombino-Mascali* and *Albert Zink* (EURAC - Institute for the Mummies and the Iceman, Bolzano, Italy).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

A wide range of mummy preservation and national recognition is explored from museum specimens to bog bodies. One of these is the Zweeloo Woman, a bog body from The Netherlands with evidence of Leri-Weill dyscondrosteosis (DSC) a dominantly inherited dysplasia marked by short stature with mesomelic shortening of middle segments of the forearms and lower legs. This is the first case of DSC syndrome recognized in a 2nd century bog body from The Netherlands.

Session Co-chairs: *Dario Piombino-Mascali*, *Albert Zink*, and *Heather Gill-Frerking* (Reiss-Engelhorn Museums, Mannheim, Germany)

1:30 216 *Introduction to Mummies as Cultural Heritage*, **DARIO PIOMBINO-MASCALI** (EURAC - Institute for Mummies and the Iceman, Bolzano, Italy).

1:45 217 *The Anatomical Collection of Giovan Battista Rini (1795-1856): A Paleoradiological Investigation*, **DARIO PIOMBINO-MASCALI^{1*}**, **ALBERT ZINK¹**, **ALBERTO CARLI²**, and **STEPHANIE PANZER³** (¹EURAC

– Institute for Mummies and the Iceman, Bolzano, Italy; ²University of Molise, Campobasso, Italy; ³Trauma Center Murnau, Murnau, Germany).

- 2:00 218** *Development of a New Glass Case System for Mummies Conservation*, **MARCO SAMADELLI^{1*}, DARIO PIOMBINO-MASCALI¹, F. U. ROLLO², VITO C. FERNICOLA³, and ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²UNICAM, Scuola di Bioscienze e Biotecnologie dell'Università degli Studi di Camerino, Camerino, Italy; ³I.N.R.I.M., Torino, Italy).
- 2:15 219** *The Royal Mummies of Ancient Egypt: A History Rewritten by Science*, **ALBERT ZINK^{1*}, YEHA Z. GAD², SOMAIA ISMAIL², PAUL GOSTNER³, ASHRAF SELIM⁴, CARSTEN M. PUSCH⁵, and ZAHI HAWASS⁶** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²National Research Center, Cairo, Egypt; ³Central Hospital Bolzano, Bolzano, Italy; ⁴Cairo Scan Radiology Centre, Giza, Egypt; ⁵University of Tübingen, Tübingen, Germany; ⁶Supreme Council of Antiquities, Cairo, Egypt).
- 2:30 220** *Marking with Needles and Lancets: The Antiquity of Therapeutic Tattooing*, **LARS KRUTAK** (National Museum of Natural History, Smithsonian Institution, Washington, DC).
- 2:45 221** *Zweeloo Woman: Multidisciplinary Investigation of a Bog Body*, **RAFFAELLA BIANUCCI^{1,2*}, DON BROTHWELL³, WIJNAND VAN DER SANDEN^{4*}, CHRISTINA PAPAGEORGIOPOULOU⁵, PAUL GOSTNER⁶, PATRIZIA PERNER⁶, EDUARD EGARTER VIGL⁷, FRANK MAIXNER⁸, MAREK JANKO^{9,10}, DARIO PIOMBINO-MASCALI⁸, GRAZIA MATTUTINO¹, FRANK J. RÜHLI¹¹, and ALBERT ZINK⁸** (¹University of Turin, Turin, Italy; ²University of Marseilles, Marseilles, France; ³University of York, York, UK; ⁴Drents Plateau, The Netherlands; ⁵Johannes Gutenberg - Universität, Mainz, Germany; ⁶General Regional Hospital, Bolzano, Italy; ⁷General Regional Hospital, Bolzano, Italy; ⁸EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ⁹Ludwig - Maximilians - Universität München, Munich, Germany; ¹⁰Center for NanoSciences, Ludwig - Maximilians - Universität München, Munich, Germany; ¹¹Zürich Irchel - Universität, Zürich, Switzerland).
- 3:00 222** *Mummies in Private Collections: Aspects of Law, Ethics, and Heritage*, **HEATHER GILL-FRERKING^{1*} and CHRISTOPHER FRERKING²** (¹Reiss-Engelhorn Museums, Mannheim, Germany; ²Attorney-at-Law and Independent Scholar, Mannheim, Germany).

A Multidisciplinary Collaboration for Tissue Analyses: The Case of Kwäday Dän Ts'inchí

KIPJ Theatre
Thursday
3:30 p.m. – 4:15 p.m.

Organizer: *María Victoria Monsalve* (Department of Pathology and Laboratory Medicine, University of British Columbia, Vancouver, BC).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

Session Chair: *María Victoria Monsalve*

- 3:30 223** *The Value of Morphological Observations of Soft Tissues of Frozen Ancient Corpses*, **MARÍA VICTORIA MONSALVE¹, ELAINE HUMPHREY², and DAVID WALKER^{1*}** (¹University of British Columbia, Vancouver, BC, Canada; ²University of Victoria, Victoria, BC, Canada).
- 3:45 224** *FTIR Spectromicroscopy Investigations of Preserved Tissue from Kwäday Dän Ts'inchí*, **LUCA QUARONI^{1*}, COLLEEN CHRISTENSEN², and MARÍA VICTORIA MONSALVE³** (¹Paul Scherrer Institut, VILLIGEN-PSI, Switzerland; ²University of Saskatchewan, Saskatoon, SK, Canada; ³University of British Columbia, Vancouver, BC, Canada).
- 4:00 225** *The identification of a Latent Tuberculosis Infection in the Ancient Kwäday Dän Ts'inchí Individual*, **TREENA SWANSTON*, HARRY DENEER, and ERNIE WALKER** (University of Saskatchewan, Saskatoon, SK, Canada).

Hair in Archaeology

KIPJ Theatre
Thursday
4:30 p.m. – 6:15 p.m.

Organizers: *Jocelyn S. Williams* (Department of Anthropology, Trent University, Peterborough, ON, Canada) and *Andrew S. Wilson* (School of Life Sciences, University of Bradford, Bradford, West Yorkshire, UK).

Program sponsored by the World Congress on Mummy Studies and the Pacific Division section on Anthropology and Archaeology.

This symposium will showcase the diversity of research using hair from archaeological contexts and explore how this research has enhanced the understanding of past populations. The chemical analysis of hair can provide information about diet, mobility, disease, stress, drug use, genetic data, season of death, and a variety of biochemical processes.

Session Co-chairs: *Jocelyn S. Williams* and *Andrew S. Wilson*

- 4:30 226** *Assessment of the State of Preservation of Archaeological Keratin Fibers – A Study of Different Analytical Approaches*, **GABRIELE WORTMANN*, ALAA**

JABUR, and FRANZ-JOSEF WORTMANN (University of Manchester, Manchester, UK).

4:45 227 *The Richest Ornament: Hair Analyses of Women from the Kellis 2 Cemetery, Dakhleh Oasis, Egypt*, **LANA J. WILLIAMS***, **TOSHA L. DUPRAS**, and **SANDRA M. WHEELER** (University of Central Florida, Orlando, FL).

5:00 228 *Life in an Extreme Environment: An Isotopic Investigation into Seasonal Resource Use in the Lower Ica Valley, Peru*, **LAUREN CADWALLADER** (University of Cambridge, Cambridge, UK).

5:15 229 *Hydrogen and Oxygen Isotope Analysis of Hair from Inca-Period Mummies: Exploring Mobility and Resource Use in Central Peru*, **JOCELYN S. WILLIAMS^{1*}**, **ANDREW S. WILSON²**, **EMMA BROWN³**, **ANDREW GLEDHILL³**, and **M. ANNE KATZENBERG⁴** (¹Trent University, Peterborough, ON, Canada; ^{2,3}University of Bradford, Bradford, West Yorkshire, UK; ⁴University of Calgary, Calgary AB, Canada).

5:30 230 *Insight into the Final Months of the Capacocha from El Plomo Using Stable Light Isotope Data*, **ANDREW S. WILSON^{1*}** and **MARIO M. CASTRO²** (¹University of Bradford, Bradford, West Yorkshire, UK; ²University of Chile, Santiago, Chile).

5:45 231 *Investigating the Use of Coca and Other Psychoactive Plants in Andean Archaeological Populations*, **EMMA BROWN***, **ANDREW S. WILSON**, **BEN STERN**, **ROB JANAWAY**, and **TIMOTHY TAYLOR** (University of Bradford, Bradford, West Yorkshire, UK).

6:00 232 *Biologic Rhythms in Ancient Hair*, **ANTONIO LANZIROTTI¹**, **MIKE SPILDE²**, **CLIFFORD QUALLS³**, **RAFFAELLA BIANUCCI^{4,5,6}**, **MARIO GIUSIANI⁴**, **VALENTINA GIUFFRÀ⁴**, **GINO FORNACIARI⁴**, **ABDUL-MEHDI ALP²**, **LARRY AGENBROAD⁷**, and **OTTO APPENZELLER^{8*}** (¹Brookhaven National Laboratory, Upton, NY; ^{2,3}University of New Mexico, Albuquerque, NM; ⁴University of Pisa, Italy; ⁵University of Turin, Italy; ⁶University of Marseilles, France; ⁷The Mammoth Site Hot Springs, South Dakota, USA; ⁸NMHEMC Research Foundation, Albuquerque, NM).

The World Congress on Mummy Studies program continues on page 21 of these Proceedings.

II. WORKSHOPS

Monday, 13 June 2011

Finding Information in Open Access Journals

Loma Hall 307
Monday
3:45 p.m. – 4:45 p.m.

Half-day workshop organized by *Amy Besnoy* (Science Librarian, Copley Library, University of San Diego, San Diego, CA; abesnoy@sandiego.edu) and *Pearl Ly* (Natural Sciences Librarian, California State University San Marcos, San Marcos, CA; ply@csusm.edu).

This half-day workshop follows the symposium, *Don't Sign Your Life Away: Author's Rights, Scientific Publishing, Digital Repositories, and the Case for Open Access*, and is a hands-on session on finding and accessing information in open access journals. Participants will learn how to utilize the Directory of Open Access Journals, Google Scholar, and PubMed to find full-text open access articles. In addition, search strategies and tips for efficient database searching will be discussed. Participants will have access to computers and will be encouraged to share topics of interest during the session.

Participation is limited to 24 individuals. Preference will be given to those who pre-registered for this event. No fee other than meeting registration.

Wednesday, 15 June 2011

Vitamin D

KIPJ Rooms E and F
Thursday
8:00 a.m. – Noon

Half-day workshop organized by *John Cannell, MD* (Executive Director, Vitamin D Council, San Louis Obispo, CA).

For the last ten years, the media has reported on hundreds of scientific studies on, what the New York Times called, “the nutrient of the decade.”

This workshop will present an overview of vitamin D with a focus on the three compelling aspects of vitamin D, influenza, autism, and athletic performance.

The manifold mysteries of influenza become less confusing when the epidemiology of vitamin D (the antibiotic vitamin according to Science News) is understood. In 2006, Dr. Cannell noticed an unusual pattern when an influenza outbreak swept through the hospital for the criminally insane where he worked. Workshop participants will review and discuss Dr. Cannell's eventual paper in *Epidemiology and Infection*.

In 2007, the Vitamin D Council's Newsletter published Dr. Cannell's detailed theory of the controlling role that vitamin D deficiency plays in the etiology of the autism epidemic, the first time anyone had connected the numerous dots. Autism experts laughed until 2009, when Scientific American published a reworked version of the same theory. Workshop participants will review and discuss Dr. Cannell's latest paper on autism and vitamin D.

Finally, workshop participants will understand the role that vitamin D plays in athletic performance. They will hear evidence that the 30-year domination of the Olympics by the East Germans and the Russians was not due to anabolic steroids but rather is related to the fact that German and Russian scientific literature of the 1950s demonstrated their understanding of the role vitamin D plays in physical performance.

No fee other than meeting registration.

Thursday, 16 June 2011

Field and Advanced Paleoimaging

Museum of Man, Balboa Park

Thursday

9:00 a.m. – 11:45 a.m.

Half-day workshop organized by *Ronald Beckett, PhD* (Professor Emeritus of Biomedical Sciences, Co-director, Bioanthropology Research Institute, Quinnipiac University, Hamden, CT; beckett@quinnipiac.edu); co-organized by *Gerald Conlogue, MHS* (Professor of Diagnostic Imaging, Co-director, Bioanthropology Research Institute, Quinnipiac University, Hamden, CT; conlogue@quinnipiac.edu).

This workshop is intended to give participants an overview of the varied methods and technologies used in paleoimaging, with a focus on field and advanced applications. The workshop will demonstrate how the participants can maximize each paleoimaging modality in the field or lab setting. Additionally, this workshop will explore advanced imaging modalities and emphasize the importance of “Diagnosis by Consensus.” Several mini-lectures will present foundational information followed by four separate rotating stations. Two stations will provide the participants with the opportunity to gain practical hands-on skills and knowledge related to field photography and endoscopy. Two additional stations will focus on interpretation of paleoimaging data with an emphasis on differential diagnoses and age at death determination using dental paleoimaging data. Participants are asked to bring in their digital cameras and slides of their research/cases for group discussion and interpretation.

The target audience for this workshop is World Congress on Mummy Studies attendees. Participation of Anthropologists, Radiologists, and students of Mummy Sciences is encouraged.

Participation is limited to 40 participants. Cost: \$20.

***Artefact Annotation – Developing
an Ontology to Help Mine Datasets***

KIPJ Room E

Thursday

11:30 a.m. – 12:30 p.m.

workshop withdrawn

III. CONTRIBUTED ORAL PRESENTATIONS

1100 (time italicized and underlined) indicates a student presentation

* indicates the speaker from among several authors listed

63 (bolded number) indicates abstract number

Sunday, 12 June 2011

World Congress on Mummy Studies Contributed Papers, Session I

KIPJ Theatre

Sunday

1:30 p.m. – 5:00 p.m.

Organizer: *Frank J. Rühli* (University of Zürich, Switzerland).

Session Chair: *Niels Lynnerup* (University of Copenhagen, Denmark)

- 1:30** **233** *Microscopic and Molecular de novo Analysis of the Iceman's Stomach Content*, **FRANK MAIXNER^{1*}**, **EDUARD EGARTER VIGL²**, **ANDREAS KELLER³**, **ANDRE FRANKE⁴**, **KLAUS OEGGL⁶**, **GIOVANNA CIPOLLINI¹**, **ANGELA GRAEFEN¹**, **PAUL GOSTNER⁵**, **DARIO PIOMBINO-MASCALI¹**, **MARCO SAMADELLI¹**, and **ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²General Hospital Bolzano, Bolzano, Italy; ³Saarland University, Homburg, Saar, Germany; ⁴Christian-Albrechts University Kiel, Kiel, Germany; ⁵Central Hospital Bolzano, Bolzano, Italy; ⁶University of Innsbruck, Sternwartestr. Innsbruck, Austria).
- 1:45** **234** *Terahertz Imaging of Ancient Mummies*, **LENA OEHRSTROEM¹**, **ANDREAS BITZER²**, **MARKUS WALTHER³**, **THOMAS BÖNI⁴**, **GIOVANNI COLACICCO⁵**, and **FRANK J. RÜHLI^{1*}** (¹University of Zürich, Switzerland; ²Albert-Ludwigs-University, Freiburg im Breisgau, Germany, ³University of Bern, Bern, Switzerland; ^{4,5}University of Zürich, Switzerland).
- 2:00** **235** *Comparative CT and MR Imaging of Ancient Mummified Tissues*, **LENA OEHRSTROEM¹**, **HENDRIK von WALDBURG¹**, **PETER SPEIER²**, **MICHAEL BOCK³**, and **FRANK J. RÜHLI^{1*}** (¹University of Zürich, Switzerland; ²Siemens Medical Solutions, Erlangen, Germany; ³German Cancer Research Centre, Heidelberg, Germany).
- 2:15** **236** *A Medieval Infant Burial from Quimper (Bretagne-France): An Example of Brain Preservation in Wetland*, **VERONIQUE GALLIEN^{1,2*}**, **CHRISTINA PAPAGEORGOPOULOU³**, **RAFFAELLA BIANUCCI^{4,5,6}**, **ANNE DIETRICH^{1,7}**, **FRANCOIS GUILLON⁸**, **KATHARINA RENTSCH⁹**, **MAANASA RAGHAVAN¹⁰**, **MARIA-INES HOFMANN¹¹**, **GIOVANNI COLACICCO¹¹**, and **FRANK J. RÜHLI¹¹** (¹INRAP, French National Institute for Preventive Archaeological Research, Le Mans, France; ²University of Nice Sophia
- Antipolis, Campus Saint-Jean-d'Angély, Nice, France; ³Zürich Irchel-Universität, Zürich, Switzerland; ⁴University of Turin, Turin, Italy; ⁵University of Marseille, Marseille, France; ⁶University of Pisa, Italy; ⁷University of Nanterre, Nanterre, France; ⁸Avicenne Hospital, Bobigny, France; ⁹University Hospital Zürich, Switzerland; ¹⁰Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; ¹¹Zürich Irchel-Universität, Zürich, Switzerland).
- 2:30** **237** *Dental Pathologies of the Iceman*, **ROGER SEILER^{1*}**, **ALBERT ZINK²**, **PAUL GOSTNER³**, **EDUARD EGARTER VIGL⁴**, and **FRANK J. RÜHLI¹** (¹University of Zürich, Switzerland; ²EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ³Central Hospital Bolzano, Bolzano, Italy; ⁴General Hospital Bolzano, Italy).
- 2:45** **238** *Evidence Based Paleopathology: Meta-analysis of PubMed-listed Scientific Studies on Pre-Columbian, South American Mummies*, **KATI DAGEFOERDE** and **FRANK J. RÜHLI^{*}** (University of Zürich, Switzerland).
- 3:00** **BREAK**
- 3:15** **239** *The Value of Ancient Mummified Tissue for Clinical Research: A Perspective*, **FRANK J. RÜHLI** (University of Zürich, Switzerland).
- 3:30** **240** *The Chehr Abad Salt Men (1,500-2,500 BP) – A Multidisciplinary International Mummy Research Project*, **FRANK J. RÜHLI^{1*}**, **AYDIN ABAR²**, **ABULFAZI AALI³**, **N. BOENKE⁴**, **DON BROTHWELL⁵**, **MARK POLLARD⁶**, **SAHAND SAEDI⁷**, and **THOMAS STÖLLNER⁸** (¹University of Zürich, Switzerland; ²Ruhr University, Bochum, Germany; ³Archaeology Museum, Zanjan, Iran; ⁴Institut für Archäologische Wissenschaften, Ruhr-Universität, Bochum; ^{5,6}University of York, UK; ⁷Abhar University, Iran; ⁸German Mining Museum and Ruhr University, Bochum).
- 3:45** **241** *Archaeogenetic and Histological Analysis of Natural Mummification under High Salt Conditions: Investigation of the Chehr Abad Salt Men (1,500-2,500 BP)*, **CHRISTINA WARINER**, **NATALIA SHVED**, **KARL LINK**, and **FRANK J. RÜHLI^{*}** (University of Zürich, Switzerland).
- 4:00** **242** *Lyuba (41,910 BP), A Baby Woolly Mammoth (Mammuthus primigenius Blumenbach, 1799): Histological Findings*, **KARL LINK**, **CHRISTINA PAPAGEORGOPOULOU**, and **FRANK J. RÜHLI^{*}** (University of Zürich, Zürich, Switzerland).

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

- 4:15 243** *CT-based Assessment of Relative Soft Tissue Alteration in Different Types of Ancient Mummy*, **CHRISTINA SYDLER, THOMAS BÖNI, ULRICH WOITEK, and FRANK J. RÜHLI*** (University of Zürich, Switzerland).
- 4:30 244** *Funeral Traditions, Premature Burial and Mummification: Advances in the “Mummies of Tamaulipas Bioarchaeological Project,”* **GUSTAVO A. RAMÍREZ CASTILLA** (Instituto Nacional de Antropología e Historia (INAH), Ciudad Victoria, Tamaulipas, México).
- 4:45 245** *A ‘Defective Mummy’ at the Museo de La Plata in Buenos Aires*, **M. BELÉN DAIZO^{2*}, HÉCTOR M. PUCCIARELLI¹, DIEGO M. SANTOS², FERNANDO ABRAMZON³, and SONIA LESYK³** (¹Museo de La Plata, Buenos Aires, Argentina; ²CEEMO Centro de Estudios del Egipto y del Mediterráneo Oriental, Ciudad Autónoma de Buenos Aires, Argentina; ³Hospital Municipal de Trauma y Emergencias Malvinas Argentinas).

The World Congress on Mummy Studies program continues on page 55 of these Proceedings.

Monday, 13 June 2011

**World Congress on Mummy Studies
Contributed Papers, Session II**

KIPJ Theatre

Monday

8:00 a.m. – 5:15 p.m.

Organizers: *Alana Cordy-Collins* (University of San Diego) and *Rose Tyson* (San Diego, CA).

Session Chair: *Teri Saffon* (San Diego Museum of Man, San Diego, CA)

- 8:00 246** *A New Use for an Old Tool: Intestinal Content ‘Histology’ in Paleopathology and Beyond*, **GUIDO P. LOMBARDI*, FRANCISCO A. TEJADA, and URIEL GARCIA-CACERES** (Universidad Peruana Cayetano Heredia, Lima, Perú).
- 8:15 247** *Sha-Amun-em-su: The Singer of Amun*, **SHEILA MENDONÇA DE SOUZA¹, ANTONIO BRANCALFON², and CLAUDIA RODRIGUES-CARVALHO²** (¹Escola Nacional de Saúde Pública/FIOCRUZ, Rio de Janeiro, Brazil; ²Museu Nacional, Rio de Janeiro, Brazil).
- 8:30 248** *The Lost Mummies of Lower Nubia*, **JENEFER A. COCKITT*, RYAN J. METCALFE, and A.R. DAVID** (University of Manchester, Manchester, UK).
- 8:45 249** *Feathered Cape, Camelid Fiber, and Cordage – Peruvian Mummies in Oslo*, **GWYN MADDEN¹, JORDAN KARSTEN^{2*}, and ROSE DREW³** (¹Grand Valley State University, Allendale, MI; ²State University of New York Albany, Albany, NY; ³University of York, Heslington, York, UK).
- 9:00 250** *The Meaning of Mummification among the Anga of the Aseki Region of Papua New Guinea: A Tradition in Transition*, **ANDREW J. NELSON¹ and RONALD G. BECKETT^{2*}** (¹The University of Western Ontario; ²Quinnipiac University, Hamden, CT).
- 9:15 251** *Scientific Exploration of the Smoked Body Mummification Practice of the Anga of Koke Village, Papua New Guinea*, **RONALD G. BECKETT^{1*} and ANDREW J. NELSON²** (¹Quinnipiac University, Hamden, CT; ²The University of Western Ontario).
- 9:30 252** *The Warrior Ways of the Anga, Trauma and Artifact Analysis*, **ANDREW J. NELSON¹ and RONALD G. BECKETT^{2*}** (¹The University of Western Ontario, London, ON, Canada; ²Quinnipiac University, Hamden, CT).
- 9:45 253** *Assessment of the Restoration of the Smoked Body of Moimango, Former Clan Leader, Warrior, and Shaman of the Anga of Koke Village, Papua New Guinea*, **RONALD G. BECKETT^{1*} and ANDREW J. NELSON²** (¹Quinnipiac University; ²The University of Western Ontario).

10:00 BREAK

10:30 254 *The Mummy Tissue Database at Manchester's KNH Centre for Biomedical Egyptology (Part I)*, **MICHAEL R. ZIMMERMAN*** and **BARBARA H. ZIMMERMAN** (Villanova University, Villanova, PA).

10:45 255 *The Mummy Tissue Database at Manchester's KNH Centre for Biomedical Egyptology, (Part II: Mummies Meet the Digital Age)*, **BARBARA H. ZIMMERMAN*** and **MICHAEL R. ZIMMERMAN** (Villanova University, Villanova, PA).

11:00 256 *The Ancient Egyptian Animal Bio Bank at the KNH Centre for Biomedical Egyptology, University of Manchester*, **LIDIJA McKNIGHT***, **A.R. DAVID**, **STEPHANIE ATHERTON**, and **CONSTANCE LORD** (University of Manchester, Manchester, UK).

11:15 257 *The Ancient Egyptian Animal Bio Bank – Preliminary Results of the Northern England Pilot Study*, **LIDIJA McKNIGHT***, **A.R. DAVID**, **STEPHANIE ATHERTON**, **CONSTANCE LORD**, and **KATHERINE CURRIE** (University of Manchester, Manchester, UK).

11:30 258 *Pathology in Sacred Bird Remains: Evidence of Sub-standard Husbandry in Ancient Egypt?* **STEPHANIE ATHERTON** (University of Manchester, Manchester, UK).

11:45 259 *IMPACT – A PACS Based Collaborative Mummy Database Project*, **ANDREW J. NELSON^{1*}**, **ANDREW D. WADE¹**, and **GREG GARVIN²** (¹The University of Western Ontario; ²London X-ray Associates).

12:15 LUNCH

Session Chair: *Tori Randall* (University of San Diego and San Diego Museum of Man, San Diego, CA)

1:30 260 *Re-thinking Anthracosis: A Critical Re-examination of a Diagnostic Trend (Case Study from a 19th Century West Virginian Mummy)*, **JULIA WOODWARD^{1*}**, **CATHERINE GAITHER¹**, **RAMONE GONZALEZ²**, **RONALD G. BECKETT²**, **GERALD J. CONLOGUE²**, **CARLYNE COOL^{3,4}**, and **STEVE GROSHONG⁴** (¹Metropolitan State College of Denver; ²Quinnipiac University; ³University of Colorado, Denver; ⁴National Jewish Health).

1:45 261 *Elmer McCurdy, Mummified "Outlaw" from Oklahoma's Wild West*, **JUDY MYERS SUCHEY** (Department of the Coroner, Los Angeles, CA).

2:00 262 *A Contextual Analysis of a Mummy from the Sierra Gorda, Querétaro Region of México, Dated 900 to 1200 BC*, **ELIZABETH MEJÍA^{1*}**, **MARTHA BENAVENTE²**, **ALEJANDRO TERRAZAS²**, and **ALBERTO HERRERA¹** (¹INAH Querétaro, Querétaro, México; ²Universidad Nacional Autónoma de México).

2:15 263 *'Thinking Makes It So': Reflections on the Ethics of Displaying Egyptian Mummies*, **JASMINE DAY** (The University of Western Australia, Perth, Australia).

2:30 264 *Cultural and Logistical Challenges in Preparing a Large Travelling Mummy Exhibition for American Museums and Science Centers*, **HEATHER GILL-FRERKING^{1*}**, **WILFRIED ROSENDAHL¹**, and **JAMES DELAY²** (¹Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany; ²American Exhibitions, Inc., Boca Raton, FL).

2:45 265 *Supernumerary Vertebrae and Other Spinal Pathology in Three 17th Century Crypt Mummies from Germany*, **HEATHER GILL-FRERKING^{1*}**, **JAMES SCHANADORE²**, and **WILFRIED ROSENDAHL¹** (¹Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany; ²North Dakota State University, Fargo, ND).

3:00 BREAK

3:30 266 *Relic, Ritual or Residue: the 'Saint Achilles' Remains at Torre de Palma, Portugal*, **MARY LUCAS POWELL¹** and **DELLA COLLINS COOK^{2*}** (¹Lexington, KY; ²Indiana University, Bloomington, IN).

3:45 267 *Tattoos and a Scar: Visible Marks and Invisible Pathology of a South American Woman from the 14th Century*, **HEATHER GILL-FRERKING***, **ANNA-MARIA BEGEROCK**, and **WILFRIED ROSENDAHL** (Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany).

4:00 268 *An Interesting and Indeterminate Disease from the Nubian Pathological Collection*, **MERVYN HARRIS** (The University of Manchester, Manchester, UK).

4:15 269 *The Ankhpkhered Mummy Project*, **SABINA MALGORA^{1*}** and **LUCA BERNARDO²** (¹Castello del Buonconsiglio di Trento, Trento, Italy; ²Fatebenefratelli and Macedorio Melloni Hospital, Milan, Italy).

4:30 270 *Teeth Used as a Tool: Evidence of Task-related Dental Modifications from an Ancient Cemetery at Saqqara, Egypt*, **IWONA KOZIERADZKA-OGUNMAKIN** (University of Manchester, Manchester, England).

4:45 271 *Hearts and Minds: Excerebration and Evisceration in the Egyptian Mummification Tradition*, **ANDREW D. WADE*** and **ANDREW J. NELSON** (University of Western Ontario).

5:00 272 *Crime and Punishment: A Reconstruction of Mortuary Practices in Nomadic Mongolia Based on the Study of Human Burials from 3,000 BP (Bronze Age) to AD 1700 (Ming Dynasty)*, **BRUNO FROHLICH¹**, **TSEND AMGALANTUGS²**, **DAVID HUNT^{1*}**, and **KRISTEN PEARLSTEIN¹** (¹National Museum of Natural History,

1100 (time italicized and underlined) identifies a student presentation

* identifies the speaker from among several authors listed

63 (bolded number) is the abstract number

abstracts contain complete contact information for authors

Smithsonian Institution, Washington DC, USA.; ²Institute of Archaeology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia).

The World Congress on Mummy Studies program continues on page 27 of these Proceedings.

**Joint Session of AAASPD Sections of
Education**

Anthropology and Archaeology

KIPJ Room 220

Monday

8:40 a.m. – Noon

Organizer for the Education Section: *William B.N. Berry* (Department of Earth and Planetary Sciences, University of California Berkeley, Berkeley, CA).

Organizer for the Anthropology and Archaeology Section: *Stephen Frost* (Department of Anthropology, University of Oregon, Eugene, OR).

Education

Session Chair: *TBA*

8:40 273 *Marine Invasive Species Assessment in San Diego Bay*, **KATHLEEN F. ESTRELLA***, **GABRIEL L. TUKE-MAN***, and **JAY S. VAVRA** (High Tech High, San Diego, CA).

9:00 274 *A Model for Empowering Young People from Urban and Diverse Backgrounds to become Tomorrow's Scientific Leaders*, **SHARA FISLER** and **LINDSAY GOODWIN*** (Ocean Discovery Institute, San Diego, CA).

9:20 275 *Initial Results from Piloting a Science Literacy Concept Inventory*, **EDWARD B. NUHFER^{1*}**, **CARL KLOOCK²**, **CHRISTOPHER B. COGAN¹**, and **GREGORY WOOD¹** (¹California State University Channel Islands, Camarillo, CA; ²California State University Bakersfield, Bakersfield, CA).

9:40 276

presentation withdrawn

10:00 BREAK

10:20 277 *Development and Implementation of a Workshop on Inclusive Teaching for Undergraduate and Graduate Teaching Assistants by Postdoctoral Scholars at UCSD*, **SANDRA L. CLEMENT***, **SAURABH JOSHI**, **SUZANNE R. LEE**, **EVAN C. MERKHOFFER**, **STEFANIE OTTO**,

MARTA VICENTE-CRESPO, and **GABRIELE WIENHAUSEN** (University of California San Diego, La Jolla, CA).

10:40 278 *On Mathematical Education: Mathematics Neither Necessary Nor Sufficient for Science*, **G. ARTHUR MIHRAM^{1*}** and **DANIELLE MIHRAM²** (¹Princeton, NJ; ²University of Southern California, Los Angeles, CA).

Anthropology and Archaeology

Session Chair: *TBA*

11:00 279 *The Seri, the Sun and the Slug: Cultural and Natural History of Berthellina ilisima (Mollusca: Opisthobranchia) from the Central Sea of Cortez*, **HANS BERTSCH^{1*}** and **CATHY MOSER MARLETT²** (¹Universidad Autónoma de Baja California, Imperial Beach, CA; ²SIL International, Tucson, AZ).

11:20 280 *Complete Fourth Metatarsal and Arches in the Foot of Australopithecus afarensis*, **JEFF MELDRUM^{1*}**, **ESTEBAN SARMIENTO²**, and **PAUL MITCHELL³** (Idaho State University, Pocatello, ID; ²Human Evolution Foundation; ³University of Pennsylvania, Philadelphia, PA).

11:40 281 *Review of the Patterson-Gimlin Film as Evidence of an Unrecognized North American Ape*, **JEFF MELDRUM^{1*}** and **BILL MUNNS²** (Idaho State University, Pocatello, ID; ²Bill Munns Creature Gallery).

**Joint Session of AAASPD Sections of
Ecology, Organismal Biology, and
Environmental Sciences**

Earth Sciences

KIPJ Room 218

Monday

8:40 a.m. – 11:40 a.m.

Organizer for the Ecology, Organismal Biology and Environmental Sciences Section: *Richard Van Buskirk* (Department of Environmental Studies, Pacific University, Forest Grove, OR).

Organizer for the Earth Sciences Section: *vacant position*.

Session Chair: *Richard Van Buskirk*

Ecology, Organismal Biology and Environmental Sciences

8:40 282 *Fungal Endophyte Growth in a Nitrogen-free Solution: Nitrogen Fixation Symbiosis May Extend Beyond Bacteria*, **RACHEL SEWELL NESTERUK^{1,2*}** and **RUSTY RODRIGUEZ²** (¹University of Washington, Seattle, WA; ²United States Geological Survey Western Fisheries Research Center, Seattle WA).

9:00 283 *A New Honey Bee Threat – the Phorid Fly* Apocephalus borealis, **ANDREW CORE^{1*}**, **CHARLES RUNCKEL²**, **JONATHAN IVERS¹**, **CHRISTOPHER QUOCK¹**, **TRAVIS SIAPNO¹**, **SERAPHINA DENAULT¹**, **BRIAN BROWN³**, **JOSEPH DERIS²**, **CHRISTOPHER D. SMITH¹**, and **JOHN HAFERNIK¹** (¹San Francisco State University, San Francisco, CA; ²University of California San Francisco, San Francisco, CA; ³Natural History Museum of Los Angeles County, Los Angeles, CA).

9:20 284 *Cutthroat Trout Phylogenetic Relationships: Geologic Processes Preserved in DNA*, **DENNIS K SHIOZAWA¹**, **PETER UNMACK**, **DEREK HOUSTON¹**, **JASON MATHIS¹**, and **R. PAUL EVANS^{*}** (Brigham Young University, Provo, UT).

9:40 BREAK

10:00 285 *Emergence Times of the Giant Clam (Genus Tridacna) in Response to Varying Degrees of Disturbance in Areas of High and Low Human Impact*, **REBECCA F. SCHWARTZ^{1*}** and **IAN TIBBETTS²** (¹University of San Diego, San Diego, CA; ²University of Queensland Australia, Brisbane, QLD).

10:20 285 *Ecological Engineering and Restoration of Six Mile Cypress Slough*, **JOHN M. MURRAY** (Southern Utah University, Cedar City, UT).

Earth Sciences

10:40 287 *Evidence for Large Scale Catastrophic Flooding in Eurasia*, **GEORGE R. DE NEEF** (Vista, CA).

**Joint Session of AAASPD Sections of
Health Sciences
Engineering, Technology, and Applied Sciences
Computer and Information Sciences**

KIPJ 219
Monday
10:00 a.m. – 11:40 a.m.

Organizer for the Health Sciences Section: *H.K. Choi* (Department of Biology, California State University Dominguez Hills, Carson, CA).

Organizer for the Engineering, Technology and Applied Sciences Section: *Frank Jacobitz* (Department of Engineering, University of San Diego, San Diego, CA).

Organizer for the Computer and Information Sciences Section: *position vacant*.

Session Chair: *H.K. Choi*

Health Sciences

10:00 288 *Cheyne-Stokes Respiration Is Caused Primarily by Cycling of Hypoxic Drive, Not CO₂ Cycling*, **WARREN G. GUNTHEROTH** (University of Washington School of Medicine, Seattle, WA).

10:20 289 *Eggsploitation in the Human Fertility Trade*, **KALA PERKINS** (Bioethics Institute, Los Angeles, CA).

Engineering, Technology and Applied Sciences

10:40 290 *Feedback Effects of Extracellular Matrix Composition on AMPK Signaling Pathway: Pathway to Novel Drug Therapeutics Targeting Atherosclerosis*, **PRASHANTHI VANDRANGI^{1*}**, **VICTOR G.J. RODGERS¹**, and **JOHN YJ SHYY²** (University of California Riverside, Riverside, CA).

Computer and Information Sciences

11:00 291 *Mapping User Search Queries to Product Categories*, **CAROLYN T. HAFERNIK** (The Pennsylvania State University, University Park, PA).

11:20 292 *How Fast Does a Continued Fraction Converge?* **C.E. FALBO** (Professor Emeritus, Sonoma State University, Rohnert Park, CA).

Tuesday, 14 June 2011

**Joint Session of Pacific Division Sections
Chemistry and Biochemistry
Cell and Molecular Biology**

KIPJ Room I
Tuesday
8:20 a.m. – Noon

Organizer for the Chemistry and Biochemistry Section: *Owen M. McDougal* (Department of Chemistry and Biochemistry, Boise State University, Boise, ID).

Organizer for the Cell and Molecular Biology Section: *Kristen Mitchell* (Department of Biology, Boise State University, Boise, ID).

Chemistry and Biochemistry

Session Chair: *Owen M. McDougal*

8:20 **293** *Predictive Potential Unraveled with DockoMatic*, **REED B. JACOB*** and **OWEN M. McDOUGAL** (Boise State University, Boise, ID).

8:40 **294** *Collagen XI $\alpha 1$ Chain Amino Propeptide Structural Model and Glycosaminoglycan Interactions in Silico*, **CHRIS MALLORY** (Boise State University, Boise, ID).

9:00 **295** *Bridging the Experimental to Computational Divide*, **OWEN M. McDOUGAL** (Boise State University, Boise, ID).

9:20 **296** *Biochemical Components Effecting Myocyte Membrane ATPase*, **DAVID BLACKMAN** (retired, UC Berkeley; current: Phoenix, OR).

9:40 **BREAK**

Cell and Molecular Biology

Session Chair: *Kristen Mitchell*

10:00 **297** *Biochemical and Biophysical Study of Functional Characteristics of Hemoglobin Components from Caspian Sea Sturgeons (*Acipenser persicus* and *Acipenser stellatus*) Blood*, **SHOHREH ARIAEENEJAD^{1*}**, **SHAHLA JAMILI^{1,2}**, **MEHRAN HABIBI-REZAEI³**, **MOHAMMAD REZA FATEMI¹**, **NAJMEH POURASAN³**, and **ALIA MOOSAVI-MOVAHEDI³** (¹Iua, Pobox, Tehran, Iran; ²Iranian Fisheries Research Organization of Iran; ³University of Tehran, Tehran, Iran).

10:20 **298** *Loss of Bacterial MTN Activity Causes Polyamine Deficiency*, **KEN CORNELL** (Boise State University, Boise, ID).

10:40 **299** *Exposure to TCDD (Dioxin) Increases Hepatic Stellate Cell Activation*, **WENDY A. HARVEY***, **COLEY J. DOOLITTLE**, **JALISA J. ROBINSON**, and **KRISTEN A. MITCHELL** (Boise State University, Boise, ID).

11:00 **300** *Expression of Multipotency Markers in Adult Adipocyte-Derived Stem Cells as a Function of Time*, **LAURINE J. SHAHMIRIAN^{1*}** and **KRISTINA I. BOSTROM²** (¹Chaminade College Preparatory High School, West Hills, CA; ²David Geffen School of Medicine, University of California Los Angeles, Los Angeles, CA).

11:20 **301** *Oncostatin M: Potential Target for Inhibiting Breast Cancer Metastasis to Bone*, **CELESTE BOLIN**, **KEN TAWARA**, and **CHERYL L. JORCYK*** (Boise State University, Boise, ID).

11:40 **302** *MicroRNA Signatures in Small Molecule Induced Cardiac and Neural Lineage-Specification Direct from Pluripotent Human Embryonic Stem Cells*, **XUEJUN H. PARSONS** (San Diego Regenerative Medicine Institute, San Diego, CA and Xcelthera, San Diego, CA).

**Joint Session of Pacific Division Sections
History and Philosophy of Science
General and Interdisciplinary Studies**

KIPJ Room G
Tuesday
8:20 a.m. – Noon

Organizer for the History and Philosophy of Science Section: *Donald J. McGraw* (Ephraim, UT).

Organizer for the General and Interdisciplinary Studies Section: *Robert L. Chianese* (Retired, California State University Northridge, Northridge, CA).

History and Philosophy of Science

Session Chair: *Donald J. McGraw*

8:20 **303** *The First Pacific Conchologist: Eusebio Kino SJ, Abalones and California's Insularity*, **HANS BERTSCH** (Universidad Autónoma de Baja California Sur, Imperial Beach, CA).

8:40 **304** *Tracing the Birth of New Science in the Literature of the 17th and 18th Centuries*, **FAYE MANKOWSKE** (University of San Diego, San Diego, CA).

9:00 **305** *Darwinian Evolution and Jack London: Dualistic Representations of Evolution and Social Darwinism in the Character of Buck*, **BERNADETTE E. SMITH** (University of San Diego, San Diego, CA).

9:20 **306** *Public Mathematics and Discrete Policy: Federal*

Administrations and Mathematics Education Reform in the 20th Century United States, **EMILY T.H. REDMAN** (University of California Berkeley, Berkeley, CA).

9:40 307 *A Measurably Sanitary Landscape: Malaria and Flooded Rice Agriculture in California's Great Central Valley*, **BARBARA YABLON MAIDA** (University of California Los Angeles, Los Angeles, CA).

10:00 BREAK

10:20 308 *Millennial Biology: The National Science Foundation and the Life Sciences, 1975-2005*, **DONALD J. MCGRAW** ("Dr. Donald J. McGraw, Independent Scholar/Contractor," Ephraim, UT).

10:40 309 *On Science: Natural Philosophy Its Basis, Analogy Its Advance*, **DANIELLE MIHRAM^{1*} and G. ARTHUR MIHRAM²** (¹University of Southern California, Los Angeles, CA; ²Princeton, NJ).

General and Interdisciplinary Studies

Session Chair: *Robert L. Chianese*

11:00 310 *Pleistocene Ecology and the Rise of Civilization*, **JEFFREY GRITZNER** (The University of Montana, Missoula, MT).

11:20 311 *Across the Divide: An Expedition into the American West*, **JOHN M. MURRAY^{1*}, WENDY V. MURRAY¹, and JOSEPH KAKAREKA²** (¹Southern Utah University, Cedar City, UT; ²Florida Gulf Coast University, Fort Myers, FL).

11:40 312 *Science and Law: A Meeting of the Minds*, **DEBORAH M. HUSSEY FREELAND** (University of San Francisco School of Law, San Francisco, CA).

***Joint Session of Pacific Division Sections
Psychology
Social, Economic and Political Sciences
Engineering, Technology and Applied Sciences***

KIPJ Room 214
Tuesday
1:40 p.m. – 4:20 p.m.

Organizer for the Psychology Section: *J. Kenneth Nishita* (California State University Monterey Bay, Seaside, CA).

Organizer for the Social, Economic and Political Sciences Section: *Carl A. Maida* (UCLA Schools of Dentistry and Medicine, University of California Los Angeles, Los Angeles, CA).

Organizer for the Engineering, Technology and Applied Sciences Section: *Frank Jacobitz* (Department of Engineering, University of San Diego, San Diego, CA).

Session Chair: *Carl A. Maida*

Psychology

1:40 313 *Heterogeneity and Transgroupness of Individual Cognitive Types*, **MAGOROH MARUYAMA** (Interactive Heterogenistics, San Diego, CA).

Social, Economic and Political Sciences

2:00 314 *Cartooning the Issues: Popular Understanding of Economic Policies, 1865-1919*, **MARK ALDRICH** (Smith College, Northampton MA).

2:20 315 *Ethiopia's Planned Gibe III Hydrodam: Dismantling Pastoral Survival Systems, Armed Conflict and Political Destabilization in the Kenya-Ethiopia-Sudan Border Region*, **CLAUDIA J. CARR** (University of California Berkeley, Berkeley, CA).

2:40 316 *Neoclassical Theory of the Fully Temporal System Yielding Completed Input/Output Substitution*, **THOMAS E. CHAMBERLAIN** (Independent Researcher, Los Angeles, CA).

3:00 317 *The Science of Laws: Data Base of Cause and Effect Reports*, **DAVID G. SCHRUNK^{1*} and GARY B. SANER²** (¹Quality of Laws Institute, Poway, CA; ²Primero Systems, San Diego, CA).

3:20 BREAK

Engineering, Technology and Applied Sciences

3:40 318 *Multidisciplinary Engineering Approach to the Design of Laws*, **DAVID G. SCHRUNK** (Quality of Laws Institute, Poway, CA).

4:00 319 *Prospective versus Retrospective View of Engineering Design –Testing the Engineering Design Process Through Litigation*, **MICHAEL S. MORSE** (University of San Diego, San Diego, CA).

Thursday, 16 June 2011

***World Congress on Mummy Studies
Contributed Papers, Session III***

KIPJ Rooms A and B

Thursday

11:30 a.m. – 12:30 p.m.

Organizers: *Alana Cordy-Collins* (University of San Diego) and *Rose Tyson* (San Diego, CA).

Session Chair: *Ryan Metcalfe* (University of Manchester, Manchester, UK)

11:30 320 *Development of a Nubian Pathological Ontology*, **RYAN METCALFE** (University of Manchester, Manchester, UK).

11:45 321 *Re-thinking Burial Dates at a Graeco-Roman Cemetery (Fag el Gamous, Fayoum, Egypt)*, **DAVID M. WHITCHURCH*** and **R. PAUL EVANS** (Brigham Young University, Provo, UT).

12:00 322 *The Alleged Bog Body or the Identification of a South American Mummy via Multi-element Isotope Analyses*, **SANDRA LOESCH¹**, **CHRISTINE LEHN²**, **ULRICH STRUCK³**, **PETER HORN⁴**, **STEFAN HÖLZL⁴**, **OLIVER PESCHEL²**, **ANDREAS NERLICH⁵**, and **BRIGITTE HAAS-GEBHARD⁶** (¹Bern University, Bern, Switzerland; ²University of Munich, Munich, Germany; ³Humboldt University of Berlin, Berlin, Germany; ⁴Bavarian State Collection of Palaeontology and Geology, Munich, Germany; ⁵Municipal Clinic Bogenhausen, Munich, Germany; ⁶Bavarian State Archaeological Collection and Museum, Munich, Germany).

12:15 323 *Hand-Schueller-Christian's Disease in an Ancient Egyptian Mummy; X-ray, CT and MR Analysis*, **MISLAV CAVKA^{1,2}**, **GORDANA IVANAC^{1,2}**, **LEJLA AGANOVIC^{3,*}**, **GERT REITER⁴**, **SONIA NIELLES-VALLESPIN⁵**, **PETER SPEIER⁵**, **IVOR JANKOVIC⁶**, **IGOR URANIC⁷**, and **BORIS BRKLJACIC^{1,2}** (¹University Department for Diagnostic and Interventional Radiology in University Hospital "Dubrava", Zagreb, Croatia; ²University of Zagreb Medical School, Zagreb, Croatia; ³University of California San Diego, San Diego, CA; ⁴Siemens AG Healthcare, Erlangen, Germany; ⁵Siemens AG Healthcare, Graz, Austria; ⁶Institute for Anthropological Research, Zagreb, Croatia; ⁷Archeological Museum Zagreb, Zagreb, Croatia).

IV. CONTRIBUTED POSTER PRESENTATIONS

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

Boards on which to attach poster presentations will be set up in KIPJ Rooms C and D. 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 board for your poster.

World Congress of Mummy Studies Posters: Posters are to be set up Sunday morning for viewing all day. All posters must be removed by 11:00 a.m. Monday. All presenters are expected to be at their posters from 5:30 p.m. to 6:30 p.m. Sunday to allow attendees the opportunity to discuss results with presenters. *Students should expect two judges to review their presentations. Judging may extend beyond 6:30 p.m.*

AAASPD Posters: Posters can be set up beginning at 11:00 a.m. Monday. All set up should be finished at least 10 minutes prior to noon, the start of the session. All presenters must be present with their posters for at least two hours during the poster session in order to discuss their work. *Students must be present with their posters from at least noon to 2:00 p.m. in order to give judges the opportunity to review and discuss their work with them.* No posters are to be removed before 4:00 p.m., the end of the session. All posters must be removed no later than 8:00 p.m. that evening.

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

Quick Directory of Sponsoring Sections/Societies and Their Posters

<u>Section or Society</u>	<u>poster numbers</u>
World Congress on Mummy Studies	324 – 363
Agriculture and Horticultural Sciences Section	372 – 373
Anthropology and Archaeology Section	381 – 382
Atmospheric and Oceanographic Sciences Section	377 – 378
Cell and Molecular Biology Section	388 – 393
Computer and Information Sciences Section	370 – 371
Earth Sciences Section	374
Ecology, Organismal Biology and Environmental Sciences Section	379 – 380
Education Section	375 – 376
Health Sciences Section	364 – 368
Oral Biology and Dental Medicine Section	383 – 387
Social, Economic and Political Sciences Section	369

Sunday, 12 June 2011

POSTER SESSION I **World Congress on Mummy Studies**

KIPJ Rooms C and D

Sunday

5:30 p.m. – 6:30 p.m.

324 *The Bioarchaeology of Activity and Labour Under Inka Occupation: A Regional Analysis of Provincial Burials from Lima, Peru*, **TRISHA M. BIERS¹* and **GUILLERMO A. COCK CARRASCO²** (¹University of Cambridge, Cambridge, United Kingdom; ²ConsultPatCu E.I.R.L., Lima Peru).**

325 *Residential Mobility and Stress in Nasca, Peru: New Insights from Cortisol and Isotopic Analyses of Archaeological Hair*, **EMILY WEBB***, **CHRISTINE WHITE**, **STAN VAN UUM**, and **FRED LONGSTAFFE** (The University of Western Ontario, London, Ontario, Canada).

326 *Labor, Gender, and Identity: Bioarchaeological Activity Patterns in Mummified and Skeletonized Individuals from the Tiwanaku State (AD 500-1000)*, **SARA K. BECKER** (University of North Carolina, Chapel Hill, NC).

327 *Dress, Death, and Identity in Moquegua Tiwanaku: Textile Evidence from the Rio Muerto Mummies, Moquegua, Peru*, **ELIZABETH M. PLUNGER*** and **PAUL S. GOLDSTEIN** (University of California San Diego, La Jolla, CA).

328 *Unwrapping Tiwanaku Diet: Carbon and Nitrogen Isotope Data from the Mummies of Rio Muerto, Moquegua, Peru*, **ANDREW D. SOMERVILLE***, **PAUL S. GOLDSTEIN**, **SARAH I. BAITZEL**, **MARGARET J. SCHOENINGER**, **SARAH RAUBENHEIMER**, and **LINDA YZURDIGA** (University of California San Diego, La Jolla, CA).

329 *Investigating the Use of Coca and Other Psychoactive Plants in Andean Archaeological Populations*, **EMMA BROWN***, **ANDREW S. WILSON**, **BEN STERN**, **ROB JANAWAY**, and **TIMOTHY TAYLOR** (University of Bradford, Bradford, West Yorkshire, United Kingdom).

330 *Life in an Extreme Environment: An Isotopic Investigation into Seasonal Resource Use in the Lower Ica Valley, Peru*, **LAUREN CADWALLADER** (University of Cambridge, Cambridge, UK).

331 *Archaeohelminthology of the Chiribaya Shepherd, *Canis familiaris*, (AD 700-1476) from Southern Peru*, **DENNIS J. RICHARDSON¹**, **SONIA GUILLÉN²**, **RONALD G. BECKETT¹**, **WESLEY KYLE¹**, **GERALD J. CONLOGUE¹***, and **KATHERINE HARPER-BECKETT¹** (¹Quinnipiac University, Hamden, CT; ²Centro Mallqui, Ilo, Peru).

332 *Preliminary Results of the Histological Study of Ancient Skin Tissue Samples from the Chinchorro Mummies*, **BRUNO DORE¹***, **BERNARDO ARIAZA²**, **ROSA BOANO¹**, and **EMMA RABINO MASSA¹** (¹University of Turin, Torino,

189 poster number is also the abstract number

abstracts contain complete contact information for authors

193 (number italicized and underlined) identifies a student presentation

*identifies the presenter from among several authors listed

Italy; ²Instituto de Alta Investigación and Universidad de Tarapaca, Arica, Chile).

333 *Shrinking Misconceptions: A Neutral Perspective on Shuar Tsantsas*, **CHEYENNE MCCARTHY*** and **BENJAMIN KOOBA** (University of San Diego, San Diego, CA).

334 *Historical Context of Tsantsa*, **TOBIAS HOULTON** (University of Dundee, Scotland).

335 *Facial Analysis of a Tsantsa: A Shrunken Head from the Shuar Tribes of South America*, **TOBIAS HOULTON** (University of Dundee, Scotland).

336 *Facial Reconstruction of an Anga Mummy*, **ANDREW J. NELSON¹**, **VICTORIA LYWOOD²**, and **RONALD G. BECKETT^{3*}** (¹The University of Western Ontario, London, ON, Canada; ²John Abbott College, Sainte-Anne-de-Bellevue, Québec, Canada; ³Quinnipiac University, Hamden, Connecticut).

337 *Analysis of an Offering of Cultural Materials Associated with Partially Mummified Remains from Sierra Gorda, Querétaro, México*, **ELIZABETH MEJÍA^{1*}**, **AURORA MONTUFAR²**, and **ALBERTO HERRERA¹** (¹INAH Querétaro, Querétaro, Qro., México; ²INAH, Laboratorios y Apoyo Académico).

338 *Haida Mummy Rediscovered*, **GWYN MADDEN** (Grand Valley State University, Allendale, MI).

339 *The German Mummy Project*, **HEATHER GILL-FRERKING***, **ANNA-MARIA BEGEROCK**, and **WILFRIED ROSENDAHL** (Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany).

340 *Standardizing Recording Forms for Mummy Studies*, **HEATHER GILL-FRERKING***, **ANNA-MARIA BEGEROCK**, and **WILFRIED ROSENDAHL** (Museum Weltkulturen, Reiss-Engelhorn Museums, Mannheim, Germany).

341 *X-ray Imaging and its Impact on Ancient DNA: A Monte Carlo-based Simulation*, **JOHANN WANEK¹**, **LIZ PARVIN²**, and **FRANK J. RÜHLI^{1*}** (¹University of Zürich, Switzerland; ²Open University, United Kingdom).

342 *The North American Mummy Database; An Interdisciplinary Online Resource*, **S.J. WOLFE** (American Antiquarian Society, Worcester, MA).

343 *New Findings on a Roman-period Egyptian Mummy at the University of Illinois*, **SARAH U. WISSEMAN^{1*}** and **DAVID R. HUNT²** (¹Illinois State Archaeological Survey, University of Illinois, Champaign IL; ²National Museum of Natural History, Washington, D.C.).

344 *Mummified Baboons, Stable Isotopes, and the Location of Punt*, **GILLIAN L. MORITZ^{1*}**, **GILLIAN A. O. BRITTON^{2*}**, **SALIMA IKRAM³**, and **NATHANIEL J.**

DOMINY⁴ (^{1,2,4}Dartmouth College, Hanover, NH; ³American University in Cairo, New Cairo, Egypt).

345 *Backroom Treasures: CT Scanning of Two Ibis Mummies from the Peabody Museum Collection*, **ANDREW D. WADE^{1*}**, **SALIMA IKRAM²**, **GERALD J. CONLOGUE³**, **RONALD G. BECKETT³**, **ANDREW J. NELSON¹**, and **ROGER COLTEN⁴** (¹University of Western Ontario; ²American University in Cairo; ³Quinnipiac University; ⁴Peabody Museum of Natural History).

346 *Interpreting the Life of the Carlos Museum's Old Kingdom Mummy*, **MONIQUE OSIGBEME***, **CHENERE PIERCE RAMSEY**, **MALU TANSEY**, **JOSHUA ROBINSON**, **JOHN KINGSTON**, and **ARRI EISEN** (Emory University, Atlanta, GA).

347 *Evidence of Trepanation in a 26th Dynasty Mummy from Akhmim, Egypt*, **JONATHAN P. ELIAS^{1*}**, **CARTER LUPTON²**, and **ROBERT D. HOPPA³** (¹Akhmim Mummy Studies Consortium, Carlisle, PA; ²Milwaukee Public Museum, Milwaukee, WI; ³University of Manitoba, Manitoba, Canada).

348 *The Weird and the Wonderful – The Scientific Study of a Miniature Mummy*, **LIDIJA MCKNIGHT***, **NATALIE MCCREESH**, and **ANDY GIZE** (University of Manchester, Manchester, UK).

349 *DNA, EDAX, and Radiocarbon Analysis of Burials and Textiles from the BYU Excavation of the Fag el Gamous Cemetery in Fayoum, Egypt*, **ADDISON ALLEY***, **CHRISTOPHER EPPICH***, **MATTHEW BIGGS**, **GARRETT MULLINS**, **CARTER NEWEWY**, **DAVID M. WHITCHURCH**, **RICHARD HECKMANN**, and **R. PAUL EVANS** (Brigham Young University, Provo, UT).

350 *Rethinking Burial Dates at a Graeco-Roman Cemetery (Fag el Gamous, Fayoum, Egypt)*, **DAVID M. WHITCHURCH*** and **R. PAUL EVANS** (Brigham Young University, Provo, UT).

351 *Parasitology of the Piraino 1 Mummy, Sicily, Italy*, **KELSEY J. KUMM^{1*}**, **KARL J. REINHARD²**, **DARIO PIOMBINO-MASCALI³**, **ADAUTO ARAÚJO⁴**, and **SCOTT L. GARDNER⁵** (^{1,2,5}University of Nebraska-Lincoln, Lincoln, NE; ³Istituto per le Mummie e l'Iceman, EURAC, Bolzano, Italy; ⁴Escola Nacional de Saúde Pública, Rio de Janeiro, Brazil).

352 *Forensic Palynological Analysis of Piraino 1, Sicily, Italy: Diet, Medicine, and Season of Death*, **MELISSA LEIN^{1*}**, **DARIO PIOMBINO-MASCALI²**, and **KARL J. REINHARD³** (^{1,3}University of Nebraska-Lincoln, Lincoln, NE; ²Istituto per le Mummie e l'Iceman, EURAC, Bolzano, Italy).

353 *Macrofossils, Microfossils and Dietary Interpretations for Piraino 1, Sicily*, **SARA LEROY-TOREN^{1*}**, **DARIO PIOMBINO-MASCALI²**, and **KARL J. REINHARD³**

(¹Lincoln Public Schools Science Focus Program, Lincoln, NE; ²Istituto per le Mummie e l'Iceman, EURAC, Bolzano, Italy; ³University of Nebraska – Lincoln, Lincoln, NE).

- 354** *Forensic Palynological Analysis of Intestinal Contents of a Korean Mummy*, **PAULETTE ARGUELLES^{1*}**, **KARL J. REINHARD²**, and **DONG HOON SHIN³** (^{1,2}University of Nebraska-Lincoln, Lincoln, NE; ³Seoul National University, College of Medicine, Seoul, South Korea).
- 355** *Parasitism of the Zweeloo Woman Bog Body with Overview of Bog Body Helminths*, **NICOLE SEARCHEY^{1*}**, **KARL J. REINHARD²**, **SCOTT L. GARDNER³**, **DON BROTHWELL⁴**, **WIJNAND VAN DER SANDEN⁵**, **FRANK MAIXNER⁶**, **DARIO PIOMBINO-MASCALI^{7,8}**, **ALBERT ZINK⁶**, and **RAFFAELLA BIANUCCI^{7,8}** (^{1,2,3}University of Nebraska-Lincoln, Lincoln, NE 68588; ⁴University of York, York, United Kingdom; ⁵Drents Plateau, Assen, The Netherlands; ⁶EURAC- Institute for Mummies and the Iceman, Bolzano, Italy; ⁷University of Turin, Turin, Italy; ⁸University of Marseilles, Marseilles, France).
- 356** *Microfossil Analysis of the Zweeloo Woman Bog Body*, **KARL J. REINHARD^{1*}**, **DON BROTHWELL²**, **WIJNAND VAN DER SANDEN³**, **FRANK MAIXNER⁴**, **DARIO PIOMBINO-MASCALI⁴**, **ALBERT ZINK⁴**, and **RAFFAELLA BIANUCCI^{5,6}** (¹University of Nebraska – Lincoln, Lincoln, NE; ²University of York, York, United Kingdom; ³Drents Plateau, Assen, The Netherlands; ⁴EURAC- Institute for Mummies and the Iceman, Bolzano, Italy; ⁵University of Turin, Turin, Italy; ⁶University of Marseilles, Marseilles, France).
- 357** *Hounsfield Units Ranges in CT-scans of Bog Bodies and Mummies*, **CHIARA VILLA** and **NIELS LYNNERUP*** (University of Copenhagen, Denmark).
- 358** *Taphonomic Studies on the Joseon Mummies in Korea*, **CHANG SEOK OH^{1,2*}**, **MYEUNG JU KIM³**, and **DONG HOON SHIN^{1,2}** (^{1,2}Seoul National University College of Medicine, Seoul, Korea; ³Dankook University College of Medicine, Cheonan, Korea).
- 359** *Examples of Paleopathological Studies on Korean Mummies*, **MYEUNG JU KIM^{1*}**, **YI-SUK KIM²**, **CHANG SEOK OH^{3,4}**, **JAI-HYANG GO⁵**, **IN SUN LEE⁶**, and **DONG HOON SHIN^{3,4}** (^{1,3}Dankook University College of Medicine, Cheonan, Korea; ²Ewha Womans University School of Medicine, Seoul, Korea; ⁴Institute of Forensic Medicine, Seoul, Korea; ⁵Seoul National University College of Medicine, Seoul, Korea).
- 360** *Leishmaniasis in 15th Century Italian Nobles and Mercury Treatment*, **ANTONIO LANZIROTTI¹**, **RAFFAELLA BIANUCCI^{2,3,4}**, **CLIFFORD QUALLS⁵**, **EZIO FERROGLIO⁶**, **ANDREAS G. NERLICH⁷**, **VALENTINA GIUFFRÀ⁴**, **GINO FORNACIARI⁴**, and **OTTO APPENZELLER^{8*}** (¹Brookhaven National Laboratory, Upton, NY, USA; ²University of Turin, Italy; ³University of Marseilles, France; ⁴University of Pisa, Italy; ⁵University of New Mexico, Albuquerque, NM, USA; ⁶University of Turin, Italy; ⁷Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ⁸NMHEMC Research Foundation, Albuquerque, NM, USA).
- 361** *Rethinking Anthracosis: A Critical Re-examination of a Diagnostic Trend, (Case Study from a 19th Century West Virginian Mummy)*, **JULIA WOODWARD^{1*}**, **CATHERINE GAITHER¹**, **RAMONE GONZALEZ²**, **RONALD G. BECKETT²**, **GERALD J. CONLOGUE²**, **CARLYNE COOL^{3,4}**, and **STEVE GROSHONG⁴** (¹Metropolitan State College of Denver, Denver, CO; ²Quinnipiac University, Hamden, CT; ³University of Colorado, Denver, CO; ⁴National Jewish Health; jhwoodw@yahoo.co.uk).
- 362** *Dental Morphology of a Juvenile Mummy from the Shelton Expedition: Observations and Measurements Made from CT Scans and Stereolithography*, **HEATHER EDGAR^{1*}** and **SHARA BAILEY²** (¹University of New Mexico, Albuquerque, NM; ²New York University, New York, NY).
- 363** *Preliminary Analysis by FTIR Spectroscopy of Ancient Egyptian Embalmed Heads from the Museum of Anthropology and Ethnography of the University of Turin, Italy*, **MARIA GRAZIA BRIDELLI¹**, **ALIDA DELL'ANNA¹**, **ROSA BOANO^{2*}**, and **SERGIA DE IASIO¹** (¹University of Parma, Italy; ²University of Turin, Italy).

The World Congress on Mummy Studies program continues on page 48 of these Proceedings.

Monday, 13 June 2011

**POSTER SESSION II
AAAS, Pacific Division**

KIPJ Rooms C and D

Monday

NOON – 4:00 PM

IMPORTANT NOTE: Please pay close attention to the instructions for poster presenters on page 55 of these *Proceedings*.

HEALTH SCIENCES

- 364** *Association of Marijuana Use and Active Caries in a National Probability Sample*, **MONIQUE R. BELIN***, **EUGENIO AQUINO***, **YAN WANG**, **HONGHU LIU**, and **MARVIN MARCUS** (California Endowment Pipeline Program, UCLA School of Dentistry, Los Angeles, CA).
- 365** *Vitamin D Deficiency in Humans Associates with Delayed P300 Latency and Reduced Voltage Predicting Cognitive Decline*, **ERIC R. BRAVERMAN¹**, **KENNETH BLUM^{2,3*}**, **KENNETH PERRINE¹**, and **UMA J. DAMLE²** (¹Weill Cornell College of Medicine, New York, NY; ²Path Foundation NY, New York, NY; ³University of Florida, Gainesville, FL).
- 366** *Relationship Between Adiposity and Physical Function in Older Adults*, **ANPALAKI J. RAGAVAN** (University of Nevada, Reno, NV).
- 367** *Role of Muscle Mass in Weight Loss Among Obese Women*, **ANPALAKI J. RAGAVAN** (University of Nevada, Reno, NV).
- 368** *Frequency of Pregnancies and Long-Term Effects of Periodontal Disease in a National Probability Sample*, **LOLIYA BOB-MANUEL***, **MARISOL CEBALLOS***, **JOSE M. RODRIGUEZ***, **YAN WANG**, **HONGHU LIU**, and **MARVIN MARCUS** (California Endowment Pipeline Program, UCLA School of Dentistry, Los Angeles, CA).

SOCIAL, ECONOMIC and POLITICAL SCIENCES

- 369** *How to Live to Be 100: Utah Centenarians in Their Own Words*, **THOMAS W. DRAPER*** and **ELENA OLIVER** (Brigham Young University, Provo, UT).

COMPUTER AND INFORMATION SCIENCES

- 370** *Quadcopter Aerial Monocular Vision for Improved Autonomous Robot Navigation*, **KENNY LEI** (Walnut High School, Walnut, CA).
- 371** *An Algorithm to Determine Protein Structure Using Secondary and Tertiary Structure Prediction*, **VIKRAM SUNDAR** (The Harker School, San Jose, CA).

AGRICULTURE and HORTICULTURAL SCIENCE

- 372** *Non-Cytotoxicity of Novel Antifungal Aminoglycosides in Mammalian Cells*, **SANJIB SHRESTHA^{1,3*}**, **CHENGWEI TOM CHANG^{2,3}**, **MARINA FOSSO²**, **YUKIE KAWASAKI¹**, **MICHELLE GRILLEY¹**, and **JON Y. TAKEMOTO^{1,3}** (^{1,2}Utah State University, Logan, UT; ³Synthetic Biomanufacturing Center (USTAR), Utah State University, Logan, UT).
- 373** *Scalable Production of Syringomycin E as an Organic Compatible Agrifungicide*, **YUKIE KAWASAKI***, **MICHELLE GRILLEY**, and **JON TAKEMOTO** (Utah State University, Logan, UT).

EARTH SCIENCES

- 374** *Modeling the Climate Effects of 21st Century Global Warming on Selected Ski Resorts in Western Canada*, **MICHAEL PIDWIRNY** (University of British Columbia, Kelowna, British Columbia, Canada).

EDUCATION (SCIENCE and TECHNOLOGY)

- 375** *Mosquito Biodiversity in San Diego: Human and Environmental Health Concerns*, **AMALIA R. BERSIN***, **LILIA GALVEZ***, and **JAY S. VAVRA** (High Tech High, San Diego, CA).
- 376** *Development and Implementation of a Workshop on Inclusive Teaching for Undergraduate and Graduate Teaching Assistants by Postdoctoral Scholars at UCSD*, **SANDRA L. CLEMENT***, **SAURABH JOSHI**, **SUZANNE R. LEE**, **EVAN C. MERKHOFFER**, **STEFANIE OTTO**, **MARTA VICENTE-CRESPO**, and **GABRIELE WIENHAUSEN** (University of California San Diego, La Jolla, CA).

ATMOSPHERIC and OCEANOGRAPHIC SCIENCES

- 377** *Analysis of Climate and Tree Growth over the Last 1000 Years Using Tree Rings from the Qinghai-Tibetan Plateau*, **ARMAND ANSELMO*** and **ZHI-YONG YIN** (University of San Diego, San Diego, CA).
- 378** *The Bioclastic Composition of Carbonate Sediments in Hurricane Hole and other Coral Reef Environments, St. John, USVI*, **CASEY CHAPMAN*** and **SARAH GRAY** (University of San Diego, San Diego, CA).

ECOLOGY, ORGANISMAL BIOLOGY and ENVIRONMENTAL SCIENCES

- 379** *Scrubbing the Air: Reducing Carbon Dioxide Levels with *Frageria californica*, *Galvezia speciosa*, *Heteromeles argutifolia*, and *Salvia clevelandii**, **CAROLINE FROST** (Chaminade College Preparatory School, Los Angeles, CA and Loyola Marymount University, Los Angeles, CA).

380 *Examination of Physiological and Behavioral Effects on White Seabass *Atractoscion nobilis* in a Closed Recirculating System*, **SAMUEL M. HOLLEY** (Huntington Beach High School, Huntington Beach, CA).

ANTHROPOLOGY and ARCHAEOLOGY

381 *Analysis of Hair Attributed to an Unidentified Species of Primate*, **KYLE GRAGG, JEFF MELDRUM***, and **HENNER FAHRENBACH** (Idaho State University, Pocatello, ID).

382 *Incomplete Lumbar Spine and Its Applications in the Estimation of Sex*, **MARIA JELACA-TAVAKOLI*** and **MARY E. LEWIS**² (¹Southwestern College, Chula Vista, CA; ²University of Reading, Reading, United Kingdom).

ORAL BIOLOGY and DENTAL MEDICINE

383 *Developing a Rat Model of Facial Inflammation*, **CHARDONNAY WARD***, **YATENDRA MULPURI**, and **IGOR SPIGELMAN** (Howard Hughes Medical Institute Pre-College Science Education Program, UCLA School of Dentistry, Los Angeles, CA).

384 *Chronic Inflammation and Epigenetic Gene Regulation in Oral Keratinocytes*, **REBECCA UDOKOP*** and **KI-HYUK SHIN** (Howard Hughes Medical Institute Pre-College Science Education Program and the UCLA School of Dentistry, Los Angeles, CA).

385 *UBC9 Expression in Oral Cancerous Cells*, **BERENICE FLORES***, **MICHELLE PICENO***, **CHENXI SONG**, **MIN ZHANG**, and **SHEN HU** (Howard Hughes Medical Institute Pre-College Science Education Program and the UCLA School of Dentistry, Los Angeles, CA).

386 *Susceptibility of Oral Cancer Stem Cells to NK Cell Death versus their Differentiated Counterparts*, **CAMILLE BROWN***, **CANDY MACIAS***, **HELEN TSENG**, **CAITLIN LANZON**, and **ANAHID JEWETT** (Howard Hughes Medical Institute Pre-College Science Education Program and The Weintraub Center for Reconstructive Biotechnology, UCLA School of Dentistry, Los Angeles, CA).

387 *Combined Effects of TGF-beta1 and TNF-alpha on Dental Pulp Stem Cell Differentiation*, **XAVIER BROOKS***, **ESMERALDA ALVAREZ***, **JU EUN OH**, **SHEBLI MEHRAZARIN**, **SUSAN BAE**, and **MO KANG** (Howard Hughes Medical Institute Pre-College Science Education Program and the UCLA School of Dentistry, Los Angeles, CA).

CELL and MOLECULAR BIOLOGY

388 *The Effect of Ginkgo biloba on the Mouse Hippocampus*, **ALEXA ARANJO** (Chadwick School, Palos Verdes Peninsula, CA and University of Southern California, Los Angeles, CA).

389 *Identifying Myostatin in Yellowtail (*Seriola lalandi*) using Degenerate PCR*, **ALYSSA BERNARDI*** and **MARY SUE LOWERY** (University of San Diego, San Diego, CA).

390 *The Effects of Exercise on the Expression of Insulin-like Growth Factor in Juvenile Yellowtail*, **SARAH JONES*** and **MARY SUE LOWERY** (University of San Diego, San Diego, CA).

391 *Identification of a Second Site Suppressor of *cdc24* in *Schizosaccharomyces pombe**, **SHANI M.C. CHAPMAN*** and **SALLY G. PASION** (San Francisco State University, San Francisco, CA).

392 *Ah Receptor Interacts with Activated Stat1 to Promote Cell Proliferation*, **CHERI L. LAMB***, **BRIAN ELLSWORTH**, and **KRISTEN A. MITCHELL** (Boise State University, Boise, ID).

393 *Effects of the *Orai1* Gene on the Skull Formation*, **AYANA USSERY**^{1*}, **ROSA NAPOLES**¹, **HYE-WON CHOI**², and **JEANNE NERVINA**³ (^{1,2}Howard Hughes Medical Institute Pre-College Science Education Program and the UCLA School of Dentistry, Los Angeles, CA; ³University of Michigan School of Dentistry, Ann Arbor, MI).

ABSTRACTS

Abstracts are grouped by program.

Not all presenters submitted an abstract.

Except for editing of titles, authors and affiliations for consistency, abstracts have not been edited to any degree for grammar or content and are presented as submitted by the authors.

PLENARY LECTURES

Sunday Evening Public Lecture Sunday, 7:00 p.m. in KIPJ Theatre

1 *NeuroEngineering: Evolution of Biopsychosocial Networks in Humans*, **ICHIRO NISHIMURA** (Professor and Director, The Weintraub Center for Reconstructive Biotechnology, UCLA School of Dentistry; inishimura@dentistry.ucla.edu).

The mission of UCLA Weintraub Center is to sustain the quality of life of our patients who suffer from facial defects and dysfunction. What are the functions of the human face? In “The Expression of Emotions in Man and Animals” published in 1872, Charles Darwin proposed that the innate facial expression was universal among all human races and obtained through our evolutionary process. Emotional experiences in the brain immediately activate neuro-muscular networks, resulting in the delicate modulation of smooth muscles of vasculature and intestinal systems and arrector pili of hair follicles, as well as skeletal muscles of shoulders, arms and legs. However, the most significant emotional influence may be projected to the facial muscles, resulting in the recognizable changes in facial form. The facial expression of emotions plays the most significant role in non-verbal communication.

Various disorders affect the central or peripheral nervous systems and interfere with the ability to control facial expression. As a result, these patients are isolated from social networks. It has been noted in many cases that innate and voluntary facial expressions are differentially affected, suggesting that the voluntary control of facial expression is regulated through a separate mechanism. In fact, a large part of social communication today may be achieved by the voluntary facial expression, which is considered unique to humans and thus may be acquired through evolutionary development of the neuro-muscular system of the face.

The therapeutic use of both innate and voluntary facial expressions may provide a clue in addressing the ill-fated biopsychosocial network of our patients. In order to engineer the lost smile, a concept of NeuroEngineering is currently being developed.

Monday Noon Public Lecture Monday, 12:15 p.m. in KIPJ Theatre

2 *Journeying Through Stressed Urban Systems*, **H.J.S. FERNANDO** (Environmental Fluid Dynamics Laboratories, Departments of Civil Engineering and Geological Sciences and Aerospace and Mechanical Engineering, University of Notre Dame, Notre Dame, IN 46530; Fernando.10@nd.edu).

The Earth system is maintained in a stable climatic state by a

myriad of forcing, responses and feedbacks. While the components of Earth system have ability to absorb disturbances while maintaining essential functions and structure (resilience), beyond certain thresholds either the entire system, its components or building blocks thereof may shift to entirely different functionalities. While little control is possible on natural (external) disturbances, humans have the ability to minimize their own environmental stressors via sound planning, designs and management so that (human-centric) urban systems can be developed and maintained in sustainable manner. This presentation concerns some recent catastrophic failures of urban ecosystems during natural disasters due to environmentally incongruous engineering designs (e.g., Hurricane Katrina) or poor regulatory enforcement (e.g., Sumatra Tsunami). Lessons learnt from such studies can be incorporated into future sustainable urban-systems designs.

Monday Evening Public Lecture Monday, 7:00 p.m. in KIPJ Theatre

3 *Multi-disciplinary Approach to the Study of Human Remains*, **DAVID R. HUNT** (Physical/Forensic Anthropologist and Collections Manager, Physical Anthropology Division, Department of Anthropology, National Museum of Natural History, Washington, D.C.; hunt@si.edu).

Comprehensive, in-depth study of human remains, especially desiccated and mummified bodies requires a broad spectrum of knowledge. With advances in techniques and methods of research, no one person can adequately conduct all the analytical procedures which should be employed. It is essential to assemble a team of specialists and experts in their particular areas of research to effectively investigate the remains, associating artifacts and the relating provenance.

A multidisciplinary study of a preserved body from a 19th Century Iron Coffin recovered in Washington, DC will be presented and used as the foundation to discuss other mummy projects which have incorporated a diverse panel of specialists and experts from various disciplines. This methodology resulted in a greater understanding about the life, death and cultural context of the individual. If we choose to risk damage to our irreplaceable artifacts of the past, it is then our responsibility to be rigorous, thorough and employ the best practices in research.

Tuesday Pre-Noon Lecture World Congress on Mummy Studies Invited Lecture Tuesday, 11:45 p.m. in KIPJ Theatre

4 *The Lanzarote and Fuerteventura Prehispanic Population, Canary Islands, Spain*, **CONRADO RODRÍGUEZ MARTÍN^{1*}, PABLO ATOCHE², and ANGELES RAMÍREZ²** (¹Instituto

Canario de Bioantropología (OAMC-Cabildo de Tenerife); ²Universidad de Las Palmas de Gran Canaria; crodriguez@museosde-tenerife.org).

This paper is devoted to the physical anthropological characteristics and pathological features of the protohistoric (Prehispanic) populations of Lanzarote and Fuerteventura, both belonging to the Canarian Archipelago (Spain), located in the Atlantoic Ocean closest to the northwest shore of Africa. Besides a comparative study between both islands, the main goal of this study is to advance the knowledge of the population groups in these islands before the European Conquest (15th century AD), especially their bioadaptability to the islands' environments.

Please note: This paper is included in the Project *Canarias: Colonización Humana Protohistórica, Bioadaptación Insular y Transformación Medioambiental* (Ministerio de Ciencia e Innovación, HAR20009-08519).

Tuesday Noon Public Lecture **Tuesday, 12:15 p.m. in KIPJ Theatre**

5 Vitamin D, JOHN CANNELL (Executive Director, Vitamin D Council, San Luis Obispo, CA; www.vitamindecouncil.org).

In the last decade, no other nutrient has been the object of as much publicity as has vitamin D. Is it really a vitamin? How does it work? How does one make it from the sun? Why has it been called the “repair and maintenance” steroid hormone? Is it true that its substrate is solely dependent on human behavior? What is the strength of the science connecting it to cardiovascular disease, cancer, infections, autoimmune disorders, and mental illness? What is an adequate vitamin D blood level? What is an ideal vitamin D blood level? How much vitamin D can one make from sunshine? How much vitamin D should indoor workers take every day? How much should pregnant women and children take every day? This talk will attempt to answer some of these questions.

Wednesday Noon Public Lecture **Wednesday, 12:15 p.m. in KIPJ Theatre**

6 Once and Future Giants: What Ice Age Extinctions Tell Us about the Fate of Earth's Largest Animals, SHARON LEVY (Science writer, PO Box 4352, Arcata, CA 95518; sharon@sharonlevy.net).

Mammoths, camels, saber-toothed cats and massive ground sloths once walked the ground that has become Wilshire Boulevard in Los Angeles, and foraged on the marsh land now buried beneath Chicago's streets. Then, just as the first humans settled the Americas, these Ice Age giants vanished forever. New research on the demise of Ice Age megafauna now offers vital insights for modern conservation. Understanding the demise of the mastodon may help us create strategies to protect today's endangered elephants, rhinos, tigers and wolves.

Conservation biologists steeped in the lessons of the Pleistocene take the argument further: they now suggest that in some cases, deliberately introducing exotic megafauna may be critical to restoring damaged ecosystems. Should we strive to replicate the species assemblages found by the first Europeans as they colonized the globe, as traditional conservation efforts assume? Or should we instead work to rebuild whole ecosystems, filling niches left empty by the top predators and large herbivores humans have extirpated?

SYMPOSIA

Applied Ethics of Ancient Mummy Research **Sunday, starting at 10:00 a.m. in KIPJ Theatre**

7 Introduction to Applied Ethics of Ancient Mummy Research, FRANK J. RÜHLI^{1*} and NIELS LYNNERUP² (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; frank.ruhli.uzh.ch; NLY@sund.ku.dk).

Research on ancient mummified human tissues may raise issues of ethical dimensions. Hitherto, only very limited scientific groundwork has been published (e.g. Kaufmann and Rühli, *J Med Ethics*, 2010). The aim of this symposium is to highlight various ethical interests as well as to propose an ethical framework for future studies. We wish to focus on how some ethical concerns have been specifically met.

8 Theoretical and Historical Background, BETTINA M. KREISSL LONFAT¹, NIELS LYNNERUP², and FRANK J. RÜHLI^{1*} (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; Bettina.kreissllonfat@anatom.uzh.ch).

In recent years new ethical challenges concerning any work with human remains have arisen, particularly in the field of mummy studies. Until now neither philosophical ethics nor medical ethics have accounted for said problems and this has led to a void that needs to be addressed. Are destructive methods of research of aDNA a lesser evil when faced with the potential gain of learning more about the genetical mutations of viruses, bacteria etc.? Are mummified remains to be considered as ‘patients’? Do historically necessary results into the causes of deaths of Egyptian Pharaohs warrant their exposedness in the media?

Classical theories of the concept of ‘person’ and its rights are geared towards the living and can therefore only ever satisfy one portion of the problem. A new examination of the historically grown theories and stances towards death, a person's rights and research for the living is needed to find new ways to balance a mummy's rights to privacy and what can be achieved through the newest methods in evolutionary medicine.

9 Stakeholder Theory for Ancient Mummy Research, INA KAUFMANN* and FRANK J. RÜHLI (Centre for Evolutionary Medicine, University of Zürich, Switzerland; frank.ruhli@anatom.muzh.ch).

Research with ancient mummies has currently evoked the discussion of ethical issues that should be reflected and integrated in the discussion of researchers. Such an undertaking poses significant hurdles in the identification of ethical claims, the legitimacy, and the evaluation of such claims. For this reason we make use of the stakeholder approach (Donaldson and Preston 1995; Mitchell, Agle, and Wood 1997), a valuable instrument to identify different interest groups with their variety of claims. Possible stakeholders affected by ancient mummy research are for example political and economical groups, the research community, civil society, and the mummy and its ancient cultural background. Claims among these

stakeholders might vary according to their ethical, political, or economical content. Next to the identification, systematization of these claims is needed in order to balance and judge those with ethical relevance and to identify morally conflicting positions. The proposed stakeholder analysis for ancient mummy research will start with a general introduction of stakeholder theory, a presentation of possible stakeholders and their claims, and finally a detailed discussion of ethical claims. The stakeholder analysis can enrich the discussion of ancient mummy research in general and the development of research guidelines in specific.

10 *Who Decides What: Ethical Committees, Local Population, Politicians, Lawyers, or Scientists?* **NIELS LYNNERUP*** and **LISE HARVIG** (Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; NLY@sund.ku.dk).

Natural science, as developed in the 17th and 18th centuries, involves utilitarian and consequential thinking. Analyzing bone tissue from archaeologically found human material, does not present an ethical problem, as the aim and result will add knowledge about the past and give us a better understanding of our biocultural development. However, categorical imperatives may be brought by people feeling close to the remains so that handling and analyzing the bones is seen as invasive and wrong. Following this line of ethical reasoning, analyzing human remains must not be done. There is no simple philosophical solution to these kinds of ethical discussions, as the deontological and utilitarian positions are incompatible. To address these problems, authorities have resorted to setting up ethics committees, to which scientists can apply for permission to perform analyses. These committees may also be charged with discussing ethical principles for the general population. In an archaeological excavation involving human remains, the use of stakeholder analysis may be advocated, as this is a quick way to ascertain who may play a role in the excavation. Setting up ethics committees, or outlining ethical guidelines, is beneficial. Aside from ethical principles, we also stress that scientific correctness is ethical in itself. Sloppy handling of human remains and botched sampling is not only bad science, but should also be judged as unethical. When excavating and analyzing human remains, ethical behaviour also implies correct documentation and the effort to keep destructive sampling to a minimum. Human remains must be seen as a fundamentally different kind of archaeological material: they must be handled with respect. The archaeologists and natural scientists involved in analyses of human remains must be prepared to explain their intended projects, analyses, and ethical considerations to the general public.

11 *Death on Display: Lived Life and a Good Story, Ethical Considerations when Displaying Mummies for a New Museum*, **PAULINE ASINGH** (Moesgaard Museum, Aarhus, Denmark; c/o frank.ruhli@anatom.uzh.ch).

Grauballe Man, the world's best preserved bog body, is on display at the Moesgaard Museum in Denmark. The exhibition is built around the results of new scientific investigations of the bog body in which ethical considerations were important in developing the scenographic context. The story of life behind the death has resulted in a tremendous interest from our audience.

In 2014 Moesgaard Museum opens a new 15,000 m² museum of archaeology and social anthropology. Focus of the exhibitions is man and a good story. Offset of the stories lies mainly in new

scientific studies of bog bodies and skeletons from past history. We let them tell the story in a whole new way to identify with the audience. The exhibited bodies and human remains are thus central to the narration. This also entails ethical considerations, as how and when recognizable, well-preserved human remains are to be exhibited, if at all, and how the human remains enter into a broader context. In a museum exhibit, the questions of ethics are not only concerned with the human remains and their provenance and ancestry, etc., but also with the ethical notions of the visitors.

11a *An Historical Perspective on the Display of Egypt's Royal Mummies*, **SALIMA IKRAM** (American University in Cairo, New Cairo, Egypt; salimaikram@gmail.com).

This paper will present the history of display of the royal mummies and discuss issues in Egypt that relate to the display of human remains from ancient Egypt.

12 *Proposal for an Ethical Framework for Ancient Mummy Research*, **FRANK J. RÜHLI^{1*}**, **BETTINA M. KREISSL LONFAT¹**, **INA KAUFMANN¹**, and **NIELS LYNNERUP²** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; frank.ruhli@anatom.uzh.ch).

The debate on whether to and if so how to examine (and display) ancient mummies is one of great controversy. One must be aware that the issue of how to store, analyze, and communicate on ancient mummies in an ethical way requires further discussions by the research community and a strong integration of current local ethical frameworks and culture. Based on the stakeholder approach (Kaufmann and Rühli 2010), we now continue with a first draft of a general ethical framework that is intended to provide ethical guidance in research with artificial and natural mummies, independent to their culture of origin. The framework addresses aspects of the integrity of the mummy, questions of informed consent, and the extent of invasive and tissue-destroying examinations. These are contrasted with the interests of the single researcher and the research community (e.g. uniqueness of the mummy as a research object and the progress of knowledge). We hope to present a framework that gives researchers working with human remains an orientation on how to ethically treat these dead. The framework intends to guide progress in ancient mummy research in an ethical, desirable, and justifiable manner. It does not advocate for completely stopping research with human remains. Thus, we do not intentionally recommend a specific solution or decision, but rather we want to stimulate an open-minded discussion. Without knowing or understanding the ethical concepts of the deceased, it is dangerous and short-sighted to assume the best manner on how to act in such unique scientific situations.

Kaufmann, I. M. and Rühli, F. J. 2010. Without 'Informed Consent'? Ethics and Ancient Mummy Research. *Journal of Medical Ethics*, 36(10): 608-613.

The Forensic Science of Clinical Mental Health Counseling: The Theresa Lewis Case Monday, starting at 8:00 a.m. in KIPJ Room E

13 Overview and Wrap-up Questions for Forensic Mental Health in Death Penalty Cases, RONN JOHNSON (Clinical Mental Health Counseling, School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; ronjohn@sandiego.edu).

Capital case research has informed the U. S. Supreme Court that jurors often make sentencing decisions based on personal feelings about a defendant. Juror decisions are also made with a measurable degree of uncertainty about their responsibilities as triers of fact. Clinical mental health professionals are frequently involved in a key role during capital cases as part of a multidisciplinary team. At a minimum, the role and responsibilities of a mental health professional by default requires advanced clinical skills, knowledge of the court system, as well as competencies for appropriately responding to cultural, ethical and forensic mental health issues emerging from capital cases. For example, one mental health standard for mitigation practice is the forensic assessment and presentation of clear and convincing evidence about a defendant's life and character that is sufficient to compel jurors to consider a complexity of biopsychosocial issues in deciding attribution of responsibility that mitigate defendants' legal accountability in capital offenses. The same concerns about scientific methods (e.g., Daubert or Frye Standards) are applicable with judges in these death penalty cases. This forensic mental health science symposium presents a conceptual framework of the issues that surround mitigation practices in capital cases. This symposium uses the capital case of Theresa Lewis as a platform to examine several forensic mental health factors. A question and answer period follows a counter-point discussion of each paper presented.

14 Opposing Forensic Mental Health Reports in Death Penalty Cases, ERICA J. BESSEN*, BRIANNA J. BOWMAN*, and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; ebessen@sandiego.edu).

Teresa Lewis was executed in the state of Virginia for two counts of capital murder for hire and related charges of conspiracy to commit capital murder, robbery, and use of a firearm. There has been much debate about Lewis's mental state at the time of her crimes and whether this was a mitigating factor in her commission of the crimes. Two opposing psychological reports will be presented, reviewing the assessment and diagnosis of her dependent personality disorder with an examination of its co-morbidity to her diagnosis of mental retardation. One psychological report will include testimony from Dr. Costanzo and Dr. Haskins, who concluded that Teresa Lewis did suffer from dependent personality disorder, which affected her mental state at the time she committed her crimes. The opposing psychological report will include testimony from Dr. Hagan, who concluded that Teresa Lewis did not suffer from dependent personality disorder and exhibited conduct that showed a passive aggressive or an aggressive dependency.

15 IQ as a Mitigating Factor in Death Penalty Cases, KRISTIN M. DASCANIO* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; kdascanio@sandiego.edu).

In 2004, the Circuit Court of Pittsylvania County sentenced Teresa Wilson Bean Lewis to death for two counts of capital murder (*Lewis v. Commonwealth of Virginia*, 2004). She was the first woman to be given a death sentence in Virginia in almost a century. Her case stirred controversy in the public eye for a number of factors, especially her low intellectual functioning. Years earlier, in *Atkins v. Virginia* (2002), the court ruled that it constituted cruel and unusual punishment to impose the death penalty on someone who is classified as mentally retarded. Opponents of the ruling on Lewis cited her low IQ score of 72 as falling within this category, arguing that the sentence of death should have been waived. This presentation will address the significant considerations for IQ that arose as a result of the Atkins and Lewis cases, specifically with regard to the question of intellectual functioning and the death penalty. It will cover definitions of mental retardation as held clinically and by state legislatures, assessment practices in forensic psychology, controversies over current practices and standards, implications and suggestions for forensic psychologists, and finally current and future trends in relevant research.

16 Dependent Personality Disorder as a Mitigating Factor in Death Penalty Cases, ERICA J. BESSEN* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; ebessen@sandiego.edu).

Dependent personality disorder is defined in the DSM IV-TR as a "pervasive psychological dependence on other people." People diagnosed with dependent personality disorder can suffer from symptoms such as difficulty making decisions without the reassurance of others, needing others to take responsibility for his or her actions, seeking relationships as a resource of comfort, care, and support, and feeling severely fearful at the thought of being left alone. Dependent personality disorder has also been brought up as a mitigating factor in death penalty cases. In the recent case of Teresa Lewis, her appeal to have her death penalty sentence commuted to life in prison was denied, although she argued that her dependent personality disorder and low IQ were mitigating factors in the commission of her crimes. She was executed in Virginia in September 2010. Dependent personality disorder has been brought up as a mitigating factor in other death penalty cases (Examples: Basden v. Lee and State v. White). In some cases, dependent personality was considered a mitigating factor and precluded the defendant from receiving the death penalty. In other cases, such as Teresa Lewis, dependent personality was not considered to be a mitigating factor in preventing her from execution. This presentation will examine these past cases of dependent personality disorder as a mitigating factor in death penalty cases in the United States.

17 Forensic Mental Health Issues in Domestic Violence, SHARLAINE BROCKHOFF* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; sharlaineb@sandiego.edu).

Teresa Lewis was convicted of domestically violent criminal offenses for hiring two gentlemen to shoot and kill her husband and her stepson. Studies have suggested that individuals who have experienced domestic violence during their childhood or within their marriage may be predisposed to act violently towards their own children or spouses later on in their lifetime. Although there is little evidence of Teresa Lewis having been exposed to serious acts of domestic violence within her marriage, Lewis testified that she was

exposed to adultery, physical abuse and abandonment from an early age. Domestic violence extends beyond physical and sexual abuse to include emotional and psychological abuse, financial abuse, and verbal abuse. Teresa Lewis' family experienced financial problems which contributed to stress in her relationship with her husband. Additionally, Teresa Lewis was assessed during court proceedings as being borderline mentally retarded with an IQ score of 72. She was also diagnosed with dependent personality disorder. This essay will review forensic mental health assessments and evaluations of offenders in domestic violence cases. The psychological effects of domestic violence both among offenders and victims will also be discussed. Lastly, we will review research on the mental health conditions of domestic violence offenders, focusing on women who commit physically violent acts in domestic relationships.

18 Forensic Mental Health Cultural and Ethical Considerations in Death Penalty Cases, KRISTEN N. GREIDER* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; kgreider@sandiego.edu).

In the U.S. Supreme Court hearing of the case of *Furman v. Georgia* (1972), which included the cases of three African American men who were sentenced to death; two for rape and one for a possibly accidental fatal shooting of a man, the public became aware that a disproportionate number of ethnic minority defendants were sentenced to death by juries. The U.S. Supreme Court decided in a 5-4 decision that the juries were violating the Eighth Amendment of the Constitution, which protects citizens from "cruel and unusual" punishment. This decision had many ramifications, but what will be discussed in this presentation is the role of ethnicity in death penalty cases.

Judgments determining an offender's level of risk and whether he/she is deemed to be a mentally disordered offender or a mentally 'normal' offender influences his/her sentencing, placement and treatment after trial. In *Barefoot v. Estelle* (1983) the U.S. Supreme Court asserted that the psychiatrists' testimony on Barefoot's future dangerousness was acceptable and allowable. Barefoot was subsequently executed. Assessments of dangerousness, therefore, can act as a significant mitigating factor in death penalty cases. Risk assessments for violence commonly used in forensic settings include the Historical, Clinical and Risk Management Scheme (HCR-20) and the Psychopathy Checklist-Revised (PCL-R). The literature review focused on the validity and reliability of the HCR-20 and the PCL-R with ethnically diverse and/or female mentally disordered criminal offenders.

19 Behavioral Disorders or Mental Impairment not Contained in the DSM-IV-TR: Clinical and Forensic Implications, HEIDI BECKENBACH* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; hbeckenbach@sandiego.edu).

For those who work in the mental health field, proper diagnosis of a client is rendered after steps that include: a clinical interview, information gathering, assessment, and consultation of the Diagnostic and Statistical Manual of Mental Disorders Fourth Edition Text Revision (DSM-IV-TR). These steps are standard practice in the clinical field, but what about the situations where a client has most but not all the criteria of a disorder listed in the DSM-IV-TR? Or when a client exhibits symptoms of a disorder/impairment that is supported by the scientific community but not contained in the

DSM-TR-IV, (i.e., Psychopathy, Munchausen Syndrome, Anaclitic Depression, Sociopathy and Battered Women's Syndrome)? How do these examples effect working with clients in clinical and forensic settings? These questions represent issues that mental health workers are currently forced to wrestle with. This proposal aims to shed light on specific disorders/impairments not listed in the DSM-IV-TR, their implications for current clinical/forensic practice and hopes for future changes in the field.

20 Clinical Mental Health Issues in Death Penalty Cases, KRISTEN N. GREIDER* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; kgreider@sandiego.edu).

Defendants in death penalty cases often present with mental health issues that act as mitigating factors during trial, sentencing, commitment, and/or execution. Important factors include the defendant's prior mental health diagnoses and history, state of mind at the time of offense, and current mental health status. Common clinical mental health issues in death penalty cases include competency, malingering, criminal responsibility and capacity, civil commitment, and assessing for dangerousness. Depending on current state law, a defendant may or may not meet the criteria for these different factors. For example, in Teresa Lewis Case, analysis of intelligence tests performed, adaptive functioning assessments, and a review of her personal history failed to meet the requirements for the determination of mental retardation in capital cases according to Virginia Code of Law Section 19.2-264.3:1.1. This presentation will review mitigating mental health factors in the context of influential death penalty cases. A critical review of current research on risk assessments and risk management in forensic populations will be used to address risk as a mitigating factor in death penalty cases; with a focus on: violence recidivism, risk assessments most commonly used in forensic populations, and civil commitment considerations for mentally-disordered criminal offenders.

21 Identifying, Securing, Organizing and Reviewing Mental Health Data in Death Penalty Cases, KELSEY R. CAMPION* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; kelseycampion@sandiego.edu).

When a counselor becomes involved in death penalty cases there is information that must be taken into consideration when evaluating, treating and making clinical judgments regarding the client. Before a counselor can determine what information is needed, clearly defined roles must be established because the information needed may vary depending upon the counselor's role as an expert witness, a consultant, or a therapist. Once roles are defined the counselor must have an understanding of legal and behavioral issues regarding the case, determine the information they will need to fulfill their roles and gather that information. School, psychiatric, psychological, criminal, and employment records need to be secured in order to review relevant background information regarding the client. Once information is gathered, counselors must organize it in a relevant, informative, and defensible manner in order to serve their intended purpose.

Counselors must determine if writing a report is necessary and/or in the best interest of the client and the case as once a report is written it is considered evidence and is discoverable. Forensic work can be extremely time consuming for counselors involved and therefore it is important that the counselor on the case is aware of

upcoming deadlines and pertinent information relating to the case. Counselors' gathering, organizing and presentation of case-related information is imperative when serving on death penalty cases. Understanding what is needed before court proceedings begin can help counselors to better manage their time and resources during often lengthy and time-consuming trials.

22 Care of the Mental Health Professional in Death Penalty Cases, NICHOLAS F. O'MADDEN* and RONN JOHNSON (School of Leadership and Education Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; nfomadden@sandiego.edu).

The idea that self-care is a primary obligation for mental health professionals is an interesting notion that should be addressed. The consensus among many mental health professionals is that self-care is an ethical imperative. Without caring for themselves, it is unlikely that they will be able to optimally care for their clients. Mental health professionals involved in death penalty cases may experience increased stress due to operating in forensic settings, having to confront and negotiate their own beliefs and ethics regarding the death penalty, and being confronted with the imminent execution of their client(s). Inmates receiving services from mental health professionals often present with loneliness, powerlessness, hopelessness, dehumanization, demoralization, tension, decay, apathy, and psychological pressure (Brown and Benningfield, 2008). Mental health professionals are ethically obligated to help their clients with these particular symptoms while operating under the realization of the inevitable death of their clients. To ensure that mental health professionals are practicing at their highest level of functioning, and are not compromised by stress or burnout, they should be encouraged to monitor four dimensions of health: physical, mental, emotional, and spiritual. Subjective and objective methods that mental health professionals can use to self-evaluate their level of health while working in death penalty cases will be explored in this presentation.

7th Annual Symposium on Advances in Materials Science and Nanotechnology Monday, starting at 8:25 am. in KIPJ Room 215

23 Single Molecule Lysozyme Dynamics Monitored by an Electronic Circuit, PATRICK C. SIMS^{1*}, YONGKI CHOP², STEVEN R. HUNT¹, ISSA MOODY³, BRAD L. CORSO¹, GREGORY A. WEISS^{3,4}, and PHILIP G. COLLINS^{1,2} (¹Department of Physics and Astronomy, University of California Irvine, Irvine, CA 92697-4576; ²Institute for Surface and Interface Science, University of California Irvine, Irvine, CA 92697-2375; ³Department of Molecular Biology and Biochemistry, University of California Irvine, Irvine, CA 92697-4292; ⁴Department of Chemistry, University of California Irvine, Irvine, CA 92697-2025; collinsp@uci.edu).

The electronic properties of nanoscale conductors are very sensitive to their environment, and this property has led to a decade-long investigation of potential chemical sensor and biosensor applications. Single walled carbon nanotubes (SWCNTs) are particularly appealing elements because they are hollow conductors with all of their conduction electrons on the exposed surface. Recently, we have demonstrated single molecule dynamic sensitivity using field effect transistors made out of individual SWCNTs (1).

Similar devices have now been applied to the problem of

sensing protein dynamics in physiologically-relevant solutions. Our work focuses on the dynamics of the lysozyme enzyme. By attaching a lysozyme to a SWCNT device, we have accomplished real-time monitoring of lysozyme's single molecule dynamics. Electronic monitoring with a temporal resolution of 10 microseconds occurs as the mechanical motions of the protein cause changes in the conductance of the SWCNT. Acquisition times can be continued for tens of minutes, allowing for the investigation of a single protein over a wide range of time scales. This data helps to address uncertainty concerning the mechanism of lysozyme's enzymatic turnover. Analysis of the changes in conductance show various Poisson processes that may be related to the hinge motion of the lysozyme molecule during non-catalytic and catalytic binding of the peptidoglycan substrate. Furthermore, the single molecule rates show the expected pH dependence.

1) B. R. Goldsmith et al., *Nano Lett.* **8**, 189 (2008); B. R. Goldsmith et al., *J. Mat. Res.* **23**, 1197 (2008).

24 Scanning Gate Spectroscopy and Its Application to Carbon Nanotube Defects, ELLIOT J. FULLER*, STEVEN R. HUNT, BRAD L. CORSO, and PHILIP G. COLLINS (Department of Physics and Astronomy, University of California at Irvine, Irvine, CA 92697, USA; efuller@uce.edu).

This presentation describes a novel type of scanning probe characterization called scanning gate spectroscopy (SGS). Our method is based upon scanning gate microscopy, a technique for characterizing the electronic properties of a surface and, in particular, of electronic devices. Scanning gate microscopy has proven very important for understand nanomaterials and how they might be used in circuits.

In the new SGS technique, we have extended the usefulness of scanning gate microscopy by acquiring images using a continuous range of probe potentials. The result captures not just a surface image, but also the energy dependence of scattering sites, boundaries, and other electronic surface features. As an example, we investigate resistance along a single-walled carbon nanotube (SWCNT). SGS clearly observes the individual sites that contribute most to a SWCNT resistance, including defects or chemical attachments that are not visible topographically. Furthermore, SGS directly resolves the energy spectrum of electronic scattering at a defect site and allows us to extract the effective barrier width and heights of such features.

25 Experimental Measurements of Endogenous Electric Fields in MEMS Devices: Toward a Second Law Challenge, DANIEL P. SHEEHAN (Department of Physics, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; dsheehan@sandiego.edu).

Nanoscale devices traditionally rely on external voltage sources for power, e.g., batteries, fuel cells, power supplies. In principle, however, electric potentials and fields at the microscale can be established between dissimilar metals and semiconductors via the dissimilar chemical potentials of their mobile charge carriers. These endogenous potentials and fields can be sustained indefinitely without power consumption and can regenerate quickly at system boundaries. It has been proposed that these fields can lead to challenges to the second law when incorporated in MEMS and NEMS devices [1,2]. A decade-long objection to these challenges has been that endogenous fields have not been experimentally measured. This paper details the experimental verification of the magnitudes and locations of these predicted fields, using scanning Kelvin probe microscopy.

1) D.P. Sheehan, A.R. Putnam, and J.H. Wright, *Found. Phys.* **32**, 1557 (2002).

2) D.P. Sheehan and D.H.E. Gross, *Physica A* 370, 461 (2006).

26 Experimental Challenge to the Second Law of Thermodynamics in High-Temperature, Gas-Surface Reactions, DANIEL P. SHEEHAN, D.J. MALLIN, and J.T. GARAMELLA (Department of Physics, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; dsheehan@sandiego.edu).

It is well known that gas molecules can adsorb, desorb, dissociate and recombine at different rates on different chemical surfaces; the world's catalyst industry relies on these differences. It has been predicted that, under low-pressure blackbody cavity conditions, differences in these rates between surfaces could give rise to steady-state gas phase nonequilibria, thereby challenging of the second law of thermodynamics [1-4]. This paper reports on the first laboratory realization of this scenario. Low-pressure molecular hydrogen was found to dissociate and desorb preferentially on rhenium compared with tungsten at elevated temperatures. Inside of blackbody cavities lined with either tungsten or rhenium, resistors and thermocouples fashioned from rhenium and tungsten filaments were monitored for changes in their temperatures, based on electrical resistance and Seebeck voltage. As predicted by theory, under hydrogen atmospheres -- but not under either vacuum or helium atmospheres -- filament resistances and Seebeck voltages indicated large temperature differentials ($> 100\text{K}$) were maintained between the metals inside the cavities, in conflict with the second law. Theory, experiment, and possible applications of these results will be detailed.

1) D.P. Sheehan, *Phys. Rev. E* 57, 6660 (1998).

2) D.P. Sheehan, *Phys. Lett. A* 280, 185 (2001).

3) V. Capek and D.P. Sheehan, "Challenges to the Second Law of Thermodynamics: Theory and Experiment" (Springer, Dordrecht, 2005).

4) S.L. Miller, *Found. Phys.* 37, 1660 (2007)

27 Aspects of Quantization in Nucleation: The Bubble, K.M. GALDAMEZ (Physics Department, Tufts University, Medford, MA 02155; kgaldamez@alumni.tufts.edu).

It is our aim to investigate the representation of macroscopic systems that exhibit quantum effects. Underlying this work is a class of systems, which, when using Dirac Quantization, lack a 1:1 mapping between classical functions and operators. This class of problems results in a position dependent mass (PDM) Hamiltonian. In nucleation, PDM Hamiltonian has not been analyzed because of the foundational questions it raises. Further, the quantum effects exhibited in this system have been well established. Thus nucleation provides an interesting template for our work. We will approach our problem from two different perspectives. Starting from first principles (*ab initio*), we will present a microscopic description of nucleation arriving at a final quantum mechanical Hamiltonian. Then, we will introduce the topic of rules of quantization with an emphasis on the Weyl transform. Surprisingly, our *ab initio* microscopic treatment is equivalent to that of Weyl quantization thus revealing a 1:1 correspondence between quantum and classical representation methods.

Subsequently, we utilize the same procedure on one and two dimensional systems with the goal to show an identification between Weyl quantization and a microscopic approach to quantization. We hypothesize that there are system characteristics such as density and size that make these similarities possible. Our aim is to attain a greater understanding of the particular traits of systems that lead to an equivalence between Weyl's procedure and that of our microscopic approach. We expect that our results may be applicable to lower dimensional fluids where the ordering of operators

is at question.

28 Rheological Measurements in the Isotropic, Nematic and Lamellar Phase of the Cesium Pentadecafluorooctanoate/ H_2O System, PANOS PHOTINOS (Department of Chemistry, Physics, Materials and Engineering, Southern Oregon University, Ashland, OR 97520; Photinos@sou.edu).

The flow curves of the Cesium Pentadecafluorooctanoate (CsPFO)/ H_2O at concentration 46% by weight are presented. The system shows a $\sim 5^\circ\text{C}$ wide disk nematic (N_D) range between the isotropic and the lamellar smectic phase. At low shear rates ($< 10\text{ s}^{-1}$) the shear stress decreases monotonically with increasing temperature as we move from the lamellar to the isotropic phase for given shear rate. In the isotropic and the N_D phase the flow behavior is essentially Newtonian for the entire shear rate range studied ($0\text{--}50\text{ s}^{-1}$). The flow behavior in the lamellar phase is more complicated. Near the lamellar to nematic phase, the behavior is shear-thinning, and as the shear rates is increased above 30 s^{-1} the shear stress in the lamellar phase is lower than the corresponding values for the isotropic and nematic phase. Near the lower end of the lamellar range the rheological behavior becomes noticeably shear-thickening above shear rates of 20 s^{-1} . The results will be discussed in terms of the micellar structure and the viscosity of the surrounding aqueous phase.

Quantum Retrocausation: Theory and Experiment, Part I

Monday, starting at 8:45 a.m. in KIPJ Rooms A and B (Continues on Tuesday at 8:45 a.m.; see page 81 in these Proceedings for abstracts.)

29 Constructing Retrocausal Models: Decision Points and Pitfalls, KEN WHARTON (Department of Physics and Astronomy, San Jose State University, San Jose, CA 95192-0106; wharton@science.sjsu.edu).

The scattered efforts to construct retrocausal models of quantum phenomena have utilized different conceptual and mathematical frameworks; in most cases a framework is assumed without explicit discussion or particular justification. Some of these frameworks are arguably internally inconsistent, and others incorporate standard quantum concepts that become problematic or unnecessary when used in a time-symmetric manner. With this in mind, I will examine the big-picture choices facing a theorist who wishes to construct a coherent retrocausal model. These decisions include whether or not to couch the theory in a single "block universe"; the role (if any) of hidden variables; the implementation of boundary constraints; the use of conditional probability vs. joint probability; and the choice between Newtonian and Lagrangian approaches.

30 Delayed Choice Experiments, the Arrow of Time, and Quantum Measurement, L.S. SCHULMAN (Physics Department, Clarkson University, Potsdam, New York, USA).

Wheeler's delayed choice experiment appears to be a shocking inversion of causality: actions *now* influence events in the past. But it is a prediction of quantum mechanics and has recently been confirmed experimentally. However, for the "special state" theory of the quantum measurement process, causality—and the arrow of time in general—are already seriously compromised. This quantum measurement theory allows only unitary time evolution and

has therefore been difficult to distinguish experimentally from the conventional view. However, certain consequences of the theory require large (i.e., Cauchy-distributed) perturbations and through these the delayed choice experiment provides the possibility of an experimental test of the “special state” theory. In the talk background information on all topics mentioned will be provided.

31 Precision Measurements and Weak Values, ANDREW N. JORDAN (Department Physics and Astronomy, University of Rochester, Rochester, NY 14627; jordan@pas.rochester.edu).

Weak values of quantum operators occur when quantum measurements are both pre- and post-selected. They are characterized by the peculiar features of both being complex and exceeding the eigenvalue bound of the operator. We show how this quantity may be described in a theoretically consistent way by defining contextual values as a generalization of the eigenvalues of an observable that takes into account both the system observable and a general measurement procedure. We further present experiments in optical systems showing how weak values may be used as a novel amplification scheme for precision measurements. A discussion of time-symmetry in generalized measurements will be given.

32 The Retrocausal Nature of Quantum Measurement Revealed by Partial and Weak Measurements, AVSHALOM C. ELITZUR (Iyar, The Israeli Institute for Advanced Research; Avshalom.Elitzur@weizmann.ac.il).

Partial quantum measurement turns the initial superposition not into a definite state but to a greater probability for it. Consequently, it enables better probing of the measurement process in cases where complete measurement, due to the uncertainty principle, obstructs it. Aharonov’s weak measurement is another method of measuring values normally obstructed by the uncertainty principle. Happily, the two methods complement and corroborate one another in some interesting ways. In this paper I gedankenly apply partial measurements to the EPR case in order to demonstrate the temporal uniqueness of quantum nonlocality. A pair of entangled particles undergoes more than a pair of measurements while remaining partially correlated (something impossible with complete measurements). Surprisingly, the temporal relations between the measurements do not follow the temporal sequence perceived by an external observer. For each particle, the measurements performed on the other particle behave as if they occurred (with their values reversed) in that particle’s *past*. This fully accords with Cramer’s transactional interpretation and Aharonov’s two-vector formalism. I next consider EPR erasure, also much easier with partial than with complete measurements. Here too, the temporal relations between several measurements and erasures are fully consistent with the intriguing spacetime zigzag of the retrocausal models.

33 The Broken Symmetry of Time, RUTH E. KASTNER (Department of Philosophy, University of Maryland, College Park, MD 20742; rkastner@umd.edu).

The fundamental physical laws of nature are time-symmetric, yet our temporal experience is decisively time-asymmetric. In this presentation I consider the question: exactly what is it that needs explaining about the broken symmetry of time, and to what extent does this situation differ from other instances of symmetry breaking in physics?

34 Mechanism of the Quantum Speed-up, GIUSEPPE CASTAGNOLI (ICT Division, Elsag Bailey, Via San Bernardo 9/A, 16030

Pieve Ligure, Italy; giuseppe.castagnoli@gmail.com).

Quantum information is more and more becoming a tool for investigating the foundations of quantum mechanics. A recent theoretical development suggests that there is a connection between the well-known quantum speed-up – the fact that quantum algorithms can require fewer computation steps than their classical equivalent – and forward and reverse time effects.

In database search, Bob chooses a database location and gives to Alice a black-box that outputs 1 if the input is that location, 0 otherwise. Alice should find the database location chosen by Bob by running an algorithm that tries black-box computations for different inputs.

There is of course a one-to-one correlation between Bob’s choice and the solution found by Alice. In quantum database search (which yields a quadratic speed-up), this correlation becomes quantum. This explains the speed-up. All is like the final read out of the solution on the part of Alice contributed to Bob’s choice. Back evolving this contribution to before running the algorithm, where Bob’s choice is positioned, shows that Alice knows half of this choice in advance. The quantum algorithm is the quantum superposition of all the possible ways of knowing in advance half of Bob’s choice and classically identifying the missing half through black-box computations. This naturally yields a speed-up with respect to the classical case where Bob’s choice is completely hidden to Alice.

Noticeably, this explanation of the quantum speed up involves a causality loop. Alice produces the solution of the problem with fewer black-box computations than classically possible because she knows in advance 50% of the information about the solution she will produce in the future, in all possible ways in quantum superposition.

The same argument extends to the quantum algorithms that yield an exponential speed up.

35 Cyclical Cosmology on a Mobius Strip, MICHAEL IBISON (Institute for Advanced Studies at Austin, 11855 Research Boulevard, Austin, TX 78759, USA; ibison@ias-austin.org).

The Cosmological Expansion will continue forever in time measured with a proper clock. But the expansion will come to an end in about 47 GYr as measured with a conformal clock. At that time, according to a literal interpretation of the Friedmann equation, the Universe will start to contract. Fermionic and electromagnetic fields expressed in a conformal coordinate system turn out to be sensitive to the conditions at the time of this sudden reversal, so it would not be safe to ignore that event as of no consequence. At issue is to what extent the future turn-around might impose an effective boundary condition, perhaps with present-day observable effects.

Based primarily on an assumption that fermionic fields continue analytically through the future singularity, we infer a relationship between discrete symmetries of charge, parity, mass, and time inversions, and the topology of the manifold. We discuss a topology that is closed in time but nonetheless permits identification of a cosmological arrow of time. The status of the electrodynamic and thermodynamic arrows for this model are presently unknown.

36 Understanding Retrocausality – and Losing a Wager, RICHARD SHOUP (Boundary Institute, P.O. Box 10336, San Jose, CA 95157; rshoup@boundary.org).

In further investigation of a wager made during the previous AAAS Retrocausality Symposium 5 years ago, we examine why exactly it is that a message cannot be sent into the past and received there, yet certain anomalous correlations can make it appear just that way. But to accomplish this, we must first explore more deeply,

and reinterpret, the usual concepts of superposition, entanglement, measurement, locality, and causality.

From these reinterpreted concepts, and through analyses of the usual forward EPR experimental arrangement and a time-symmetrical backward version, we can better understand the fundamental inadequacy of the idea of “causality” (both forward and backward), and also provide a possible explanation for retrocausal anomalies such as those of the recent Bem experiments. Finally, we conclude whether the wager was actually lost or not.

36a *Pre and post-selection, weak measurements and the flow of time in quantum mechanics*, **JEFF TOLLAKSEN** (Director, Center for Quantum Studies, Head, Faculty of Physics, Associate Professor of Physics, Schmid College of Science, Chapman University, One University Drive, Orange, CA 92866; tollaksen@chapman.edu).

Quantum mechanics allows one to independently fix both the initial and final state of a single system. Novel effects occur for such systems, challenging our ideas about what time is and how it flows.

**Don't Sign Your Life Away:
Author's Rights, Scientific Publishing,
Digital Repositories and the Case
for Open Access**
Monday, starting at 9:00 a.m. in KIPJ Room 217

37 *Bibliometric Information Services for Computing, Interpreting and Reporting Research Productivity and Impact Indicators Using Cited Reference Enhanced Databases – Some Caveats for Librarians*, **PETER JACSO** (University of Hawaii, Department of Information and Computer Sciences, Library and Information Science Program, 2550 The Mall, Honolulu, HI 96822; jacso@hawaii.edu).

Citation-based, purportedly simple and objective assessments of the research performance of individual scientists, research groups, departments and entire institutions have moved center stage in academia. They complement traditional reviews by a panel of peers for decision-making in promotion, tenure and grant applications, as well as for creating league-tables of scientists, journals, and universities. Most are based on the innovative h-index (introduced by Jorge E. Hirsch in 2004), or some of its derivative bibliometric indicators.

More than 300 papers were published about these new bibliometric indicators. Much less has been published about how the content and the software deficiencies of the cited reference enhanced databases may yield highly discordant indicators due to differences in the rigor of the citation matching module of the software, in the scope, breadth, completeness of source coverage, and in the consistency and accuracy of metadata elements about authors, journals, numerical or chronological designations, institutional and country affiliations.

The essential findings of this author will be presented and explained on a sample set of prominent scholars and journals of various disciplines using 5 bibliometric indicators created from the Web of Science, Scopus, Google Scholar, Scimago and the Eigenfactor databases. They demonstrate the essence of what librarians must know about the content and software of these databases in order to produce, interpret and validate metrics-based research reports adequately and/or to provide support for faculty and

administrators in such exercises.

38 *Bibliometric Analysis of The Production of Graduate Nursing Students: 2002-2009*, **VALERIA E. MOLTENI** (Academic Liaison Librarian, Dr. Martin Luther King Jr. Library, San Jose State University, One Washington Square, San José, CA 95192-0028; Valeria.Molteni@sjsu.edu).

Bibliometric provide useful analyses of the nature of research in small knowledge areas such as university departments that can be convened to larger scientific domains at institutional or national levels. This presentation will deliver publications habits, most commonly used journals, and the productive knowledge areas covered in the production of a specific graduate course in San Jose State University.

San Jose State University is an urban university located in San Jose, California, United States and it has nearly 31,280 students. SJSU is part of the California State University system, which--with its 23 campuses, 417,000 students, and 46,000 faculty members--is one of the largest institutions of public higher education in the nation.

The SJSU Valley Foundation School of Nursing has 2,045 students (Academic Year 2010-11) and offers undergraduate and graduate degrees. The Master program has concentrations in four different nursing roles: Nurse Administrator, Nurse Educator, Family Nurse Practitioner, and School Nurse Clinical Specialist. In addition, the program offers Post-Master preparation in Nurse Educator, Family Nurse Practitioner Certificate, and School Nurse Credential. Undergraduate, graduate and post-master certification programs are certified by National and States Boards.

The MSN Program students have two options for their Graduate Degree: a thesis or project (course number NURS297). The outcome of the latter is the submission of a publishable article to a specific journal. This presentation will concentrate on the bibliometric analysis of the published articles of this course.

39 *HighWire's Role in the Scholarly Publication Process*, **BONNIE ZAVON** (Public Relations, HighWire Press, Stanford University, 1454 Page Mill Road, Palo Alto, CA 94304; bzavon@stanford.edu).

HighWire's role in the scholarly publication process will be discussed, including a brief “tools and features on the HighWire portal” section; a bit about the Free and OA content that is currently or about-to-be hosted on HighWire; and then some time for questions and answers from the audience.

40 *Retaining Authors' Rights: Long-term Protection in Adopting New Habits for a Flexible Scholarly Future*, **JULIA GELFAND** (Applied Sciences and Engineering Librarian, University of California, Irvine, Ayala Science Library 228, Irvine, CA 92623-9556; jgelfand@uci.edu).

Copyright law today encourages authors and all contributors to intellectual capital to consider the best methods to protect their output. With increasingly technology directed publishing and communications mediums it is in all authors' best interests to consider how they can retain their rights to their creative works in an electronic environment. When academics or faculty want to use their scholarly work in their teaching, share with colleagues via disciplinary repositories or make available on an institutional repository, or professional or personal website, it is in one's best interests to consider adding an author's addendum to the copyright notice a publisher usually

requires. Today's reliance on electronic delivery and dissemination and a growing presence of digital resources forming the core collections in libraries also are motivating reasons to develop familiarity with the components of an author's addendum and how to promote the need for such a document when authors are negotiating over the terms of submission and acceptance of manuscripts and other creative work with scholarly and commercial publishers. This presentation will contextualize the publishing process and review standard steps in how authors' can be comfortable in requesting to retain their author's rights and introduce the key elements of an author's addendum.

41 *How Faculty in Higher Education Understand Copyright: A Multidisciplinary Study of Research and Teaching Universities and Community Colleges*, **PATRICK NEWELL** (Henry Madden Library, California State University, Fresno 5200 N Barton Avenue, Mailstop ML34, Fresno, CA 93740; pnewell@csufresno.edu).

Copyrighted materials are used by faculty throughout higher education, although the way in which faculty learn about and understand how the copyright law applies to the materials that they use varies greatly. This empirical study uses qualitative and quantitative methods to investigate how faculty in three different disciplines (Art History, Physics, and Political Science) at three different levels of public higher education institutions (Two-Year Colleges, Teaching Universities, and Research Universities) learn to enact the copyright law in their daily work lives. A delineation of areas in which faculty in different disciplines and institutions understand how to use materials within the boundaries of copyright law (and their beliefs about how the law should pertain to the world of higher education) is followed by a typification of faculty by their interest in and understanding of copyright law and areas in which the Academy can improve faculty knowledge of copyright law and how to apply it in the fair use of materials in their work.

42 *The Role of Librarians in the Protection of Author's Rights and Copyright*, **IFEOMA ANN OLUWASEMILORE¹* and NGOZI BLESSING UKACHI²** (¹Law Library, University of Lagos. Akoka-Yaba, Lagos, Nigeria, ifeomashodeinde@yahoo.com; ²University of Lagos. Akoka-Yaba, Lagos, Nigeria. ukachingozi2001@yahoo.com).

This paper gives an overview of Authors' rights and copyright with emphasis on the librarians who are the custodians of most artistic and literary works. The paper dwells on the librarian's role in the protection of their users' rights and also safeguarding the interests of creators who are authors. Such copyright protection provides the necessary incentives for scientific, technological and intellectual creativity. Librarians need to pay close attention to the balance between promoting the users' right to research and development and the creator's right. It is submitted that it is the responsibility of librarians to protect the copyright of authors. They have to discourage library users from infringing on copyright laws. The paper offers suggestions that will reduce the infringement on copyright to the barest minimum.

43 *Communicating Science in the Future*, **PHILIP BOURNE** (Editor in Chief, PLoS Comp. Biol., Professor and Associate Director RCSB and PDB, Skaggs School of Pharmacy and Pharmaceutical Sciences, University of California San Diego, San Diego, CA).

Scientific publishing has changed too little over the years. It is my opinion that in its present form it does not maximize the dissemination and comprehension of research results obtained using

taxpayer dollars. This is particularly true in the internet era, when much of the research enterprise is digital, yet much of publishing (authors and publishers alike) is still analog. The ideas that a paper distributed as a PDF file is just one view of the research, that supplemental material is too useless, that we hold reproducibility as a cornerstone of science but can't do it, and that as quantitative scientists we evaluate ourselves in a qualitative way at best, are just examples of what we will touch on as we consider one person's view of communicating science in the future.

44 *Helping Users Find Versions of Record in the Scholarly Literature*, **CAROL ANNE MEYER** (CrossRef, 40 Salem Street, Lynnfield, MA 01940; cmeyer@crossref.org).

Researchers have a wealth of resources open to them in discovering and using scholarly literature: journal sites, aggregated databases, author home pages, institutional repositories, and disciplinary digital libraries. But what happens when a published article must be changed? Corrigenda, errata, notices of concern, corrected versions, and even retractions might impact the interpretation of a work that a research has already accessed and stored locally. This presentation will discuss CrossMark, a collaborative service that researchers can use to identify whether a piece of content is being maintained by the publisher, whether it is up to date, and where the latest version of record can be found. Librarians will learn tools to be able to educate their patrons about how to evaluate scholarly content.

45 *Maximizing the Potential Impact of Digital Repositories*, **CRYSTAL GOLDMAN** (San Jose State University, King Library, One Washington Square, San Jose, CA 95192-0028; crystal.goldman@sjsu.edu).

This presentation will discuss strategies for encouraging involvement in digital repositories by marketing the many value-added services the repository provides to various constituencies in the campus community.

The prevailing attitude when digital repositories first emerged in the United States was "If you build it, they will come." Libraries relied on faculty to self-archive pre-prints and post-prints of their scholarly output. Not only was this assumption proven incorrect, forcing librarians to reconsider their approach with teaching faculty, but many institutions found that the scope of their repository needed to widen in order to sufficiently grow their content.

Focusing solely on archiving refereed publications limits the potential of the repository to serve as a venue to publicize the administrative business of the institution, highlight undergraduate and graduate student research, and provide open access to electronic dissertations and theses (ETDs). Librarians may also consider partnering with faculty and scholarly societies to use the repository as a publishing platform for conference proceedings, peer-reviewed journals, and even scholarly monographs. Additionally, teaching faculty might be interested in disseminating datasets, images, multimedia, video, and audio content that may be produced during the research and teaching process, but are not always included in academic publications.

46 *Building a Local Environmental Repository*, **STEPHEN STRATTON* and MELISSA MINDS VANDEBURGT*** (JS Broome Library, California State University Channel Islands, One University Drive, Camarillo, CA 93012; stephen.stratton@csuci.edu).

The Broome Library has actively sought collections from

Ventura County environmental and conservation activists to create a digital repository of materials to be used by students, faculty and the community interested local environmental issues. The Jean Harris Environmental Collection will serve as a research base for multiple departments here at Channel Islands; specifically the Environmental Science and Resource Management, Chicana/o Studies, Political Science, and History departments will find material in these collections that will be useful to their research and the study of local history, activism and the natural environment in Ventura County.

47 *Building a Global Virtual Herbarium – From the Collection Book to the Computer Screen*, **LARRY SCHMIDT** (University of Wyoming, UW Libraries, Department 3334, 1000 E. University Ave., Laramie, WY 82071-2000; lschmidt@uwyo.edu).

The Global Plants Initiative (GPI) is an international project with the goal to digitize and make available the world's plant type specimens. Funded by the Andrew W. Mellon Foundation, GPI started as the African Plants Initiative in 2003, then expanded in 2008 to include Latin America and is now global. In 2009 the University of Wyoming (UW) Libraries and Rocky Mountain Herbarium (RM) joined this international undertaking, which now has over 190 partner institutions from over 60 countries.

University of Wyoming's participation in this global initiative is a direct outgrowth of building on previous projects, in particular major efforts by UW Libraries to create a virtual herbarium for Grand Teton National Park in 2008. UW Libraries took an active role in the imaging of specimens, database management and the development of an online interface to the virtual collection. UW Libraries was able to parlay those experiences and obtain additional grants. This includes not only a major grant from the Mellon Foundation to digitize RM type specimens but also grants for imaging additional Grand Teton specimens. In addition, this has led to funding for a forest service collection, as well as the digitization of collecting books of prominent botanists.

GPI content is managed, preserved and published online by JSTOR as "JSTOR Plant Science" and now contains over 1 million images of type specimens, botanical illustrations, archival materials and other related content. UW's and UW Libraries experience proves the importance of engaging with communities beyond our traditional library sphere of operation.

Panama Canal Expansion **Monday, starting at 1:30 p.m. in KIPJ Room H**

48 *General Overview of the History of the Panama Canal*, **J. DAVID ROGERS** (Department of Geological Sciences and Engineering, Missouri University of Science and Technology, 1400 N. Bishop Ave., Rolla, MO 65409; rogersda@umr.edu).

The French began excavating the Panama Canal in 1881, envisioning a sea level crossing, like the Suez Canal completed in 1869. When excavations of the highlands approaching Continental Divide ensued in 1884, damaging landslides occurred at Culebra and Cucaracha. As geological problems slowed progress, health epidemics related to outbreaks of yellow fever and malaria bankrupted the enterprise and the French abandoned the project in 1889. After re-financing an allegedly improved scheme, they began anew in 1894, but without success. They sold their franchise to the

United States in 1903. The Americans approached the project with vigor and confidence, treating it as an enormous railroad engineering project. By 1907 the various excavation problems led American engineer John Stevens to redesign the project, using a series of three locks at either end to lift ships 85 feet and transit across man-made Gatun Lake. In 1908 control of the project passed to the Army Corps of Engineers, who completed the project in August 1914, excavating 96 million cubic yards of material at a cost about 260% beyond that originally envisioned, which required an additional 2-1/2 years to complete. Despite all the setbacks and cost-overruns, the project was the jewel of an emerging American empire, and its contributions to world health and sea-borne commerce were without precedent.

49 *The History of the Panama Canal: An Imperial/Latin American Counterpoint*, **MARÍA BÁRBARA ZEPEDA CORTÉS** (Department of History, University of California San Diego, MC 0104, 9500 Gilman Drive, La Jolla, CA 92093-0104; mzepedac@ucsd.edu).

While 2014 announces itself as the centenary of the opening of the Panama Canal, the possibility of such feat of engineering had been in the minds and dreams of powerful statesmen, businessmen, and political leaders for more than a hundred years before its completion. This paper offers an overview of the significance of a Central American artificial waterway for men of influence from different empires and world powers, such as Spain, Great Britain, and later France and the United States, but also from Latin America, like Francisco de Miranda and Simón Bolívar in the early nineteenth century, and General Omar Torrijos in the second half of the twentieth century. I compose an imperial/Latin American counterpoint to show how the less than fifty miles that separate the Atlantic from the Pacific Ocean have been conceived as a strategic "natural resource" for empires and national governments alike since the 1700s. My analysis of these leaders' projects and actions illuminates a progression of contemporary understandings about the Panama Canal. It also provides provocative insights into competing agendas and ambitions among empires and Latin American countries. This "great men" approach may seem antiquated, but I demonstrate that single political wills have loomed largely in the background of this enterprise throughout different periods of its long history, precisely because of the outstanding implications of planning, building, and maintaining a "path between the seas," as historian David McCullough simply, but poetically called the Canal.

50 *Sociological Aspects of the Panama Canal*, **THOMAS REIFER** (Department of Sociology, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110).

The building and development of the Panama Canal, viewed from the vantage point of both geohistory and historical sociology, brings together both the centrality of transport in the modern world-system, and its relationship to the global division of labor and construction of America's informal empire of trade and finance. This paper reviews the creation and development of the Panama Canal, with a particular focus on the role of transportation and transport workers from the dawn of the American Century to the early 21st century, with a particular focus on the shift of the global economy first towards the Atlantic and more recently in the shift of the center of the global market towards the Pacific.

51 Landslides of the Panama Canal, J. DAVID ROGERS (Department of Geological Sciences and Engineering, Missouri University of Science and Technology, 1400 N. Bishop Ave., Rolla, MO 65409; rogersda@umr.edu).

The French began excavating the Panama Canal in 1881, and began experiencing landslides in 1884, and abandoned the project in 1889. The Americans took over the project and commenced construction in 1905. Within two years they began experiencing slope failures and the decision was made to construct a locked canal, the supervision of which, passed onto the Army Corps of Engineers in 1908. By 1911 landslides threatened to shut the project down. The Corps was forced to alter their approach to the excavation and project completion was pushed off for 2-1/2 years. The volume of excavation increased by 300% beyond its original estimates at Culebra and Cucaracha. By 1913 75 million m³ of material was excavated from the Gaillard Cut, of which, 60% was slide debris or slope laybacks made necessary to achieve stability. In October 1913 the Corps gave up on stabilizing the slopes through unloading and drainage diversion, opting to flood the canal and complete the canal excavation using suction dredges, because it was a less expensive method to excavate the slide debris. The canal has been closed by landslides on 16 occasions over the past 97 years. Concerted effort was made to understand how the Cucaracha Shale loses significant shear strength during shearing, which has led to a better understanding of landslides, world-wide.

52 General Overview of the Panama Canal Expansion Project, ELDON GATH (Earth Consultants International, 1642 E. 4th St., Santa Ana, CA 92701, gath@earthconsultants.com).

Driven by the desire to accommodate larger container ships, the \$5.2B expansion of the Panama Canal is well underway. This expansion program has dozens of components, including new Pacific and Atlantic locks, extensive water recycling facilities, deepening of both oceanic approach channels, an ~7 km long bypass channel, four new dams (collectively termed ‘Borinquen Dam’) to form this channel 11 m above Miraflores Lake, main channel deepening, a ~1 m raising of the Gatun Lake level, raising of dozens of Gatun Lake’s surrounding saddle dams, a new spillway for Gatun Dam, a new bridge over the Atlantic approach, and numerous roads, pipelines, and other new infrastructure components. As currently planned, the new locks will be 427 m long, 55 m wide, 18.3 m deep, employ a three-step drop, use roller gates, and recycle most of the water. The design will result in 140 million cubic meters of excavation, not including remedial volumes. As part of the planning for the expansion, hundreds of new geotechnical borings have been drilled and geologically logged, and extensive studies have been completed to define and quantify the seismic hazards of central Panama. The schedule calls for the grand opening of the Expansion Project to be on August 15, 2014, the 100th anniversary of the original Panama Canal opening.

53 Tectonic Geomorphic and Paleoseismic Investigations of the Pedro Miguel Fault for the Panama Canal Expansion Project, ELDON GATH (Earth Consultants International, 1642 E. 4th St., Santa Ana, CA 92701, gath@earthconsultants.com).

As part of the seismic hazard investigation for design of the Panamá Canal Expansion Project, we completed detailed investigations of the Pedro Miguel fault. The previously assumed inactive fault was shown to right-laterally deform all fault-crossing streams and paleoseismic trenching excavations demonstrated that the fault

has experienced recurrent Holocene displacements. Therefore, the fault not only poses a shaking hazard to the Panamá Canal structures, it also poses a rupture hazard where it crosses through the proposed footprint of the ~7 km long, 11 m high, multi-segmented earthen Borinquen Dam, a critical part of the expansion program. Our studies of the fault eventually involved over 100 geologically logged trenches, including 3 locations where we excavated the fault in 3-D to determine earthquake recurrence, quantify displacement magnitudes and understand the fault’s detailed fault slip kinematics. We were able to determine that it has had 3 surface-rupturing earthquakes in the last 1600 years that cumulatively produced at least 8 meters of right-lateral displacement. The most recent event produced 3 meters of slip on May 2, 1621. At the surface, the fault exploits weak, low-angle bedding planes of the La Boca and Pedro Miguel Formations to rupture as a series of north-stepping, en-echelon, west-dipping fault petals that roll over near the surface to almost horizontal. The challenge for the dam’s designers will be to understand the geology of the fault-crossing location to be able to predict the fault rupture kinematics, and then to understand how that rupture will transfer into the dam’s earthen structure.

54 Historical Earthquake Activity in Central Panama, TANIA GONZALEZ (Earth Consultants International, Inc., 1642 E. Fourth Street, Santa Ana, CA 92701; tgonzalez@earthconsultants.com).

Panama in general, and central Panama specifically, has long been considered as having a low seismic activity. This perception is based on a lack of large, damaging earthquakes in more than 120 years. However, recent geomorphic and paleoseismic studies conducted as part of the Panama Canal expansion project, together with a new review of the historical records, show that this region has a much higher seismic hazard. The historical record shows that several moderate to large earthquakes have occurred here since the Spanish arrival in the early 1500s, including two very large events in 1621 and 1882. Our field studies have shown that several faults local to the Canal area have experienced at least one surface-rupturing earthquake in the last about 500 years, with the Limón and Gatún faults rupturing in the late 1800s. The geomorphic signature of these ruptures, extending tens of kilometers in length, indicate that these earthquakes had magnitudes of at least 6.7. Detailed topographic and paleoseismic studies of the Camino de Cruces have shown that the old Spanish cobblestone road was displaced about 2.8 meters right-laterally by rupture of the Pedro Miguel fault, confirming the source of the 1621 earthquake that destroyed the old capital of Panama. These findings indicate that central Panama is undergoing substantial internal deformation, at the rate of several millimeters per year, and that the earthquake hazard of this area has, until recently, been underestimated.

**New Humanities and Science Convergences:
New Languages for New Realities:
Literature, Poetry, and Hypertext
Monday, starting at 1:30 p.m. in KIPJ Room F**

55 Whither Hypertext? Electronic Literature and the Literary Canon, HUGH BURKHART (Copley Library, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110-2492; hburkhart@sandiego.edu).

‘Hypertext’ is a broad term often assigned to electronic literature. Starting with a few enthusiasts’ works in the 1980s, electronic literature grew steadily following the birth of the Web. The enthusiasm and media coverage that welcomed literary hypertext diminished over time, however, eclipsed by Kindles, iPads, social networking, and texting. Many hypertext creations have since entered the literary canon, yet permanent access to these seminal works is strangely absent in academic libraries. In his 2000 book *Othermindedness: The Emergence of Network Culture*, hypertext creator and scholar Michael Joyce discusses “an area that...most troubles librarians – common formats...and shared listings of electronic resources”(73). Eleven years later, this issue has still not been adequately addressed by academic institutions. This paper aims to engage scholars in a discussion of electronic writing by providing a brief history of literary hypertext, exploring the possible effects this gap in library collections could have on future scholarship, and offering a rationale for providing stable electronic access to canonical texts. In light of recent scholarship such as Astrid Ensslin’s 2007 book, *Canonizing Hypertext: Explorations and Constructions*, scholars, especially those involved with building collections for departments with creative writing programs or emphases, should be aware of this field and prepared to promote access that maintains this small but valuable part of the cultural record.

56 *Exploring the Labyrinth: Typography and Reader Engagement in House of Leaves*, **ALISON PEARL** (Department of English, University of Utah, 255 S Central Campus Drive Room 3500, Salt Lake City, UT 84112; pearl.alison@gmail.com).

This paper explores the interaction of hypertext and codex in Mark Danielewski’s, *House of Leaves*. Digital technologies allow for new uses of the traditional page, expanding the author’s ability to engage the reader. Typographical play in the novel forces the reader to manipulate the codex in a manner that evokes a physical reaction from the reader, a reaction that mirrors that of the characters. It changes our perceptions of how one can construct character: not simply with words, but with text, the pages themselves. Reader interaction becomes a means for character development. *House of Leaves* is not only aware of itself as a book by pointing to the physicality of pages, it’s aware of the physical reality of the reader and of reading as an action.

The application of technology through typography is literally and figuratively influencing the shape of narrative in Danielewski’s novel. Reading *House of Leaves* is reading an object that we hold in our hands, born out of the tradition of the codex, but understanding itself as a codex in a whole new physicality through its hypertextual implications. While a print novel asks us to turn pages and controls our reading with pacing, *House of Leaves* asks us to hold the book sideways by one side and read upward, toward the center, and then upward again, toward the margin with Danielewski asking: how can I use technology and the physicality of print to enhance or distort the reader’s experience of narrative and the traditional techniques novels employ?

57 *The [] Project: How Hypermedia Can Reshape the Critical Essay*, **ROBERT GLICK** (Department of English, University of Utah, Languages and Communication Building, 255 S. Central Campus Drive, Room 3500, Salt Lake City, UT 84112; robert@robertglick.com).

Robert Glick’s “The [] Project” explores how writers and critical theorists might use the web and other new media to expand

not simply what falls under the definition of critical theory but how we read it. As an example of Raymond Federman’s notion of “critification,” “The [] Project” salvages and spin-cycles critical theory, fiction, memoir, and news clipping in an attempt to provoke unusual and sometimes anxious understandings of ideas from unaligned discourses. In an extension of critification away from the printed page, hypermedia further allows the content of “The [] Project” to be revealed not as a linear presentation of axioms but as blocks of text whose appearance, order, and design (size, font, opacity) fall in and out of the reader / viewer’s control. “The [] Project” asks us to ask: Can new media help widen what we understand as theory? What happens if we imagine theoretical texts less as rigorous chains of logic and more as tumults of loosely linked ideas that spark creative response?

58 *Ethnopoetics and Ethnography of the Oral Tradition*, **CARLA MAIDA** (University of California, 63-037 Center for the Health Sciences, Los Angeles, CA 90095; cmaida@ucla.edu).

Ethnopoetics redefines poetry by focusing on alternative traditions in language and performance. The “recovery of the oral,” in Jerome Rothenberg’s words, “involves a poetics deeply rooted in the powers of song and speech, breath and body...with or without the existence of a visible/literal text.” Ethnopoetics surfaced after World War II, with the end of European colonialism, risks of nuclear and environmental hazards, and concern for the fate of wilderness and traditional societies. Two postwar frameworks inform its cognitive model. Social phenomenology views the body as a “community of senses” organizing individual experience and shaping meaning. A social “life world” emerges from commonly shaped experiences and interpretations. Culture, as social memory, promotes adaptive learning, taking precedents into account to anticipate outcomes, and using foresight and intentionality as cognitive potentials to reorganize the world to resist entropy. Symbolically representing the physical universe as a cognitive map, culture imposes “consistency among meanings” for working with the energetic world. Symbolic anthropology views this unifying of the mental and the energetic in a symbolic system as encoding cultural knowledge through ritualization. Ritual symbols prompt social action because their referents call up polarities between physiological phenomena and norms. Social dramas are recurrent forms of experience surrounding life crises, with their attendant liminality—a transitional state analogous to the “subjunctive mood” of culture (fantasy, hypothesis, conjecture). Performance behavior promotes “living through” this passage, using multiple sensory domains to dramatize the liminal state to provoke an exchange between physiological and cultural poles, and restore a sense of *communitas*.

59 *Poetry, Science, and Ecological Language: the Description of Birds*, **ROBERT LOUIS CHIANESE** (California State University, Northridge, Department of English, Northridge, CA 91320; robert.chianese@csun.edu).

In science, ecologists insist on a comprehensive view of life that attends to the web of connections that underlie biological systems. The new way of seeing requires new language, but science often lacks or even shuns this “ecological” language, a vocabulary, grammar, and syntax of interdependent life systems and processes.

Such language would convey complex interactions among things rather than the simple one-way effects of *a* subject upon *an* object. Poet Gerard Manley Hopkins achieves this in the poem “The Windhover,” where he describes the diving of a kestrel in its

interaction with the air, its prey object, and itself, and equates it symbolically to the “pursuit” of the non-believer by Christ. This mystical description nonetheless evokes the dynamics of the kestrel’s hovering and diving with both denotative and connotative accuracy. Other poets express the behavior of birds in similar, ecological language.

Scientists, ornithologists, and field guide writers usually avoid radical forms of expression that might push their descriptive language to new metaphoric heights. Science in its traditional focus on individual subject-object interactions of a single creature misses an opportunity to learn and borrow from poets. While the core of scientific description often relies heavily on metaphor, the “As if” explicit and implicit in scientific discourse, few scientists deliberately venture over the denotative, abstract language line to employ a poetic, suggestive, and evocative language which would in fact lead to more, not less accurate descriptions. Both science and poetry would gain from it.

Human Leishmaniasis in Mummified Remains: From Iconographical Sources to Modern Day Techniques
Tuesday, starting at 8:00 a.m. in KIPJ Theatre

60 *Introduction to Human Leishmaniasis in Mummified Remains: From Iconographical Sources to Modern Day Techniques*, **ANDREAS G. NERLICH^{1*} and RAFFAELLA BIANUCCI^{2,3,4}** (¹Academic Teaching Hospital München-Bogenhausen, Engelschalkingerstr. 77, D-81925 Munich, Germany; ²Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ³Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseilles, Boulevard Pierre Dramard, 13344 Marseilles, France; ⁴Division of Paleopathology, History of Medicine and Bioethics, Department of Oncology, Transplants and Advanced Technologies in Medicine, University of Pisa, Italy; andreas.nerlich@extern.lrz-muenchen.de).

Parasitic diseases affected mankind since antiquity. The investigation of human remains- with particular emphasis on mummified tissues- provides us with an encouraging novel source to evaluate origin and spread of those diseases.

The present symposium is devoted to an update presentation on the history of human leishmaniasis and related parasitic infections. This will include also the comparison between molecular analysis and archaeological disease evidence, such as from literary and iconographic sources.

The symposium is planned to start with an overview of the current microbiology of present day leishmaniasis as both as local and systemic disease dependent on the parasite strain. Molecular investigations on modern strains will provide first clues as to the origin and potential evolution of the pathogens.

Subsequently presentations on the most recent findings of Old and New World leishmaniasis in mummies and skeletonized human remains will shed light on the distribution and strain differences during antiquity. Particular reference will be made to the “clinical” consequence of the occurring disease, including cutaneous (CL), mucocutaneous (MCL), and visceral leishmaniasis (VL) for infected individuals and the disease impact on living conditions.

Thereby, we aim to reconstruct both the temporary and spatial evolution of the disease. As a further important issue, the significance of analytical techniques- including paleoserology and ancient DNA technology- will be presented and discussed as well.

In summary, the symposium may add a though specialized, but circumstantial view on a disease where novel analytical techniques are beginning to teach us much about biology, pathology and live conditions by help of the investigation of mummy tissues.

61 *Molecular Phylogeny, Taxonomy, and Evolution of Leishmania*, **GABRIELE SCHOENIAN** (Institute of Microbiology and Hygiene, Charité University Medicine Berlin, Dorotheenstr. 96, D-10117 Berlin, Germany; gabriele.schoenian@charite.de).

Leishmaniasis are sand fly-borne diseases caused by protozoan parasites of the genus *Leishmania* that affect people in vast areas of the world. The obligate intracellular parasites are known to infect humans leading to different forms of the disease, visceral (VL), cutaneous (CL) and muco-cutaneous (MCL) leishmaniasis in 88 countries of the Old New Worlds.

The current classification system of the genus *Leishmania* based on multilocus enzyme electrophoresis proposes up to 35 species. Molecular phylogenies of *Leishmania* have, however increasingly suggested that the number of species may be too large. A revision of *Leishmania* classification leading to its simplification without losing the detailed knowledge built up so far is therefore now under discussion. Whether the genus appeared first in the Old World or in the New World is still controversial although several rooted sequenced-based phylogenies favour a neotropical origin.

Many molecular markers, most recently multilocus microsatellite typing, have demonstrated substantial intra-species diversity and the existence of geographically and genetically isolated populations in all *Leishmania* species tested so far. Microsatellite analysis revealed that the agent of visceral leishmaniasis in the New World has recently been imported from southwest Europe to south and Central America.

A predominantly clonal evolution has been proposed for *Leishmania* with rare sexual recombination events. This hypothesis has repeatedly been challenged by the detection of hybrids, mosaic genotypes, and gene flow between populations, strong inbreeding and, finally, the detection of recombination under laboratory conditions.

62 *The Unresolved Origins of Leishmaniasis: a Phylogenetic Perspective*, **KELLY M. HARKINS** (Center for Bioarchaeological Research, School of Human Evolution of Social Change, Arizona State University, Tempe, AZ, 85287; kelly.harkins@asu.edu).

Understanding disease in the past, including host-parasite evolution, relies on the use of many lines of evidence, none of which are without limitations. The incongruence of molecular and host-based phylogenies has stirred debate regarding the origins and dispersal of the parasite *Leishmania* and the resulting human disease, leishmaniasis. Despite advancements in molecular techniques and sequence availability, evolutionary relationships within the genus *Leishmania* remain poorly resolved. Here, maximum likelihood, maximum parsimony and Bayesian analyses are used to highlight the shortcomings of these methods when applied to multiple gene sequences within *Leishmania*. Additional genomic data, as well as new sequences isolated from ancient remains may help resolve the debate; however, the “true” phylogenetic tree is yet to be found.

63 Evolutionary Origin of Phlebotominae (Diptera: Psychodidae) Based on Fossil Evidence and Potential Evolution of Host-Leishmania Interactions in the Old and the New World, REGINALDO PEÇANHA BRAZIL^{1*} and JOSÉ D. ANDRADE FILHO² (¹Instituto Oswaldo Cruz/FIOCRUZ, Lab. Bioquímica & Fisiologia de Inseto, Av. Brasil 4365, Pav. 26 -S/213, Rio de Janeiro, 21045-900, RJ, Brazil; ²Centro de Pesquisas René Rachou/FIOCRUZ, Belo Horizonte, MG, Brazil; rpbrasil@ioc.fiocruz.br).

The Psychodidae is widespread on all continents except Antarctica, suggesting that the family has a long evolutionary history which began during the Mesozoic. The earliest known psychodid is from the late Triassic of Virginia, USA) and the next oldest specimens in this group are from the Jurassic period of Germany. Large numbers of these Diptera have been found preserved in amber from the Baltic region, Lebanon, México, Dominican Republic, and Burma (Myanmar).

The sub-family Phlebotominae includes several genera that are habitual animal-biters and the vectors of flagellates Kinetoplastidae (Trypanosomatidae) to different groups of animals including humans. Of all Trypanosomatidae infecting extant animals there is no doubt that leishmaniasis is one of most widespread in the world, and humans may be one of the early hosts of this parasite.

Evolutionary hypotheses are given to explain the long relationship of Phlebotominae sandflies and *Leishmania* in the world.

64 Iconography of Mochica Leishmaniasis in Ancient Peru, ALFREDO ALTAMIRANO (Department of Archaeology of San Marcos University, Lima, Perú; Alfredo-altamirano@hotmail.com).

Leishmaniasis (CL and ML) has been present in Peru since ancient times. It seems to have influenced the cosmology of ancient people and been represented in portrait vessels (or *huacos retratos*), where a skin form ulcer appears on pottery within the middle valleys of the north coast occupied by the Moche.

We analyzed a group of 90 *huacos* with apparent CL and ML, noting their relationship to living human groups which cultivate coca leaf, corn, cotton, fruits, and potatoes. Some of these *huacos* depict humans sitting on llamas; they are mutilated and have had their extremities amputated. They are associated with sand flies, brushy areas, and dogs. This animal is the principal host of ML and CL.

Our working hypothesis is that those suffering from diseases (Leishmaniasis and Bartonellosis), a hard life, and mutilation in the Mochica area had received punishment by the “Mythic Woman” who organized “the revolt of the objects” and produced weather changes in ancient times. Mutilation and amputation were means to control those diseases in a relationship to the agrarian calendar.

Human sacrifice to mountains was important in the Mochicas’ cosmology to calm the ire of land gods (mountains) who were believed to produce epidemics of those diseases. Ceremonies were organized by elites to restore equilibrium between the World of the Dead and the World of the Living. Our interpretation is that the symbolic significance of these *huacos* is traceable to persons who saw CL and ML in living people.

65 Review of Paleopathology of Leishmaniasis in South America, ALFREDO ALTAMIRANO (Department of Archaeology of San Marcos University, Lima, Perú; Alfredo-altamirano@hotmail.com).

The origin of the most severe form of Leishmaniasis (ML or

espundia) has been proposed to have been in the western Amazon region, between Brazil, Peru and Bolivia. Research indicates at least four principal routes in pre-Columbian times. The first route is proposed to have been from Loreto-Amazonas-Cajamarca-La Libertad, across the Porculla Abra and Jequetepeque valley on the north coast of Peru, beginning in the late Formative period. In this valley, the Amazon forest advances to the “heart” of the Andean region; our proposal can be supported by iconographic representations in Moche and Salinar cultures and petroglyphs. The second route was via Huanuco-Junin-Lima because in the Makatampu, Rimac valley, central coast of Peru, were discovered five cases of adults with ML. The third route was via Madre de Dios-Puno-Cuzco-Ayacucho, a route supported by rich ethnohistoric data of ML and high mortality cases of highland herders (*mitmaq*) who went down to the Amazon forest to exploit coca leaf during the Inca Empire. The fourth route was Beni/Cochabamba-La Paz-Atacama where four cases of adult women with ML were found, dating to the Middle Horizon during Tiwanaku domination (700 to 1200 AD).

The risk of acquiring this disease is and was high because most Andeans who entered the forest were principally farmers. Those routes could have originated during the beginnings of agriculture and llama domestication. The expansion of *Leishmania (V.) braziliensis* and its adaptation to the Andean region probably developed into *Leishmania (V.) peruviana* that is well documented by recent paleopathological research.

66 Molecular Identification of Visceral Leishmaniasis in Ancient Egyptian and Nubian Tissue Samples, ANDREAS G. NERLICH^{1*}, MARK SPIGELMAN^{2,3}, BETTINA SCHRAUT¹, CHARLES L. GREENBLATT², ALBERT ZINK^{1,4}, and HELEN D. DONOGHUE⁵ (¹Institute of Pathology, Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ²Kuvin Center for Infectious Diseases, Hadassah Medical School, The Hebrew University Jerusalem, Israel; ³Department of Microbiology, University College, University of London, England; ⁴present address: EURAC Bolzano, Italy; ⁵University College London, Centre for Infectious Diseases and International Health, Windeyer Institute of Medical Sciences, 46 Cleveland St., London W1T 4JF, UK; andreas.nerlich@extern.lrz-muenchen.de).

This report describes the identification of *L. donovani* DNA in ancient Egyptian and Christian Nubian mummies. We analyzed 91 bone samples from Egyptian mummies and skeletons and 70 bone marrow samples from naturally mummified remains from Upper Nubia. The Egyptian material is from the Pre- to Early Dynastic site of Abydos (n = 7; 3500–2800 BC), a Middle Kingdom tomb in Thebes West (42; 2050–1650 BC), and tomb complexes in Thebes West, used between the Middle and New Kingdom until the Late Period (42; c. 2050–500 BC). The Nubian samples (pre-flooding of Aswan Dam) were taken from two early Christian sites at Kulubnarti, dated from 550–750 AD and c.750–1500 AD. All samples were characterized by direct sequencing.

In four of the 91 Egyptian and nine of the 70 Nubian samples, a 120-bp fragment of a conserved region of the parasite’s minicircle molecule of kinetoplastid mitochondrial DNA was successfully amplified. With the first primer pair, it was unambiguously related to *L. donovani* species after sequencing. The positive samples from Egypt originated from the Middle Kingdom tomb, while no molecular evidence for ancient *Leishmania* DNA was found in the Pre- to Early Dynastic and the New Kingdom to Late Period specimens.

The Sudan is highly endemic for visceral leishmaniasis,

considered to have originated in East Africa and spread to the Indian subcontinent and the New World. In the Middle Kingdom, the Egyptians traded with Nubia. Therefore, the high incidence of *Leishmania* DNA in the Middle Kingdom samples (4 [9.5%] of 42) and its lack in earlier or later time periods, may indicate that leishmaniasis was introduced into Egypt at this time. The high frequency of *Leishmania* DNA-positive samples in the Nubian mummies (12.9%) suggests that leishmaniasis may have been endemic in Nubia during the Early Christian period and probably several thousand years before. Our results support the theory that the Sudan could have been the original focus of visceral leishmaniasis.

67 First Evidence of *Leishmania infantum*/Mycobacterium tuberculosis Co-infection from Renaissance Europe, RAFFAELLA BIANUCCI^{1,2,9*}, ANDREAS G. NERLICH³, ABIGAIL BOUWMAN⁴, CHARLOTTE ROBERTS⁴, GABRIELE SCHEENIAN⁵, ANNA TRISCIUOGGIO⁶, CARSTEN M. PUSCH⁷, MARKUS BALL⁷, BEATRICE BACHMEIER⁸, EZIO FERROGLIO⁶, VALENTINA GIUFFRÀ⁹, SANDRA LOESCH^{3,10}, and GINO FORNACIARI⁹ (¹Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ²Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseille, Boulevard Pierre Dramard, 13344 Marseille, France; ³Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ⁴Department of Archaeology, University of Durham, United Kingdom; ⁵Institute for Microbiology, Charité Universitätsmedizin, Berlin, Germany; ⁶Laboratory of Parasitology and Parasitic Diseases, Department of Animal Production, Epidemiology and Ecology, University of Turin, Italy; ⁷Institute of Anthropology and Human Genetics, Division of Molecular Genetics, University of Tübingen, Germany; ⁸Department of Clinical Chemistry and Clinical Biochemistry, University of Munich, Germany; ⁹Division of Paleopathology, History of Medicine and Bioethics, Department of Oncology, Transplants and Advanced Technologies in Medicine, University of Pisa, Italy; ¹⁰present address: Department of Physical Anthropology, Institute of Forensic Medicine, University of Bern, Switzerland; raffaella.bianucci@unito.it; raffaella.bianucci@gmail.com).

We provide first evidence for visceral leishmaniasis (VL) and *Mycobacterium tuberculosis* complex (TB) co-infection in the skeletal remains of Eleonora of Toledo (1522 – 1562), wife of Cosimo I de' Medici.

Positive identification of *Leishmania infantum* in bone samples by Western blot SDS-PAGE detected an IgG response anti-*L. infantum*. PCR yielded successful amplification of a 121-bp fragment of a conserved region of the minicircle molecule of the parasite's kinetoplast mitochondrial DNA. Unique *M. tuberculosis* complex sequences (IS 6110 and rpoB) were also identified in Eleonora's remains indicating that the historical reports which implied that, at age of 29, she developed pulmonary tuberculosis, were correct.

Although distinct in aetiology and transmission mechanisms, VL and TB share several features. Many infections remain asymptomatic. Symptoms usually develop after several months or years in those who progress to clinical disease. The very long incubation periods may be related to immune suppression which apparently turns the latent infection into active disease.

It has been suggested that TB represents one of the

immunosuppressive conditions that can cause the progression of latent leishmanial infection to clinical leishmaniasis. Similarly, VL can reactivate a latent mycobacterial infection.

Eleonora's true state of health cannot now be evaluated. Long-term infections such as VL and TB pose many fundamental biological questions which are of great current interest in mammalian immune surveillance.

Geophysical Turbulence

Tuesday, starting at 8:10 a.m. in KIPJ Room E

68 INVITED PRESENTATION: Turbulent Rotating Convection, HERMAN CLERCX (Department of Applied Physics, Eindhoven University of Technology, Den Dolech 2, Eindhoven, The Netherlands; h.j.h.clercx@tue.nl).

Rayleigh-Bénard convection is a classical problem in which a fluid layer enclosed between two parallel horizontal walls is heated from below and cooled at the top. In a rotating frame of reference the dynamics can change considerably through the fundamental involvement of a combination of buoyancy and Coriolis forces. The rotating Rayleigh-Bénard (RRB) setting is important for many applications, e.g., in engineering and climate modelling. Direct numerical simulation (DNS) is used to calculate the heat transfer, flow structuring and small-scale turbulent properties at systematically varied rotation rates. The DNS code solves the incompressible Navier-Stokes equations in a cylinder in a rotating frame of reference, coupled to the heat equation within the Boussinesq approximation. The results from the DNS will be compared to data from SPIV measurements in a water-filled cylindrical convection cell and Nusselt measurements. In particular, the fate of the Large Scale Circulation, present in non-rotating RB convection, and enhanced heat transfer under influence of increasing rotation rate will be discussed in this talk.

69 Numerical Simulations of Stratified and Rotating Turbulence using Feature Extraction, ERIC AROBONE* and SUTANU SARKAR (Department of Mechanical and Aerospace Engineering, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0411; earobone@ucsd.edu).

Submesoscale ocean dynamics are characterized by significant, but far from dominant effects of rotation and stable stratification. Coherent vortices are a prominent feature of flows in this regime. Stratification tends to increase vertical shear via the kinematic decorrelation mechanism, while rotation can either stabilize or destabilize the flow field via the shear/Coriolis instability.

We focus our study on a mixing layer with purely horizontal shear and moderate rotation and stratification, with Rossby and Froude numbers of $O(1)$. This model seeks to help explain dynamics of quasi-vertical submesoscale coherent structures in the ocean without the influence of horizontal density variation.

To facilitate greater understanding of the role of coherent vorticity in the evolution of the flow field, we utilize coherent vortex extraction via the λ_2 criterion and wavelet analysis. The computational domain is divided into coherent and incoherent vortical regions. Prior work by the authors investigating a stratified mixing layer showed that both subdomains (λ_2) are important according to global fluxes, with the incoherent field accomplishing most of the lateral energy transfer in the flow and coherent field being

responsible for most of the vertical mixing. Wavelet analysis showed a significant reduction in degrees of freedom for stratified turbulence, with the incoherent vorticity field playing a lesser role in the turbulence energetics than when density was uniform.

70 Interactions of Building Flows and Influence of Tall Buildings on Ground Level Concentration, HANSHENG PAN*, **MARKO PRINCEVAC**, and **CHRISTIAN BARTOLOME** (Department of Mechanical Engineering, University of California Riverside, 900 University Ave., Riverside, CA 92521; hapan@engr.ucr.edu).

Water channel experiments were conducted to model an urban area in downtown Los Angeles with complex building configurations and traffic arterials. Tracer plumes were released from ground level line sources to simulate pollutants emitted from vehicles in arterials. Simultaneous Particle Image Velocimetry/Planar Laser Induced Fluorescence (PIV/PLIF) technique was applied to acquire the flow velocity and plume concentration data in selected vertical planes.

The impact of an individual tall building on flow characteristics and plume dispersion was investigated. The non-dimensional concentration (where the concentration of pollutant is $[\text{mg}/\text{m}^3]$, the free stream velocity is $[\text{m}/\text{s}]$, the characteristic length is $[\text{m}]$, taken as the average building height, and the pollutant emission rate is $[\text{mg}/\text{s}]$) of plume was compared between case with tall building and without tall building. In the presence of the tall building, clockwise vortex regions were observed upwind the building. At the upstream roof edge of the tall building, there was an acceleration region with high turbulent kinetic energy. The street level plume can be lifted up by the wake of tall building. The near surface concentration is much higher for the case without the tall building. The recirculation flow upwind of the tall building diluted the plume quickly, which is corresponding to the high turbulence intensity region. The concentration of this region is more uniform and much lower than that without tall building. The presence of tall building could amplify the influence on plume extend. The influence of building configurations and the physical mechanisms governing ground level concentrations will be presented.

71 An Application of a Simple Free Convection Model to the Fire Flickering Phenomenon, TREVOR MAYNARD* and **MARKO PRINCEVAC** (Department of Mechanical Engineering, University of California Riverside, 900 University Ave., Riverside, CA 92521; tmaynard@engr.ucr.edu).

A unique characteristic of non-premixed (diffusion) flames is their tendency to pulsate, or “flicker”, at a well-known frequency that appears to be sensitive only to fire diameter and ambient air entrainment path. Though the dynamics of fire oscillation have been widely studied, no simple and consistent physical explanation for this phenomenon currently exists. In this presentation, physical mechanism for flickering will be related to another phenomenon of free convection, the development of thermals (warm fluid “blobs”) over a heated surface. A simple scaling model adapted from the study of thermals will be introduced. The model assumes uniform entrainment and blob separation from the surface upon reaching a critical size expressed via Rayleigh number. The model predicts a pulsation frequency which is proportional to the inverse of fire diameter. The model is compared with high-speed photography experiments and numerical simulations performed using the NIST Fire Dynamics Simulator (FDS), a computational fluid dynamics (CFD) fire model. It was found that the frequency of pulsation for

fires greater than 5 cm in diameter is proportional to the inverse square root of fire diameter, which agrees with existing experiments in the literature. However, fires smaller than 5 cm pulsated at a greater frequency. It is hypothesized that upon reaching a critical fire diameter, multiple thermals begin to form above the fuel surface, modifying overall fire behavior. Theoretical analysis, numerical modeling and laboratory experiments will be presented.

72 Laboratory Measurements and Sensitivity Modeling of the Thermodynamic and Droplet Characteristics of Superfog, CHRISTIAN BARTOLOME^{1*}, **MARKO PRINCEVAC¹**, **AKULA VENKATRAM¹**, **SHANKAR MAHALINGAM²**, **DAVID R. WEISE³**, **GARY ACHEMEIER⁴**, **HENRY VU¹**, and **GUILLERMO AGUILAR¹** (¹Department of Mechanical Engineering, University of California, 900 University Ave., Riverside, CA 92521; ²College of Engineering, University of Alabama, 301 Sparkman Drive Huntsville, AL 35899; ³PSW Research Station, USDA Forest Service, 4955 Canyon Crest Drive, Riverside, CA 92507; ⁴Forestry Sciences Laboratory Southern Research Station, USDA Forest Service, 320 Green Street Athens, GA 30602-2044; cbartolo@ucr.edu).

Land management techniques in wildland areas include prescribed fires to promote biodiversity and reduce risk of severe wildfires. Several fatal car pileups have been associated with smoke-related visibility reduction from prescribed burns. Superfogs are special cases of smoke visibility reduction to less than three meters. The need to accurately characterize and model conditions that lead to superfog is of importance to land managers to be able to prevent dangerous low visibility situations when planning prescribed burns.

Empirical relations developed for naturally occurring advection fogs relate visibility to the liquid water content (LWC). It has been hypothesized that extremely hygroscopic cloud condensation nuclei (CCN) from the smoldering phase of a fire can produce a large number of droplets smaller in size than in naturally occurring fog. Consequently, it is feasible to achieve superfog conditions at relatively low LWC ($\sim 2 \text{ g m}^{-3}$). Laboratory generated fogs resembling near superfog visibilities have been measured by Phase Doppler Particle Analyzer (PDPA) system to determine droplet number density and size distribution. A sensitivity study of droplet size distributions was carried out to understand the impact on visibility and LWC. Superfog formation under various concentrations of solute CCN was modeled. It was found that for high concentrations of solute pollutants, water vapor will readily condense to a large number of droplets to form superfog. Effect of turbulent entrainment of the ambient air was investigated numerically. Modeling results of droplet size distribution and turbulent entrainment impact on visibility will be presented together with laboratory measurements of size distribution and number density during superfog generation.

73 Development of the Urban Nocturnal Boundary Layer, SAM POURNAZERI*, **MARKO PRINCEVAC**, **AKULA VENKATRAM**, **SITAN**, and **NICO SCHULTE** (Department of Mechanical Engineering, University of California Riverside, Riverside, CA 92521; spournazeri@engr.ucr.edu).

Boundary layer height is one of the key input parameters into air pollution dispersion models as it limits the vertical mixing of pollutants especially during nighttime. Correct parameterization of nocturnal boundary layer height can significantly improve the performance of models in predicting the ground level concentrations. Although many parameterizations of the boundary layer height exist, none of them predicts the nighttime boundary layer height

accurately. Therefore, in order to have a better understanding on the nighttime urban boundary layer, a comprehensive field study was conducted in Riverside, CA where the vertical profiles of temperature; wind speed; and humidity were measured using a tethered meteorological balloon up to 500m from the ground. In addition to sounding data, surface meteorology was also measured using sonic anemometers.

Results from this field study have shown that during nighttime, urban boundary layer is very stable close to the ground and becomes neutrally stable at distances of 200-300m from the ground. Using the sounding data, boundary layer height associated with each profile was determined. It has been observed that nighttime boundary layer height increases almost linearly with time ($h \sim t^{0.9}$).

In addition to analyses of observations, a methods for predicting the boundary layer height using surface friction velocity (u_*) were proposed. The performance of this method was evaluated using the observed data. The new model performs well in predicting the boundary layer height during nighttime.

Data from the field study and the performance of the new boundary layer height parameterization will be presented.

74 Systematic Modeling of the Effects of Sound Barriers on the Dispersion From Roadways, BRANDN GAZZOLO*, **SAM POURNAZERI**, and **MARKO PRINCEVAC** (Department of Mechanical Engineering, University of California, Riverside, 900 University Ave. Riverside, CA 92521; bgazz001@student.ucr.edu).

Previous research of air quality in the vicinity of roadways has used either field measurements, where results are site specific, or modeling, which can be computationally expensive or too simplified and misleading. The presented research consists of systematical laboratory and numerical investigation of the influence of different sound barrier (SB) and roadway configurations. The laboratory experiments are being conducted at the Laboratory for Environmental Flow Modeling at the University of California, Riverside which has a custom made water channel with the capability of performing Particle Image Velocimetry and Planar Laser Induced Fluorescence. The water channel is also being used for visualizations by releasing a mixture of dye and alcohol (to obtain the desired dye buoyancy) and presented measurements have been made with a neutrally buoyant release. The laboratory experiments are accompanied with numerical modeling using Quick Urban and Industrial Complex, which consists of a wind model and a dispersion model. The wind model is a Computational Fluid Dynamics model that solves the Reynolds Averaged Navier-Stokes equations and the dispersion model is a Lagrangian particle dispersion model. It was found that in both water channel and QUIC simulations the presence of SBs increases the vertical spread of the plume relative to that of no SBs. Having two SBs of equal height produces a small recirculation cavity on the lee side of the downwind SB, and this recirculation is much greater when the downwind SB is double the height of the upwind SB. We expect to find that the presence of SBs will decrease the downwind concentrations due to the increased vertical mixing. The effects of increased roadway turbulence, buoyant release and the effects of ground heating on the dispersion of pollutants will be investigated next.

75 Rise of Buoyant Emissions from Low Level Sources in Urban Areas, MARKO PRINCEVAC*, **SAM POURNAZERI**, and **AKULA VENKATRAM** (Department of Mechanical Engineering, University of California Riverside, Riverside, CA 92521;

marko@engr.ucr.edu).

Rapid increase in the use of distributed power generators (DGs) has raised the concerns on the impact of DGs on the air quality in urban areas. The pollutants produced due to the combustion process in DGs are released at relatively low heights (about 10 m) in urban areas in the vicinity of businesses, schools, hotels, and hospitals where they can be captured in the wake of surrounding buildings, thus increasing the ground level concentrations. One way of increasing the efficiency in DGs is by capturing the waste heat from exhaust and coolant. This heat recovery process decreases the exhaust temperature and leads to a lower plume rise, which can cause higher ground level concentrations. Therefore, realistic modeling of plume rise from DGs plays a major role in determining the ground level concentrations associated with these sources.

Since none of the past and current studies have focused on plume rise from low level buoyant sources a comprehensive field study was conducted in Palm Springs, CA where plume rise from a DG located in Sunrise Park was measured by using a new plume rise photography method. Results from field study show that for low wind speeds the plume rise is not influenced by the buildings and the Briggs plume rise model performs reasonably well.

In addition to the field study, a laboratory study was conducted in a water channel in order to understand the effect of surrounding buildings on plume rise. The experiments reveal that plume rise from low level buoyant sources is highly affected by the complex flows induced by buildings stationed upstream and downstream of the source. The results obtained from the laboratory study were compared with a revised numerical plume rise model based on the conservation equations of mass, momentum and buoyancy flux.

Results from field, laboratory and numerical plume rise model will be presented.

76 Scale-dependent and Directional Statistics in Anisotropic Turbulence using Wavelets, KAI SCHNEIDER^{1*}, WOUTER BOS², MARIE FARGE³, FRANK JACOBITZ⁴, YUKIO KANDEA⁵, LUKAS LIECHTENSTEIN⁶, NAOYA OKAMOTO⁵, and KATSUNORI YOSHIMATSU⁵ (¹M2P2-CNRS & Centre de Mathématiques et d'Informatique, Université de Provence, 39 rue Frédéric Joliot-Curie, 13453 Marseille cedex 13, France; ²LMFA, Ecole Centrale Lyon, France; ³LMD, Ecole Normale Supérieure, Paris, France; ⁴University of San Diego, San Diego, CA USA; ⁵Nagoya University, Japan; ⁶M2P2, Aix-Marseille University, Marseille, France; kschneid@cmi.univ-mrs.fr).

Wavelet decomposition of flow fields yields information on scale, position and direction. Scale-dependent statistical analysis of turbulent flows can thus be performed by considering the wavelet coefficients, e.g., of velocity or vorticity. Wavelet-based directional energies can be defined which capture the properties of velocity gradients. A comparison with Reynolds stress and the dissipation rate anisotropy provides a reference for these newly defined wavelet based anisotropy measures. The intermittency of the flow in different directions can be quantified with scale-dependent directional flatness. The scale-dependent velocity flatness is shown to quantify the spatial variability of the energy spectrum. Scale-dependent helicity probability distribution functions allow one to statistically characterize the geometry of the motion at different scales. We will present applications to different anisotropic flows computed by direct numerical simulation, like rotating, sheared and stratified turbulence and also give some illustrations for MHD turbulence. This work is joint work with Wouter Bos, Marie Farge, Frank Jacobitz,

Yukio Kaneda, Lukas Liechtenstein, Naoya Okamoto and Katsunori Yoshimatsu.

Publications can be downloaded from <http://www.cmi.univ-mrs.fr/~kschneid> and <http://wavelets.ens.fr>.

77 On Helical Properties of Homogeneous Turbulence, FRANK G JACOBITZ¹, KAI SCHNEIDER², WOUTER J.T. BOS³, and MARIE FARGE⁴ (¹Mechanical Engineering Program, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110, USA, jacobitz@sandiego.edu; ²M2P2-CNRS & CMI, Aix-Marseille University, 39, rue F. Joliot-Curie, 13453 Marseille, Cedex 13, France, kschneid@cmi.univ-mrs.fr; ³LMFA-CNRS, Ecole Centrale de Lyon - Université de Lyon, 36, avenue Guy de Collongues, 69134 Ecully, France, wouter.bos@ec-lyon.fr; ⁴LMD-IPSL-CNRS, Ecole Normale Supérieure, 24, rue Lhomond, 75231 Paris, Cedex 5, France, farge@lmd.ens.fr).

Helical properties of a variety of prototypical turbulent flows, including forced isotropic turbulence, sheared turbulence, rotating sheared turbulence, and rotating turbulence, are investigated in this study using results obtained from direct numerical simulations. Distributions of velocity helicity show a preference for two-dimensionalization for flows with growing turbulence and a trend to helical motion for decaying turbulence. A scale-dependent analysis shows a trend to two-dimensionalization for large scales of motion and a preference for helical motion at small scales. These results are consistent for all flows considered in this study. Joint probability distribution functions show a strong correlation of the signs of velocity helicity and vorticity helicity for all cases. This correlation implies that vorticity helicity diminishes velocity helicity.

78 Turbulence in the Near Wake of Strongly Stratified Flow Around a Sphere, KYLE A. BRUCKER*, THOMAS T. O'SHEA, JAMES W. ROTTMAN, and DOUGLAS G. DOMMERMUTH (Naval Hydrodynamics Division, Science Applications International Corporation, 10260 Campus Point Drive, San Diego CA 92121; kyle.a.brucker@saic.com).

The results of a set on numerical simulations of a spherical body traveling horizontally at constant speed through uniform and uniformly stratified fluids, are presented and discussed. This study employs the Numerical Flow Analysis (NFA) tool for simulating high Reynolds number flows around obstacles. Details of the implementation of NFA on distributed memory high performance computing platforms and the addition of the stratified flow capability are discussed. The results of several validation studies are discussed; subsequently attention is given to the case where the internal Froude number is unity. Here, the internal Froude number is defined as $Fr=U/(ND)$, where U the speed, N is the buoyancy frequency, and D the diameter of the sphere. Visualizations of the density disturbance, $\rho(x,y,z,t)-\rho(x,y,z,t=0)$, on the vertical center plane illustrate the formation of thin shear-layers in the lee of the sphere. These shear layers are unstable and rapidly breakdown which results in the generation of turbulence. The turbulence modifies the body generated internal gravity waves. The presence of these shear layers have not been previously observed in numerical simulations because the Reynolds numbers were moderate.

79 Evening Transition in Complex Terrain, H.J.S. FERNANDO¹, L. LEO², S. DISABATINO², and A. DALLMAN¹ (¹University of Notre Dame, Environmental Fluid Dynamics Laboratories, Departments of Civil Engineering and Geological Sciences and Aerospace

& Mechanical Engineering, Notre Dame, IN 46556; ²Dipartimento di Scienza dei Materiali, Università del Salento, Lecce, Italy; Fernando.10@nd.edu).

The evening transition between up and down slope/valley flows in complex terrain remains one of the least understood aspects of mountain meteorology. Non-stationary and spatially inhomogeneous nature of processes involved and possible front formation have stymied the data analysis, delineation of physical processes and numerical modeling of evening transition. Following the theoretical, laboratory and observational insights gained from VTMX, we have conducted an evening transition experiment in the complex terrain of Phoenix airshed (TANSFLEX-2007) and participated in Meteo-Diffusion studies in the Biferno Valley of Italy, organized by ENEA. The results of former show that evening transition is associated with the formation of a front, immediately followed by its downward propagation to initiate the katabatic flow. Once the downslope flow is established, the near surface stable layer cuts off the communication of ground with the upper layers, thus increasing the longevity of upslope flow aloft. On the other hand, the Biferno valley case is complicated by the contiguous ocean, and differential cooling rates between oceans and valley complicate the transition mechanism. The front formation may still be present, but the mean flow is dominated by the horizontal pressure gradients induced by the variation of land cover.

80 INVITED PRESENTATION: What is Geophysical Turbulence and Which Way Does it Cascade? CARL H. GIBSON (Departments of MAE and SIO, University of California San Diego, La Jolla, CA 92093; cgibson@ucsd.edu, <http://sdcc3.ucsd.edu/~ir118>).

Geophysical turbulence can be considered as turbulence in a particular context, like oceanic turbulence or astrophysical turbulence. If the definition of turbulence is restricted to eddy-like states of fluid motion where the inertial vortex forces of the eddies are larger than any other forces that tend to damp the eddies out, then it becomes unnecessary to distinguish between different forms of turbulence. Turbulence flows become universally similar according to the Kolmogorov similarity laws, whether the context is geophysical, laboratory or numerical simulations, or cosmological.

This is the good news. The bad news is that generations of students must unlearn what they have been taught about turbulence. We were all taught that turbulence cascades from large scales to small. This is wrong. Turbulence defined by the inertial vortex forces of its eddies always cascades from small scales to large. Eddy-like motions that are irrotational are not turbulence by definition, even though such motions supply the kinetic energy of turbulence at the Kolmogorov scales where turbulence begins. The mechanism of the turbulence cascade is merging of adjacent eddies with the same spin, which induce inertial vortex forces towards each other. Adjacent eddies of opposite spin induce repulsion and translation, and entrainment of irrotational fluid into the interstices of the turbulence.

In natural flows such as geophysical turbulence, the cascade from small scales to large is limited by buoyancy, converting turbulent kinetic energy to that of fossil turbulence waves that dominate all vertical transport processes and mixing.

Antarctic Ice Is Nice**Tuesday, starting at 8:20 a.m. in KIPJ Room H**

81 *Elevation Changes on Antarctica's Ice Shelves*, **FERNANDO S. PAOLO^{1*}, HELEN A. FRICKER¹, and LAURIE PADMAN²** (¹IGPP, Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0225, USA, fpaolo@ucsd.edu and hafriker@ucsd.edu; ²Earth and Space Research, 3350 SW Cascade Ave., Corvallis, OR 97333-1536, USA, padman@esr.org).

Recent observations have shown that ice sheets of Antarctica and Greenland are likely to become the dominant contributors to global sea level rise in the 21st century; the global sea level equivalent of these ice sheets is about 65 m. In Antarctica, more than 80% of the ice drains through its fringing ice shelves. Since they are in direct contact with both the atmosphere and the ocean, ice shelves are potentially vulnerable to environmental changes. Indeed, over the past 15 years several ice shelves of the Antarctic Peninsula (AP) have undergone dramatic collapses in response to local warming (e.g., Wordie, Larsen-B, Wilkins). Although ice shelf collapse itself does not affect sea level, measurements of the velocity and elevation of grounded glaciers feeding these ice shelves indicate that the flow of land ice into the ocean rapidly accelerates after the buttressing ice shelf has collapsed, which does contribute to sea level. Predicting global sea level rise therefore requires that we understand the link between climate forcing, ice shelf change and glacier flow, which means we need to establish the causes and mechanisms of recent changes in the ice shelves around the Antarctic continent. Our approach to the problem is based on the use of multi-mission satellite radar altimetry: combining historical altimeters [e.g., Seasat (1978) and Geosat (1985)] with modern ones [ERS-1, ERS-2 and Envisat, as well as the recently launched CryoSat (2010)], to investigate changes in Antarctic ice shelves and the links between this process and atmospheric and oceanic forcing.

82 *Cooling, Dilution and Mixing of Ocean Water by Free-drifting Icebergs in the Weddell Sea*, **JOHN HELLY** (San Diego Supercomputer Center, University of California San Diego, La Jolla, CA 92093-0505, USA; hellyj@ucsd.edu).

Iceberg C-18a (35 x 7 x 0.184 km) was studied repeatedly by five circumnavigational surveys in March-April 2009. During the period of the surveys, C-18a traveled 109 nautical miles in 23 days, covering an area of 8.1×10^3 km². This iceberg was formed from iceberg C-18 (76 x 7 km) that originated from the Ross Ice Shelf in May, 2002. Ship-based measurements showed that this iceberg produced fresh meltwater above the seasonal pycnocline that diluted and chilled the water it passed through from the surface to a depth of approximately 50 m (summer mixed layer). The surface meltwater effects were detectable as far away as 19 km and persisted for at least 10 days. We also found evidence that this iceberg was disrupting the Weddell Deep Water to depths up to 1500 m. If we include these deep effects through the water column, the estimate of ocean water altered by this single iceberg reaches 3×10^{12} m³ over 23 days. Chemical and biological effects were detected at the same space and time scales as the physical properties, with decreasing partial pressure of carbon dioxide (pCO₂) close to the iceberg and lower particle and chlorophyll concentration. Ten days after the passage of C-18a, chlorophyll *a* had increased by 15%. These results are consistent with alternative hypotheses regarding the role of icebergs as mediators of a localized geophysical disturbance (H1) as well as promoters of chlorophyll *a* production (H2).

83 *Subsurface Melting of a Free-Floating Antarctic Iceberg*, **GORDON R. STEPHENSON, JR.***, **JANET SPRINTALL**, **SARAH T. GILLE**, **MARIA VERNET**, **JOHN J. HELLY**, and **RONALD S. KAUFMANN** (Scripps Institution of Oceanography, University of California San Diego, 9500 Gilman Dr., Mail Code 0230, La Jolla, CA 92093, USA; grstephe@ucsd.edu).

Temperature and salinity profiles were used to estimate the dispersal of meltwater from melting below the sea surface near a large tabular iceberg in the Weddell Sea in March and April 2009. Two distinct modes of distribution were observed. Turbulent entrainment of meltwater at the iceberg's base into the surrounding water resulted in upward transport of water from the permanent thermocline; this appeared as a warm, salty anomaly in T-S diagrams. Double-diffusive processes acting on the vertical sidewall of the iceberg transferred meltwater horizontally, rather than vertically, and resulted in stepped profiles of temperature, salinity, and density in the seasonal thermocline. The amounts of meltwater contributed by each process to the upper 200 m were similar: O(0.1 m³) in a 1 m² water column, but only basal melting resulted in significant local upwelling, suggesting the two processes may have different effects on vertical nutrient transport.

84 *From Enigmatic Extremophile Environment to a Window on the Workings of a Water System: Antarctica's Subglacial Lakes and Waterways*, **SASHA CARTER** (Scripps Institution of Oceanography, 9500 Gilman Drive, La Jolla, CA 92093-0225, USA; Shasha.ase.carter@gmail.com).

As recently as eight years ago subglacial lakes were popularly believed to be static, sparse, and hydraulically isolated water bodies located primarily beneath the remotest, thickest parts of the Antarctic ice sheet. Recent satellite remote sensing of changes in the ice surface has since revealed that subglacial lakes are far more widespread than previously thought and undergo periodic fluctuations in volume. Consequently they comprise a critical component of the water system that controls basal lubrication and enables the rapid basal motion of the overlying ice in nearly all of the major ice streams through which mass loss occurs in Antarctica. Where sufficient data exists, it has been recently shown that the volume change undergone by subglacial lakes can account for nearly all of the basal meltwater produced upstream. Therefore it is possible to use observations of subglacial lake volume change over time to test hypotheses about the evolution of the water system, predict its impact on the flow of the overlying ice, and make inferences about the geological and glaciological controls on the subglacial environment.

85 *The Effect of Free-Drifting Icebergs on the Physiology of Antarctic Krill, Euphausia superba, in the Southern Ocean*, **DANIELLE N. GARCIA^{1*}**, **RONALD S. KAUFMANN¹**, and **MARY SUE LOWERY²** (¹Marine Science and Environmental Studies Department, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; ²Department of Biology, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; dgarcia-09@sandiego.edu).

Recent loss of ice shelves around Antarctica has resulted in an increase in free-drifting icebergs in the Southern Ocean. These icebergs are thought to enrich surrounding waters by releasing terrestrially-derived material, but few studies have examined their effects on surrounding ecosystems. Antarctic krill, *Euphausia superba*, represent the keystone species in the Antarctic pelagic food web and serve as a major food source for organisms at higher

trophic levels. Morphological measurements and activities of the enzymes lactate dehydrogenase (LDH) and citrate synthase (CS) were used to assess the metabolic status of *E. superba* collected at various distances from free-drifting icebergs in the Atlantic sector of the Southern Ocean over three seasons. Krill collected during late spring were larger and had higher enzyme activity compared to krill captured in late fall. Male krill generally had higher activities of LDH than females (especially during the late spring), but CS activities were similar between males and females. There was no consistent pattern in physical and metabolic indicators among krill with distance from different icebergs, and in many cases significant differences were found in these indicators among samples from the same distance. These results suggest that physiological condition in *E. superba* is influenced primarily by seasonal variation and not by proximity to an iceberg.

86 Composition and Structure of Macrozooplankton and Micronekton Communities in the Vicinity of Free-Drifting Icebergs in the Southern Ocean, RONALD S. KAUFMANN^{1*}, ROB E. SHERLOCK², STEPHANIE L. BUSH³, KAREN J. OSBORN⁴, DANIELLE N. GARCIA¹, KIM R. REISENBICHLER², MARY S. LOWERY⁵, BRUCE H. ROBISON², and KENNETH L. SMITH, JR.² (¹Marine Science and Environmental Studies Department, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; ²Monterey Bay Aquarium Research Institute, 7700 Sandholdt Rd., Moss Landing, CA 95039; ³Department of Biological Sciences, University of Rhode Island, Kingston, RI 02881; ⁴Institute of Marine Science, University of California Santa Cruz, 1156 High Street, Santa Cruz, CA 95064; ⁵Biology Department, University of San Diego, 5998 Alcalá Park, San Diego, CA, USA 92110; kaufmann@sandiego.edu).

Recent warming in the Antarctic has increased iceberg production, with ecological effects that are not yet well-understood. We studied macrozooplankton and micronekton in the upper 300 m of the water column near free-drifting icebergs in the Atlantic sector of the Southern Ocean during three seasons. Communities were dominated in all seasons by Antarctic krill (*Euphausia superba*) and salps (*Salpa thompsoni*), which collectively comprised 60-95% of the community wet biomass in most cases. During spring and summer, mean biomass was elevated within 0.4 km of large icebergs vs. >9 km away. No trend in biomass with distance was apparent in late fall, when total biomass was relatively low. Biomass levels near icebergs during spring and summer were comparable to values from highly productive marginal ice zones. Sample variance also was significantly higher within 1.85 km of icebergs during spring and summer, reflecting increased patchiness on scales of 10⁴ m³. This trend was not significant during late fall. Large predatory medusae were observed within 1.85 km of icebergs and in areas through which icebergs pass frequently, but were virtually absent in areas remote from icebergs. Small euphausiids showed an inverse distribution, with low densities in areas populated by large medusae. Our results suggest that the macrozooplankton and micronekton assemblages near free-drifting icebergs can be quantitatively and qualitatively different from those in surrounding, iceberg-free waters, perhaps due to both bottom-up and top-down processes as well as physical forcing by the passage of a large object through the upper ocean.

Quantum Retrocausation:

Theory and Experiment, Part II

Tuesday, starting at 8:45 a.m. in KIPJ Rooms A and B (Continued from Monday; see page 67 of these Proceedings for Monday abstracts.)

87 Experimental Evidence for Anomalous Retroactive Influences on Human Cognition and Affect, DARYL J. BEM (Department of Psychology, Cornell University, Uris Hall, Ithaca, NY 14853; d.bem@cornell.edu).

Six experiments are described that take well-established psychological effects on human cognition and affect and “time-reverse” them so that the individual’s responses are obtained before the putatively causal stimulus events occur. For example, two experiments tested for the *retroactive facilitation of recall*: It is well known that rehearsing or practicing a set of verbal materials enhances an individual’s ability to recall them on a subsequent test. In our experiment, participants are first shown 48 common words one at a time and are then asked to recall as many of those words as they can. They are then given practice exercises on a randomly selected subset of those words. The results show that participants recalled more of the words they later practiced than the control words they did not practice. Two experiments on *retroactive priming* provide evidence for retroactive influence on an individual’s response times when judging the pleasantness or unpleasantness of visual stimuli. Finally, two experiments provide evidence for the *retroactive habituation* to emotionally arousing visual stimuli. Each of the six experiments was independently statistically significant, and across all six, the combined $z = 3.66$, $p = .0001$, with an effect size (d) of 0.25. The six experiments described are a subset of nine retroactive influence experiments whose combined $z = 6.66$, $p = 1.34 \times 10^{-11}$, with an effect size of 0.22.

88 Retrocausal Effects as a Consequence of Orthodox Quantum Mechanics Refined to Accommodate The Principle of Sufficient Reason, HENRY P. STAPP (Lawrence Berkeley National Laboratory, University of California, Berkeley, CA 94720; hpstapp@lbl.gov).

The principle of sufficient reason asserts that anything that happens does so for a reason: no definite state of affairs can come into being unless there is a sufficient reason why that particular thing should happen. This principle is usually attributed to Leibniz, although the first recorded Western philosopher to use it was Anaximander of Miletus. The demand that nature be rational, in the sense that it be compatible with the principle of sufficient reason, conflicts with a basic feature of contemporary orthodox physical theory, namely the notion that nature’s response to the probing action of an observer is determined by pure chance, and hence on the basis of absolutely no reason at all. This appeal to pure chance can be deemed to have no rational fundamental place in reason-based Western science. It is argued here, on the basis of other basic principles of quantum physics, that in a world that conforms to the principle of sufficient reason, the usual quantum statistical rule will naturally emerge at the pragmatic level, in cases where the reason behind nature’s choice of response is unknown, but that the usual statistics can become biased in an empirically manifest way when the reason for the choice is empirically identifiable. It is shown here that if the quantum statistical rule were to be biased in this way then the basically forward-in-time unfolding of empirical reality described by orthodox quantum mechanics would generate

appearances of backward-time-effects of the kind recently reported in the scientific literature.

89 Laboratory Demonstration of Retrocausation in a Digital System, GARRET MODDEL^{1*}, ZIXU ZHU¹, and ADAM M. CURRY² (¹Department of Electrical, Computer, and Energy Engineering, UCB 425, University of Colorado, Boulder, CO 80309-0425; ²Psyeron, Inc., 211 N. Harrison St., Suite C, Princeton, NJ 08540; moddel@colorado.edu).

We show experimental evidence for retrocausal signal transfer between digital systems. A system incorporating two electronic random event generators (REGs) was designed and built to test for machine-based retrocausal signaling. In each trial one REG, the “controller”, sent a signal at a random time to a relay shutting off the power to a second REG, the “subject”. The output of the REGs was recorded for a run (set of trials). After the run was completed the data were analyzed, showing any deviation from randomness of the subject-REG output as a function of time.

Statistically significant changes in the subject-REG output occurred before its power was cut. As a control, the controller-REG sent the usual power shut off signals to the relay, but the relay was deactivated before those trials. In the control runs, the subject-REG output did not exhibit a significant deviation from randomness before the dummy shut off signals sent from the controller-REG.

The scientific literature includes many reports of retrocausation and precognition in living systems. We show how the effects that we observe in our machine-based system are linked to the effects of intention and consciousness.

90 Electrocardiac Evidence for Retrocausation, DEAN RADIN^{1*}, CASSANDRA VIETEN¹, LEENA MICHEL¹, and ARNAUD DELORME² (¹Institute of Noetic Sciences, 625 Second St. Suite 200, Petaluma, CA 94954, dean@noetic.org; ²Swartz Center for Computational Neuroscience, University of California, San Diego, 9500 Gilman Drive # 0559, La Jolla, CA 92093).

Advanced meditators occasionally report states of awareness that seem to transcend the usual boundaries of the subjective present. To investigate this phenomenon in eight experienced meditators and eight matched controls, 32 channels of EEG were measured prior to exposure to unpredictable light and sound stimuli. The postulate was that if some aspect of awareness extends beyond the present moment, then pre-stimulus electrocardiac signals would differ depending on stimuli that were about to be selected by a truly random process, and that such differences would be more apparent in meditators than in non-meditators. Each of the 32 EEG channels was baseline-adjusted by the electrical potential averaged between 2 to 1 second pre-stimulus, then for each channel the average potential was determined from 1 second pre-stimulus to stimulus onset. Resulting means across subjects in each group were compared by stimulus type using randomized permutation procedures and adjusted for false discovery rate. Within the control group, no EEG channels showed pre-stimulus differences between light vs. sound stimulus conditions, but within the meditator group 5 of 32 channels resulted in significant differences. Comparisons between control and meditator groups showed pre-stimulus differences prior to audio tone stimuli in 14 of 32 channels ($p < 0.05$, two-tailed), of which 8 channels were at $p < 0.005$, two-tailed. This outcome resembles similar effects reported in over 30 previously published experiments, suggesting that some aspect of information processing may be influenced by future events.

91 Retrocausation, Consistency, and the Bilking Paradox, YORK DOBYNS (Department of Electrical Engineering, Engineering Quadrangle, Princeton University, Princeton, NJ 08544; ydobyns@princeton.edu).

Retrocausation seems to admit of time paradoxes in which events prevent themselves from occurring and thereby create a physical instance of the liar’s paradox, an event which occurs iff it does not occur. The specific version in which a retrocausal event is used to trigger an intervention which prevents its own future cause is called the bilking paradox (the event is bilked of its cause).

The analysis of Echeverria, Klinkhammer, and Thorne (EKT) suggests time paradoxes cannot arise even in the presence of retrocausation. Any self-contradictory event sequence will be replaced in reality by a closely related but noncontradictory sequence. The EKT analysis implies that attempts to create bilking must instead produce logically consistent sequences wherein the bilked event arises from alternative causes.

Bilking a retrocausal information channel of limited reliability usually results only in failures of signaling. An exception applies when the bilking is conducted in response only to some of the signal values that can be carried on the channel. Theoretical analysis based on EKT predicts that, since some of the channel outcomes are not bilked, the channel is capable of transmitting data with its normal reliability, and the paradox-avoidance effects will instead suppress the outcomes that would lead to forbidden (bilked) transmissions.

A recent parapsychological experiment by Bem displays a retrocausal information channel of sufficient reliability to test this theoretical model of physical reality’s response to retrocausal effects. A modified version with partial bilking would provide a direct test of the generality of the EKT mechanism.

92 Toward a Classical Thermodynamic Model for Precognition, EDWIN C. MAY (Laboratories for Fundamental Research, 330 Cowper Street, Palo Alto, CA 94301; may@LFR.ORG).

Precognition - a human response before a randomly determined future stimulus - has always been part of our experience. Experiments over the last 80 years, show a small but statistically significant effect. If this turns out to be true, then it suggests a form of macroscopic retro-causation. The 2nd Law of Thermodynamics provides an explanation for the apparent single direction of time although time is reversible at the microscopic level. I examined seven anomalous cognition (a.k.a., ESP) studies in which the entropic gradients and the entropy of their associated target systems were calculated, and the quality of the response was estimated by a rating system called the figure of merit. The combined Spearman’s correlation coefficient for these variables for the seven studies was 0.211 ($p = 6.4 \times 10^{-4}$) with a 95% confidence interval for the correlation of [0.084, 0.332]; whereas, the same data for a correlation with the entropy itself was 0.028 ($p = 0.36$; 95% confidence interval of [-0.120 – 0.175]). This suggests that anomalous cognition is mediated via some kind of a sensory system in that all the normal ones are more sensitive to changes than they are to inputs that are not changing. A standard relationship for the change of entropy of a binary sequence appears to provide an upper limit to anomalous cognition functioning for free response and for forced-choice Zener card guessing. This entropic relation and an apparent limit set by the entropy may provide a clue for understanding macroscopic retro-causation.

93 Causality is Inconsistent with Quantum Field Theory, FRED ALAN WOLF (Have Brains / Will Travel: a Global Quantum Physics Educational Company, San Francisco CA, USA; fred@fredalanwolf.com).

It is shown that the usual quantum field theoretical argument for the vanishing of the commutator (VC) for spacelike separated fields implying causality is not tenable. For VC to be tenable negative energy antiparticles traveling forward in time must exist and negative energy particles traveling backward in time are not allowed. Hence VC denies the existence of positive energy antiparticles.

94 Retroactive Event Determination and Its Relativistic Roots, SKY E. NELSON (3414 Idaho Drive, Santa Rosa, CA 95405; theskyband@gmail.com).

Quantum theory limits what we are allowed to say about the “true” state of a quantum system if that system is unobserved. But special relativity relies fundamentally on a universal assumption about what a light particle is doing at *ALL* times, regardless of being observed (namely, traveling at speed c relative to any inertial observer). This constitutes a fundamental conceptual gap between the theories. In resolving this impasse we show that the state of a light particle (and hence space and time) is not objective or continuous.

Time dilation and length contraction become infinite for a photon, so light has no “experience” of event separation in space or time ($\Delta t' = 0, \Delta x' = 0$). The principle of simultaneity is applied between an inertial observer and a light particle, such that the relative speed of the two systems is c , and $\gamma = \infty$ /undefined. Although light experiences no separation between events, the Lorentz transform $\Delta t' = \gamma (\Delta t - \Delta L v/c^2)$ implies that *the inertial observer* experiences a separation between those same events of exactly $\Delta t = \Delta L/c$, a light-like separation. In other words, although light has no sense of time or space itself, light will always be measured by an observer at a position and time exactly *as if* it had travelled at speed c continuously through the intervening medium. This fits nicely within the limitations set by quantum mechanics.

This result is connected with previous work on retroactive event determination, suggesting the ubiquitous existence of “synchronicity”.

The Second Law of Thermodynamics: Status and Challenges, Part I
Tuesday, starting at 8:45 a.m. in KIPJ Rooms C and D
(Continues on Wednesday at 8:45 a.m.; please refer to page 99 of these Proceedings for abstracts.)

95 Second Law Violation for Non-Ergodic Interactions, L. S. SCHULMAN (Physics Department, Clarkson University, Potsdam, New York, USA, schulman@clarkson.edu).

The implication of the title should surprise no one. What may be surprising though is how easy it is to produce a quantum system with this feature; moreover, that system is one that is often used for the purpose of showing how systems equilibrate. The violation can be variously manifested; for example, bringing together two systems at the same temperature can cause one of them to cool, with no work necessary to maintain the disequilibrium.

96 Reduced Statistical Fluctuations for an Object in a Partitioned Environment, E. DELRE^{1,2}, P. DIPORTO², S. DI SABATINO¹, and B. CROSIGNANI^{3*} (¹Department of Electrical and Information Engineering, University of L'Aquila, 67100 L'Aquila, Italy; ²IPCF-CNR, University of Rome “La Sapienza”, 00185 Rome, Italy; ³California Institute of Technology, Pasadena CA 91125 USA; bcross@caltech.edu).

Objects that are small enough as to feel the single collisions of the agitated molecules that make up their hosting medium move randomly about their equilibrium position. This is, in particular, the mechanism at the basis of the intriguing behavior of the so-called “adiabatic piston”, a system which appears to be unable to reach thermal equilibrium if not for extremely long time scales. This problem, which does not admit a clear way out in the frame of non-equilibrium statistical mechanics, is part of the general problem of understanding the statistical fluctuations of partitioning objects. Their stochastic movement is expected to obey the ergodic hypothesis, which states that equal phase-space allowed volumes are occupied for equal time durations, provided a conveniently long observation time has elapsed. We here demonstrate how ergodicity is to all practical purposes violated and replaced by a considerable lower noise limit for specific micro-objects partitioning in two their environment. More precisely, we show how the final ergodic limit is only attained after an extremely long time, during which quite relevant time slots are present, characterized by the quasi-static sub-ergodic vibrations of the object. The above results, obtained by numerical dynamics simulations, can also be theoretically justified. These reduced random movements breach statistical limits and may form a paradigm for ultrasensitive instruments and for the design and operation of non-Brownian deterministic microscale mechanical motors.

97 A Thermodynamic Time-Arrow for Single Particle Interactions? AVSHALOM C. ELITZUR^{1*}, ELIAHU COHEN², and PAZ BENIAMINI³ (¹Iyar, The Israeli Institute for Advanced Research, Avshalom.Elitzur@weizmann.ac.il; ²Physics Department, Tel-Aviv University, eliahuco@post.tau.ac.il; ³Physics Department, Hebrew University of Jerusalem, Israel, paz.beniamini@gmail.com).

The debates on the origin of entropy increase (such as the Einstein-Ritz controversy) usually study many-particles interactions and macroscopic processes, assuming that no preferred time direction appears in one- or two-particle systems. We argue that the fact that every single particle has a field (electric and/or gravitational) suffices to give rise to a probabilistic time-asymmetry. The macroscopic time asymmetry may be thus derived from two givens of the microscopic world: *i*) The presumably-infinite field is larger than the presumably-pointlike particle, and *ii*) The causal influences between these two entities propagate with finite velocity. The next move is more speculative. A single particle's electric field exhibits a striking similarity between the curvature of the field lines under *i*) acceleration of the charge and *ii*) interaction of the charge with another charge. Since the latter case also involves acceleration (attraction or repulsion), a very simple symmetry, unnoticed so far, suggests itself between field curvature and acceleration. Our attempts, however, to find a simple mathematical equation relating the two are still hindered by technical difficulties. Nevertheless, if the above intuition is correct, the resulting symmetry offers a basis for the time-asymmetry governing a single particle-plus-field system.

98 *The Repelling Bose String*, **J.B. McGUIRE** (Department of Physics, Florida Atlantic University, 777 W. Glades Rd, Boca Raton FL, 33431, mcguj@me.com).

There is a body of conventional wisdom that holds that a solvable quantum problem, by virtue of its solvability, is pathological and thus irrelevant. It has been difficult to refute this view owing to the paucity of theoretical constructs and experimental results. Recent experiments involving equivalent ions trapped in a spatial conformation of extreme anisotropic confinement (longitudinal extension tens, hundreds or even thousands of times transverse extension) have modified the view of relevancy, and it is now possible to consider systems previously thought pathological, in particular point bosons that repel in one dimension. It has been difficult for the experimentalists to utilize existing theory, mainly due to long-standing theoretical misunderstanding of the relevance of the permutation group, in particular the non-commutativity of translations (periodicity) and transpositions (permutation). This misunderstanding is most easily rectified in the case of repelling bosons.

99 *The Quantum Solar Cell: Using Quantum Thermodynamics to Mitigate Recombination and Enhance Efficiency*, **KONSTANTIN E. DORFMAN***, **MARLAN O. SCULLY**, and **ANATOLY A. SVISZINSKY** (Texas A&M University, College Station, TX 77843 and Princeton University, Princeton, NJ 08544; dorfman@physics.tamu.edu).

The fundamental limit to solar cell efficiency is radiative recombination which balances radiative absorption. This detailed balance condition yields a classical Carnot thermodynamic limit. We here show that it is possible to break detailed balance via quantum coherence, as in the case of lasing without inversion and the photo-Carnot quantum heat engine. This yields, in principle, a quantum Carnot limit to solar cell operation which exceeds the classical one.

The efficiency of solar energy conversion is an important problem of twenty first century quantum science and engineering. The first p-n junction Si solar cells had an efficiency of around 5%. The (empirical) limit at that time was thought to be 20%. Half a decade later, Shockley and Quiesser (SQ) showed that the limit was more correctly attributed to the fact that electron-hole pairs generated by absorption of sunlight are often lost due to radiative recombination before they can contribute to useful work.

Here we analyze a toy photocell illuminated by a monochromatic slice of the solar spectrum to show how we can mitigate radiative recombination and enhance efficiency via quantum coherence.

100 *Experimental Challenge to the Second Law of Thermodynamics in High-Temperature, Gas-Surface Reactions*, **D.P. SHEEHAN***, **D.J. MALLIN**, and **J.T. GARAMELLA** (Department of Physics, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; dsheehan@sandiego.edu).

It is well known that gas molecules can adsorb, desorb, dissociate and recombine at different rates on different chemical surfaces; the world's catalyst industry relies on this. In principle, under low-pressure blackbody cavity conditions, differences in these rates between different surfaces can give rise to steady-state gas phase nonequilibria, thereby challenging of the second law [1,2]. This paper reports on a laboratory realization of this scenario. Low-pressure molecular hydrogen was found to dissociate and desorb preferentially on rhenium compared with tungsten at elevated temperatures. Inside of blackbody cavities lined with either tungsten or

rhenium, resistors and thermocouples fashioned from rhenium and tungsten filaments are being monitored for changes in their temperatures, based on electrical resistance and Seebeck voltage. Under hydrogen atmospheres -- but not under either vacuum or helium atmospheres -- Seebeck voltages indicate large temperature differentials ($\Delta T \sim 100K$) can be maintained between the metals inside the cavities, in apparent conflict with the second law. Theory, experiment, and possible applications of these results will be detailed.

References:

- 1) D.P. Sheehan, Phys. Rev. E 57, 6660 (1998).
- 2) D.P. Sheehan, Phys. Lett. A 280, 185 (2001).

101 *Experimental Evidence Violating Laws of Thermodynamics In Magnetostrictive Materials*, **GERALD PELLEGRINI** (Department of Electrical and Computer Engineering, Northeastern University, 360 Huntington Ave., Boston, MA 02115; gnpellegrini@aol.com).

There have been a number of experimental results which show that the magnetomechanical coupling in certain magnetostrictive materials do not satisfy the thermodynamic "Maxwell Relations". These startling results have come from different laboratories including the Naval Surface Warfare Center, Carderock Division and the University of Maryland, College Park. If these experiments are correct, and the "Maxwell Relations" are violated, the experiments represent the very important discovery of magnetic materials that do not obey the standard thermodynamic laws. In this paper, the experimental evidence will be presented along with the theoretical analysis demonstrating that the experimental data is not consistent with the existence of the standard thermodynamic potentials, and demonstrating how magnetomechanical cycles may be constructed by which energy can be extracted from the ambient temperature environment. Experimental measurements of an extraction of energy in such magnetomechanical cycles will also be presented.

102 *The Proell Effect: A Macroscopic Maxwell's Demon*, **KENNETH M. RAUEN** (1005 Huron, Lubbock, TX 79416; kmpr27@yahoo.com).

Maxwell's Demon is a legitimate challenge to the Second Law of Thermodynamics when the "demon" is executed via the Proell effect. Thermal energy transfer according to the Kinetic Theory of Heat and Statistical Mechanics that takes place over distances greater than the mean free path of a gas circumvents the microscopic randomness that leads to macroscopic irreversibility. No information is required to sort the particles as no sorting occurs; the entire volume of gas undergoes the same transition.

The Proell effect achieves quasi-spontaneous thermal separation without sorting by the perturbation of a heterogeneous constant volume system with displacement and regeneration. The classical analysis of the constant volume process, such as found in the Stirling Cycle, is incomplete and therefore incorrect. There are extra energy flows that classical thermo does not recognize. When a working fluid is displaced across a regenerator with a temperature gradient in a constant volume system, complimentary compression and expansion work takes place that transfers energy between the regenerator and the bulk gas volumes of the hot and cold sides of the constant volume system. Heat capacity at constant pressure applies instead of heat capacity at constant volume. The resultant increase in calculated, recyclable energy allows the Carnot Limit to be exceeded in certain cycles. Super-Carnot heat engines and heat pumps have been designed and a US patent has been awarded.

Technical Studies on the Head of an Egyptian Child Mummy

Tuesday, starting at 10:30 a.m. in KIPJ Theatre

103 *Digital Extraction of Surface Volumes Rendered from the CT Scans of a Late Period Egyptian Mummy*, ANITA PETTY (Director, Digital Manufacturing, 3M Unitek, 5620 Venice Ave NE, Suite G, Albuquerque, NM 87113; anitapetty@comcast.net).

This project is part of a multidisciplinary study of a Late Period Egyptian child mummy head (MCCM 1921.56) collected from Egypt during the 1920 Shelton Expedition. Its purpose is to demonstrate the efficacy of a non-destructive method for digitally extracting 3-D volumetric data sets from CT scans. In this study, the primary and unerupted permanent dentition of a four year-year old child mummy were digitally extracted, separated, and rendered using advanced surfacing algorithms and 3-D engineering software. The resulting teeth models were then physically reproduced using stereo-lithography to allow for follow-on odontology studies.

104 *Chemical Analysis of the Resin on Wrappings of a Late Period Egyptian Mummy*, DAVE SEAPY¹, ADEL SAIED¹, MARVIN ROWE^{1,2*}, and ANITA PETTY³ (¹Science Program, Texas A&M University (Qatar campus); ²Conservation Lab, Museum of New Mexico, 706 Camino Lejo, Santa Fe, NM 87505; ³Digital Operations, 3M Unitek, 5620 Venice Ave NE, Suite G, Albuquerque, NM 87113; anitapetty@comcast.net).

This analysis is part of a multidisciplinary study of a Late Period Egyptian child mummy head (MCCM 1921.56) collected from Egypt during the 1920 Shelton Expedition. Its purpose is to derive information on the chemical composition and potential origin of the resin collected from this mummy using gas chromatography - mass spectrometry (GC-MS), Fourier Transform Infrared (FTIR) and Nuclear Magnetic Resonance (NMR) Spectroscopy. Samples of the resin-coated wrappings were obtained from the mummy head and prepared for analysis. Solid state FTIR was performed to obtain a molecular fingerprint and qualitative analysis of the materials present. The resin was then extracted from the wrappings using dichloromethane (CH₂Cl₂) and other solvents which allowed the molecules present to be studied. GC-MS and NMR spectroscopy studies of the resin are complementary techniques to the FTIR analysis as they are capable of yielding specific identities of substances present in test samples. Test data collected will then be compared with the chemical signatures and compositions of resins known to be used in the ancient Egyptian mummification process.

105 *Radiocarbon Dating of a Late Period Egyptian Mummy Using Plasma Oxidation*, MARVIN ROWE^{1,2*}, KAREN L. STEELMAN³, JERRY KING⁴, and ANITA PETTY⁵ (¹Conservation Lab, Museum of New Mexico, 706 Camino Lejo, Santa Fe, NM 87505; ²Science Program, Texas A&M University, Qatar, P.O. Box 23874, Doha Qatar; ³Department of Chemistry, Central Arkansas University, Conway, AR 72035; ⁴Department of Chemical Engineering, University of Arkansas, Fayetteville, AR 72701; ⁵Digital Operations, 3M Unitek, 5620 Venice Avenue NE, Suite G, Albuquerque, NM 87113; marvin.rowe@qatar.tamu.edu).

This study seeks to determine the radiocarbon date of a sample of the wrappings collected from a Late Period Egyptian child mummy (MCCM 1921.56). Plasma oxidation, a non-destructive radiocarbon dating method that offers an alternative to conventional

destructive combustion methods, has been shown to be extremely accurate in dating organic samples—there is no statistical difference between combustion and plasma oxidation derived results. This technique was employed as part of a multidisciplinary study to help verify the mummy's age and to demonstrate the efficacy of plasma oxidation in analyzing vary rare or valuable organic test samples.

A sample of the wrappings obtained from the mummy head was first treated with dichloromethane (CH₂Cl₂) and other solvents to remove surface contaminants and the resin coating that was applied to the wrappings in the mummification process. The collected sample appears to have been conserved in recent years with subsequent application(s) of resin, therefore, additional super critical fluid cleaning steps were employed to carefully remove all resinous layers prior to dating. Using low-temperature (~50-150°C) electrically excited ionized gases (non-reactive argon and reactive oxygen), minute samples of organic carbon dioxide from the flax (linen) gauze wrapping were collected and analyzed without any detectable change to the original test specimen

106 *Nondestructive X-ray Fluorescence Analysis of the Head of an Egyptian Child Mummy*, MARVIN ROWE^{1,2*}, ANITA PETTY³, and MARK MACKENZIE¹ (¹Conservation Lab, Museum of New Mexico, 706 Camino Lejo, Santa Fe, NM 87505; ²Science Program, Texas A&M University, Qatar, P.O. Box 23874, Doha Qatar; ³Digital Operations, 3M Unitek, 5620 Venice Ave NE, Suite G, Albuquerque, NM 87113; marvin.rowe@qatar.tamu.edu).

This analysis is part of a multidisciplinary study of a Late Period Egyptian child mummy head (MCCM 1921.56) collected from Egypt during the 1920 Shelton Expedition. The mummified skull in this study was covered with linen wrappings coated with a dark brown, resinous material. Using portable, Bruker Tracer III-V, X-ray fluorescence spectroscopy (pXRF), low-level radiation was applied to various regions of the surface wrappings to obtain the elemental composition at those sites. This analysis (see figure below), indicated that beneath the wrappings, both orbits had been covered with gold (Au) foil during the mummification process. Physical inspection revealed that a thin layer of this material extended from the superciliary to the zygomatic arches of the right orbit with a smaller foil overlaying the left orbit.

The two major gold peaks at energies at 9.71 And 11.44 keV are among the most prominent of the elements seen. The one exception is that for iron (Fe) at energies of 6.403 and 7.057 keV. The iron may have been added as iron ochre to provide an initial red coloration to the mummy. Another explanation for the presence of iron is that it is a post-depositional remnant resulting from the subject's exposure to soil after burial. Other elements are observed are at relatively low levels and are likely just due to soil/dirt contamination. All peaks occurring at energies over 16 keV are disregarded in this analysis as they are caused by instrumental artifacts and are not representative of the sample.

107 *An Analysis of Mummified Intracranial Content*, OTTO APPENZELLER^{1*}, MIKE SPILDE², ANITA PETTY³, CLIFFORD QUALLS⁴, GENEVIEVE PHILLIPS⁵, PETER APPENZELLER⁶, and BOB BRIER⁷ (¹NMHEMC Research Foundation, Albuquerque NM; ²Institute of Meteoritics, University of New Mexico, Albuquerque NM; ³Digital Manufacturing, 3M Unitek, Albuquerque, NM; ⁴Department of Mathematics and Statistics, University of New Mexico, Albuquerque NM; ⁵Cancer Research

and Treatment Center, Fluorescence Microscopy Facility, University of New Mexico, Albuquerque, NM; ⁶Tricore Laboratories, Albuquerque, NM; ⁷Long Island University Greenvale, NY; ottoarun12@aol.com).

Identification of mummified tissues presents great difficulties; their appearance having been altered by taphonomic changes, trauma and climatic influences over millennia.

Here we describe a multimodal analysis of tissue obtained non-invasively, through an existing hole in the skull of an Egyptian mummified child's head.

We used histological sections with special stains and comparisons with contemporaneous tissues, confocal microscopy-autofluorescence and scanning electron microscopy, X-ray analysis using wavelength dispersive spectrometers equipped with layered synthetic crystals optimized for light elements to quantize Al, C, Ca, Cl, Fe, K, Mg, Na, O, P, S, and Si as well as statistical analyses including fractals. We found that the piece was composed of resin which contained significantly higher levels of C and other biologic material, most likely *dura mater*.

Plant resin used in ancient Egypt for embalming is a proxy for atmospheric CO₂, climate and of tree growth rate. Thus Egyptian embalmers intentionally preserved the body but unwittingly left a climate record which could be of interest to modern climate-modelers.

108 *The Lanzarote and Fuerteventura Prehispanic Population, Canary Islands, Spain*, **CONRADO RODRÍGUEZ MARTÍN^{1*}, PABLO ATOCHE², and ANGELES RAMÍREZ²** (¹Instituto Canario de Bioantropología (OAMC-Cabildo de Tenerife); ²Universidad de Las Palmas de Gran Canaria; crodriguez@museosde-tenerife.org).

This paper is devoted to the physical anthropological characteristics and pathological features of the protohistoric (Prehispanic) populations of Lanzarote and Fuerteventura, both belonging to the Canarian Archipelago (Spain), located in the Atlantoic Ocean closest to the northwest shore of Africa. Besides a comparative study between both islands, the main goal of this study is to advance the knowledge of the population groups in these islands before the European Conquest (15th century AD), especially their bioadaptability to the islands' environments.

Please note: This paper is included in the Project *Canarias: Colonización Humana Protohistórica, Bioadaptación Insular y Transformación Medioambiental* (Ministerio de Ciencia e Innovación, HAR20009-08519).

**Music and the Sciences:
Synergies Among Musical Arts,
Math, Science, and Engineering
Tuesday, starting at 1:15 p.m. in KIPJ Room F**

109 *Music, Expectation, and Information Theory*, **GARETH LOY** (POB 151185, San Rafael, CA 94915; dgl@GarethInc.com).

When is music successful? Taking a Darwinian view, music is successful if listeners attend to it, which they do if they find it sufficiently interesting. Listeners reward successful music with interest based on how well it sustains their ordinarily quite fleeting attention. Attention is sustained by manipulating the expectations of the listener. Expectation is an anticipatory belief that ranges from certainty to uncertainty. The perspective thus articulated allows for

the question of when is music successful to be studied via the information theory of Shannon and Weaver. The thesis of this talk is that information theory can contribute to a theory of musical expectation, meaning, and emotion in music. This presentation introduces key ideas of information theory and points in the direction of a theory of musical expectation.

110 *Restoration of Musical Meter from Memory: How We Represent Musical Styles?* **SARAH C. CREEL** (Department of Cognitive Science, UC San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0515; creel@cogsci.ucsd.edu).

What happens in the mind when a listener hears a tune? Recent work suggests that listeners activate detailed memory representations of previous hearings of that tune. For instance, if one has heard a melody previously in a 3/4 meter, the isolated melody yields a percept of 3/4 meter. The current study explores how such melody-specific memories might build up to representations of musical style—specifically, whether listeners integrate meter (event rate) and timbre (tone quality) in style-specific representations.

In several different experiments (108 listeners total), each listener was exposed to 12 melodies. Half each occurred in one of two artificial musical “styles,” each with a characteristic meter (3/4, 6/8) and timbre (French horn, saxophone). During the exposure phase, additional musical instruments heard with the melodies provided clear metrical information. After hearing each melody several times, listeners heard isolated melodies followed by metrical continuations. Ratings of metrical continuations suggested that listeners' perceptions of meter were shaped by their listening exposure. Meter percepts were limited to the original instrumental timbre as long as meter-timbre pairings were consistent (horn always played in 3/4, saxophone in 6/8). Meter percepts generalized across timbre when meter-timbre pairings were inconsistent (e.g. horn and saxophone were equally likely to play in 3/4 or 6/8).

These data suggest that, when musical features (timbre and meter) are consistently linked, listeners represent them integrally, influencing processing of a basic aspect of musical experience (meter). This suggests a basis for acquisition of style-specific musical expectations.

111 *A Seventeenth-Century Mathematical History of Tuning the Musical Scale*, **JOHN F. BUKOWSKI** (Department of Mathematics, Juniata College, 1700 Moore Street, Huntingdon, PA 16652; bukowski@juniata.edu).

The tuning of the intervals in the musical scale has a long history dating back to the Pythagoreans. Several seventeenth-century mathematicians proposed ways of resolving the inherent difficulties in tuning the musical scale.

We will discuss the methods proposed by Simon Stevin, Marin Mersenne, and Christiaan Huygens, and we will discuss in detail how Huygens used logarithms to divide the octave into a 31-tone scale. We will then compare his tuning to other tunings of the scale.

112 *Generation and Analysis of Heptatonic Harmonic Scales*, **JOHN H. CHALMERS** (Geosciences Research Division, Scripps Institute of Oceanography, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92038; jhchalmers@ucsd.edu).

Harmonic scales are composed of Prime (generalized major) and Conjugate (generalized minor) triads such that every note is a member of at least one triad and all the triads are connected by common tones. There are 52 species of such scales with seven tones,

and these may be described as points on the D (dominant) x M (Mediant) rectangular or triangular lattice, the latter having a third axis for the Conjugate (D-M) interval. Examples of harmonic scales include the Principal Trichordals of Ellis, the 5-limit Incipient Tonality Diamond of Partch, the Gypsy Minor scale and, of course, the major mode and the harmonic and melodic minor scales. This set of 52 species may be further reduced to six equivalence classes related by linear transformations when the notes of the scales are expressed as vectors in the D x M plane.

Software has been written in TrueBasic to analyse the properties of these scales as D and M each vary over the range from 0 to 1200 cents. Functions computed include harmonic function sequence, Rothenberg-propriety, interval sequence, interval content, number of in-tune triads, heteromorphic profile, and the number of interval differences. For example, the major mode, expressed as functions of D and M by $0\ 2^*D\ M\ 1200-D\ D\ M-D\ D+M\ 1200$ in cents, has 32 harmonic function sequences and 6 regions of Strictly Proper or coherent tunings and 16 of R-Proper. The output of these programs is graphical and tabular. Selected examples are available in Scala format for sound synthesis.

113 *Temperament of Mind: Hector Berlioz and Evariste Galois*, JEFF JOHANNES (Mathematics Department, South Hall, State University College of Arts and Sciences, Geneseo, NY 14454-1401; johannes@geneseo.edu).

Composer Hector Berlioz and mathematician Evariste Galois were both revolutionising their disciplines in Paris during the restoration. In this talk we will examine several parallels in their lives and in their art. We will also consider to what extent they were merely a product of their tumultuous time.

114 *An Analytical Oboe Design*, RONALD L. FOX^{1*} and E. RANDOLPH HAGER^{2*} (^{1,2}Retired, General Atomics, 3550 General Atomics Ct., La Jolla, CA 92037; ²San Diego State University, Campanile Dr, San Diego CA; ¹current; 2973 Fried Ave., San Diego, CA 92122, rlf055@aol.com; ²current; 2322 Bahia Drive, La Jolla, CA 92037, randyhager@aol.com).

The typical present day oboe is based on the empirical design developments of several centuries of hand crafting. Each instrument requires careful tuning based on position and modification of tone holes and their respective back-countersinks. Such fine tuning applies primarily to first class orchestral instruments, and even these are, at best, a compromise in uniformity of tone quality, in relative intonation and tuning stability. Tone quality is related to the number of harmonics present, their relative amplitudes and their positions with respect to the fundamental frequency or first harmonic. Relative intonation within the fundamental range or first register of the instrument is related to tone hole position, size, shape, and depth for each hole. Relative intonation between the fundamental range and its second harmonic or octave range depends on bore uniformity, which includes uniformity of the type of bore aberrations caused by the existence of the closed tone holes. Current oboes possess sufficient empirical compromise that the harmonics deviate from perfect multiples of the fundamental frequencies beginning with some 3rd, and particularly with 5th and higher harmonics. This affects tone quality and requires special fingerings in the third octave range. A relatively small and constant ratio of tone hole size to that of the bore is required to yield a spectrum of harmonics of roughly equal amplitude and of correct multiples of its fundamental frequency for each note.

The mathematical principles derived by Arthur Benade and others were used to calculate tone hole positions and dimensions for a theoretical oboe design. This included correction factors for the reed cavity, effect of closed holes, and of the straight section without holes. The strong interdependence between bore and tone holes was programmed for calculation, iteration, and converging to the initial oboe design specifications, from which the first oboe was constructed and tested. From this, the effect of small open holes was measured, and a further uniform correction was defined empirically. Small open holes add a more critical step to tuning than those of the open end cylindrical flute, etc., whose tone hole diameters are almost comparable with that of the bore. Applying the final correction, a second instrument was constructed and tested. This showed accuracy of tuning to the equal tempered chromatic scale base on $A = 440$ Hz within a few 10ths of a cycle for each note. Further, the octave range of 2nd harmonics were in tune, as were the 3rd and 4th playable harmonics. The instrument represents a current state of achievement and proof of concept for a model based on certain principles of acoustics. The next step could be to add a bell and set of keys to make a playable instrument.

115 *Using Vocal Spectroscopy to Take the Guesswork Out of Powerful Singing*, RONALD SHAHEEN (Music Department, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; rshaheen@sandiego.edu).

As an important part of their training, classical singers learn to produce a full, resonant sound that can be heard over an orchestra without the use of microphones. That process has traditionally relied on the singers' perception of vibratory sensations inside their own bodies and on the ears of their voice teachers, a method that is highly subjective and sometimes unreliable. Nowadays the act of maximizing resonance for efficient and effective singing can be objectively seen by using a computer program called "Voce Vista" ("The Visible Voice"), which is essentially a portable sound spectrometer. This presentation will review the relevant basics of acoustics as they pertain to singing, and then discuss the related concepts of vowel formants, vowel modification, and resonance tuning. This presentation will then show how, by using Voce Vista, singers can actually see (not just feel or hear) how to align the strongest harmonic of a pitch with the strongest frequencies of the vowel formant, and thus, based on scientific data, maximize the power of their voices.

116 *Objective and Subjective Analyses of the Steel-String Acoustic Guitar*, DAVID M. MALICKY (Department of Engineering, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; dmalicky@sandiego.edu).

Through trial-and-error, keen sensitivity, and some objective methods, luthiers and factories have developed the design, materials, and manufacturing processes of the steel-string acoustic guitar to a relatively refined level. The scientific relationship of the guitar's subjective sound qualities to material and component properties (stiffness, density, thickness, damping, resonance, etc) is poorly understood. The aim of this pilot study is to examine some initial correlations among component properties, acoustic resonances, and the subjective sound qualities of the acoustic guitar.

Twenty-five Sitka spruce tops (soundboards) were prepared using common luthier practices. Tops were assessed for density and bidirectional bending stiffnesses, and two common subjective acoustic measures: shake-tone strength and tap-tone strength.

Acoustic guitars of a common design were constructed using these tops by students in a shop practice class. Finished guitars were first assessed for subjective sound qualities, then for FFT analysis of body resonances (main air, main top, and main back). Univariate linear regression was performed among candidate input, output, and intermediate variables. Correlations were found between tops' shake-tone strength and tap-tone strength ($R^2 = 0.34$), shake-tone strength and guitar sound complexity ($R^2 = 0.32$), tap-tone strength and guitar sound complexity ($R^2 = 0.14$), and main top and main air frequency ($R^2 = 0.57$).

This pilot study demonstrates that relationships may exist between an isolated guitar top's tone properties and the sound quality of the finished guitar. Future work will develop the reliability of subjective measures, assess additional material and component properties, and develop a multiple-regression model.

Science Education and Civic Engagements Tuesday, starting at 1:15 p.m in KIPJ Room G

117 *What are the Benefits of Taking the Lab Outside?* **STEVEN BACHOFER** (Department of Chemistry, Saint Mary's College of California, 1928 Saint Mary's Road, Moraga, CA 94556; bachofer@stmarys-ca.edu).

Field sampling labs give students the science content in context. Students observe and evaluate field conditions directly. Students work diligently on labs when the results are to be communicated to the public. Faculty must have alternatives in case of inclement weather.

Two field sampling labs will be presented. An air monitoring lab is somewhat low tech and it utilizes gas diffusion tubes. The soils analysis is somewhat high tech and uses a field-portable XRF to screen for various elements in the soil. Civic engagement questions are explored in both labs. A self reported student attitudinal data will be discussed along with the general trends in the data.

118 *Using Course-Specific Student Course Evaluations to Drive Learning-Centered Teaching*, **STEPHEN CARROLL¹* and **MELISSA GANUS²** (¹Department of English, Santa Clara University, 500 El Camino Real, Santa Clara, CA, scarroll@scu.edu; ²School of Business, Seattle Community Colleges, 8746 Phinney Ave. N, Seattle, WA 98103, ganus.research@gmail.com).**

The SALG (Student Assessment of their Learning Gains) is a valid, reliable, FREE, online instrument developed by the National Science Foundation to improve teaching by providing course-specific, formative feedback on students' learning gains and on the pedagogy responsible for those gains. The SALG drives learning by promoting alignment of objectives and pedagogy and by stimulating metacognition. A SALG for departments collects and analyzes data about department learning goals while preserving faculty's privacy and ability to adapt the instruments to their own classes.

McKeachie and Seldin (POD, 2006) reported that over 85% of American universities and colleges use standardized student course evaluations (SCEs) as the primary means of evaluation of faculty. Yet as Seymour (and others) found, traditional student course evaluation instruments are inaccurate as indicators of students' learning gains and ineffective in soliciting useful feedback. (Seymour, 2005).

Now there is an alternative: the SALG. This free, online course evaluation system focuses not on teacher behaviors, but on learning outcomes. It promotes pedagogical innovation and development by encouraging reflection on learning goals and suggesting pedagogical strategies to meet those goals. Instructors are encouraged to tailor their assessment instruments to their classroom pedagogies and to measure students' learning gains relative to their specific learning goals. The SALG embeds current research on how people learn, and extensive testing shows that the results are valid and reliable. It is easy to use, yet it offers analytical tools powerful enough for professional researchers.

119 *Preservice Science Teachers Think About Science and Teaching*, **CAROLYN VIVIANO** (Department of Natural Sciences, Loyola Marymount University, 1 LMU Drive, MS 8160 Los Angeles, CA 90045; cviviano@lmu.edu).

Students become agents of change and empowered teachers as they tackle issues related to water and the environment. Participation in a community based learning course enables pre-service science teachers to work with environmental educators as they develop high school service learning projects. This presentation will focus on the development and outcomes of an NSF funded SENCER (Science Education for New Civic Engagement and Responsibility) project designed to foster collaborations between future science teachers and environmental educators for the benefit of all stakeholders. The project resulted in the creation of the capstone course, Workshop Biology/Chemistry, for LMU's secondary science education majors. Broad issues related to water and the environment form the core of the course, whereas individual projects focus on topics relevant to the Santa Monica Bay and Los Angeles River watersheds. LMU students collaborate with environmental educators from Heal the Bay and Environmental Charter High School in the design of service learning projects that enable high school students to address environmental issues within their community. As a result, both groups of students strengthen their ties to the community and begin to appreciate the connection between environmental health and community health. Science content becomes relevant, and each student begins to think about his/her role in a wider context. The science curricula created as part of the project will become an online service learning resource available through Heal the Bay (Healthebay.org). By sharing our experiences we hope to encourage others to explore the role of community based learning in science and to promote a fruitful discussion of civic engagement in the classroom.

120 *Community Guest Speakers Show Forensics Students How to Become More Involved in Preventing Campus Crimes*, **VIRGINIA R. CARSON** (Crean College of Health Sciences, Chapman University, One University Drive, Orange, CA 92866; carson@chapman.edu).

One in four coeds experience sexual assault, yet, according to a recent *60 Minutes* episode, most of these assaults go unreported. Often sexual assaults involve the use of alcohol and/or drugs. While studying Forensics, students learn about ways to prevent themselves and others from getting into situations where they could be harmed.

One topic in Forensics is the study of drugs. A local police drug recognition expert comes and gives a very interactive presentation about alcohol. He demonstrates various field sobriety tests and has students wear glasses that give them the visual impression of being under the influence. When they are wearing the glasses, he

has them try to do the field tests. Students are encouraged to keep their fellow students from engaging in drinking and driving.

After learning about drugs and alcohol, students study DNA. In the course of this study, rape is discussed. A physician and female police officers come and talk with the students. The physician describes what to do if one is raped. (Don't shower but report the crime to the police.) The police will take the victim to a hospital where she will be examined. The details of the exam are explained. The police then describe various date rape drugs and give the females in the class advice about how to avoid getting themselves into situations where they might be raped. After learning about how to avoid rape, many students take active parts in various rape prevention workshops.

121 Science Education in Rural America: SENCER Related Learning Outcomes and Attitudes in Chemistry Courses for Non-majors, GREGORY S. VAN DOREN¹ and LAWRENCE K. DUFFY^{2*} (¹White Earth Tribal and Community College, 124 S. 1st St., Mahnomon, MN 56557; ²University of Alaska Fairbanks, Department of Chemistry and Biochemistry, PO Box 6160, Fairbanks, AK 99775; lkduffy@alaska.edu).

A comparative study using the SENCER capacious topic approach was piloted to examine participants' self-assessments of their science learning gains and attitudes towards chemistry. In this comparison, we report the results of the SALG survey at the University of Alaska Fairbanks (UAF) and Heritage University (HU), Washington. University students consistently claimed the greatest learning gains (post-course survey) for the same areas that they claimed the greatest understanding in the pre-course survey. This result was observed in relation to the topics of "ph" and "periodic table". The topic of dyes discussed in Chem 100 at HU was not discussed in the UAF Chem 100x class. The UAF course was used as an internal validation of the comparison. Supported by NSF and NIH.

122 Metacognitive Learning: Enhancing Performance by Teaching Students HOW to Learn, STEPHEN CARROLL^{1*} and MELISSA GANUS², (¹Department of English, Santa Clara University, 500 El Camino Real, Santa Clara, CA 95053, scarroll@scu.edu; ²School of Business, Seattle Community Colleges, 8746 Phinney Ave. N, Seattle, WA 98103, ganus.research@gmail.com).

We aim to develop self-motivated critical thinkers, yet few instructors know how to teach students how to do this kind of learning. Explicitly teaching students optimized methods of learning that leverage advancements in cognitive science, physiology of learning and emotional intelligence accelerates students' progress toward these goals.

Teaching students how to learn (especially higher-order thinking skills) through an in-class learning boot camp (LBC) has proven an effective way to address this problem. Five years of data show that taking up to two weeks of class time (in a ten-week quarter) not only helps students learn *more course content*, they learn faster, retain what they learn better and become more sophisticated, more intentional learners.

Drawing on diverse sources from *Mind Brain and Education: Neuroscience Implications for the Classroom* and *The Art of Changing the Brain to Emotional Intelligence: Key readings on the Mayer and Salovey Model* and *Language and Learning in the Digital Age*, LBC teaches students learning strategies optimized for different purposes. Students learn: purpose-driven reading strategies that

minimize time spent and maximize retention of information, how to take notes that help them retain more while spending less time, and how to think about what they are learning in strategic, metacognitive ways. Students also learn to work with Bloom's taxonomy, Perry's scheme of intellectual development, Kolb's learning cycle and the Mayer-Salovey model of emotional intelligence. All help students not only learn course content better and retain it longer, but also become the kinds of learners we want them to become.

123 Applying the Innovation Diffusion Model to Science Education Reform: What can SENCER and Other Reform Efforts Learn? AMY SHACHTER (Department of Chemistry and Biochemistry, Santa Clara University, 500 El Camino Real, Santa Clara, CA 95053; ashachter@scu.edu).

For over ten years, faculty, staff and students have worked to develop a SENCER courses across the country. In some cases, the SENCER approach has moved beyond individual courses and has been applied to the development of general education programs and to courses within science majors. The innovation diffusion model will be discussed, generally, as a way to understand how innovation can move from innovators and early adopters to the mainstream or majority. The potential for the model to serve as a framework for reforming the undergraduate science curriculum will be explored. In addition, we will consider strategies based on the innovation diffusion model for advancing science education reform efforts.

Human Experimental Mummification Tuesday, starting at 1:30 p.m. in KIPJ Theatre

124 Introduction: Human Experimental Mummification, FRANK J. RÜHLI* and CHRISTINA PAPAGEORGOPOULOU (Center for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland; frank.ruehli@gmail.com).

Artificial mummification methods have been developed in many parts of the world with that of the Ancient Egyptian being among the most successful. Many ancient, e.g. Herodotus, and modern historical reports have been concerned with the ancient Egyptian mummification method. Nevertheless, little effort has been made to explore this process on an experimental basis. The present symposium aims 1) to present the results of a large project which tried experimentally to reconstruct the ancient Egyptian mummification method applying evidence-based diagnostic criteria and state-of-the-art methodology (macroscopical, radiological, histological and biomolecular analysis) and 2) to bring together researchers which have conducted similar experiments on animal and human tissues. We hope that this session will help to improve knowledge on post-mortem alterations, both within ancient and modern settings, will advance our knowledge on artificial and natural mummification, and will motivate researchers of the field on carrying out more experimental analysis.

125 Human Mummification: The Experimental Approach, BOB BRIER (C.W. Post Campus, Long Island University, Greenvale, NY 11548, USA; mummy123@aol.com).

The experimental approach to learning about mummification has been successfully used by numerous researchers. However, most of this experimentation has been with animals and relatively

little as been with human cadavers. This paper surveys the history of experimental mummification with humans, discusses why this is important, and suggests areas of future research.

126 Post-mortem Alterations of Mummified Human Tissue under Experimental Setting, CHRISTINA PAPAGEORGOPOULOU*, NATALLIA SHVED, and FRANK J. RÜHLI (Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland; christina.p@anatom.uzh.ch).

Post-mortem alterations of human bodies are of utmost importance in forensic medicine, bioarchaeology and associate disciplines. The determination of the time and cause of death, the interment duration, the burial micro-environment with its various parameters and the diagenetic changes are crucial issues with which researchers have to confront. Thus, conducting taphonomic experiments to post-mortem alterations of human bodies is of great importance. Many forensic reports exist on post-mortem changes but few experimental studies. The present study is a part of a larger project which tries experimentally to reconstruct the ancient Egyptian mummification method. Specifically, macroscopical, radiological, histological and biomolecular analysis has been performed on samples from a mummified human limb sampled on a standard basis. The current paper discusses the alterations seen on the measurements made on the temperature, the humidity, the pH and the weight of the mummifying tissue. All measurements were made (1) on a constant point on the tissue and (2) on the area from where each sample was extracted. An 24-hour automatic measurement of the temperature and humidity was also made. Temperature was on average stable (20°C) whereas a steady increase of pH and humidity from 35% to 70% were observed. This had a negative effect on the mummification rate resulting to a prolonged duration in the mummification process compared to known historical sources (e.g. Herodotus ca. 484 – 425 BC). Based on this pilot study one may be able in future research to enlighten the puzzling process of human tissue mummification and post-mortem disintegration.

Grant Support: Swiss National Science Foundation (Nr. 325130_120662) and Mäxi Foundation.

127 Modeling Ancient Egyptian Mummification Method Using Evidence Based Methodology: Histological Analysis, CHRISTINA PAPAGEORGOPOULOU^{1*}, NATALLIA SHVED¹, JOHANN WANEK¹, GIOVANNI COLACCICO², and FRANK J. RÜHLI¹ (¹Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland, ²Division of Functional Neuroanatomy, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland; christina.p@anatom.uzh.ch).

Artificial mummification methods have been developed in many parts of the world with that of the Ancient Egyptian being among the most successful. Many ancient and modern historical reports have been concerned with the ancient Egyptian mummification method. Nevertheless, little effort has been made to explore this process on an experimental basis. An experiment was carried out at the Institute of Anatomy (University of Zürich). One human lower limb was amputated from a female donor and underwent an ancient Egyptian-like mummification (20-26°C, 35-70%) using natron (54% NaCl, 16% Na₂SO₄, 18% Na₂CO₃, 12% NaHCO₃). Skin and muscle samples were taken for histological examination at specific time intervals and standard histological analysis was

performed (Hematoxylin-Eosin, Goldner and Van Gieson staining). The total duration of the experiment was 208 days. From the 125 day on, additional samples were taken for rehydration in a Ruffer solution (Ruffer, 1921). Photographic documentation was at the same time intervals performed using the same setting and equipment for meticulous documentation of the changes. The current paper deals with the alterations seen on a macroscopical (discolorations, skin slippage, putrefactive dehiscence) and microscopical level (degeneration of the epidermis and the *stratum corneum*, muscle disintegration particularly affecting the *epimysium*) offering a valuable record on the appearance of human tissue on various stages of mummification.

Grant support: Swiss National Science Foundation (Nr. 325130_120662) and Mäxi Foundation.

128 Modeling Ancient Egyptian Mummification Methods Using Evidence Based Methodology: MRI, CT Analysis, STEPHANIE PANZER¹, JOHANN WANEK², CHRISTINA PAPAGEORGOPOULOU², NATALLIA SHVED², GIOVANNI COLACCICO^{2,3}, and FRANK J. RÜHLI^{2*} (¹Berufsgenossenschaftliche Unfallklinik Murnau, Murnau am Staffelsee, Germany; ²Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland; ³Division of Functional Neuroanatomy, Institute of Anatomy, University of Zürich, Winterthurerstr.190, 8057 Zürich, Switzerland; stephanie.panzer@bgu-murnau.de, frank.ruehli@gmail.com).

The radiologic appearance of mummified human tissues is of foremost interest in forensics and paleopathology. The goal of this study is to apply evidence-based diagnostic criteria and state-of-the-art methodology to analyze mummified human tissues to improve knowledge on post-mortem alterations in ancient and modern settings with a particular focus on radiological appearance. Two human lower limbs (LL) were amputated from a female donor (intra vitam body donation declaration; ethics committee approval) 24h post-mortem and “naturally” mummified by heat (ca. 40°C, 10-20% humidity (H)) and by “ancient Egyptian-style artificial” mummification (20-26°C, 35-70% H) by natron (54% NaCl, 16% Na₂SO₄, 18% Na₂CO₃, 12% NaHCO₃). At multiple days magnetic resonance imaging (MRI; a.o. T1-, T2-weighted, ultra-short-echo time sequences) and computed tomography, were performed. According to MRI, the remaining pockets of humidity were particularly visible along anatomical compartments and more towards the interior regions of the limb. The initial study outcome shows a surprisingly low rate of mummification-related tissue alteration. However, based on this pilot study, future research will enlighten the enigmatic process of human tissue mummification, particularly at a radiological level.

Grant support: Swiss National Science Foundation (Nr. 325130_120662) and Mäxi Foundation.

129 Swiss Mummy Project: Experimental Human Tissue Mummification and Post-mortem DNA Degradation, NATALLIA SHVED¹, CHRISTINA PAPAGEORGOPOULOU¹, KATJA PAULSEN¹, CORDULA HAAS², and FRANK J. RÜHLI¹ (¹Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057 Zürich, Switzerland; ²Institute of Legal Medicine, University of Zürich, Winterthurerstr. 190, Zürich, Switzerland; n.shved@anatom.uzh.ch).

The aim of this study is to analyze the degree of post-mortem DNA alterations in such tissues in order to improve our knowledge

of the level of DNA fragmentation that occurs during the mummification process in both ancient and modern mummies. Human lower limbs used in the study were from a female donor's body (approved by Ethics committee). They were amputated ca. 24h post-mortem and mummified by an ancient Egyptian-like artificial mummification process with natron (hood temperature 20-26°C, 35-70% relative humidity). At days 0, 1, 3, 5, 7, 11, 14, 19, 25, 32, 38, 45, 52, 60, 73, 94, 125 and 322 post-mortem, skeletal muscle and skin were excised. The level of nuclear DNA and mitochondrial DNA (nDNA and mtDNA) preservation was assessed by PCR amplification of different fragment sizes within the hypervariable region I of the mtDNA control region and hypoxanthine guanine phosphoribosyl transferase 1 gene of the nDNA. In addition, sex and autosomal chromosome genotyping with short tandem repeats (STR)-multiplex system was completed. The initial study outcome shows a lower rate of skin genomic DNA fragmentation in comparison to muscle and no change in mtDNA amplification rate occurred in either tissue during the experiment. Chromosome genotyping demonstrated stable STR profiles for the skin at all investigated time points and incomplete STR profiles for the muscle towards the end of the experiment. Based on this pilot study, future research shall further enlighten the process of human tissue mummification at the molecular level.

Grant support: Swiss National Science Foundation (Nr. 325130_120662); Mäxi-Foundation.

130 *Experimental Human Ice Mummification for Conservation and Taphonomic Studies*, **E. EGARTER VIGL¹, ANGELA GRAEFEN^{2*}, MARCO SAMADELLI², FRANK MAIXNER², ASTRID GRUMER², and ALBERT ZINK²** (¹Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; ²EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; egarter.vigl@claudiana.bz.it, albert.zink@eurac.edu).

Twenty years ago, the Tyrolean Iceman was discovered in the Ötztal Alps, near the Austrian-Italian border. The exceptional state of preservation of this 5300-year-old ice mummy makes it an invaluable archive, on the one hand offering unique scientific opportunities, on the other hand requiring meticulous long-term conservation and invasive studies kept to a minimum, with a careful evaluation of the potential insights to be gained versus the costs (in terms of material loss). One of the projects to support these requirements was the experimental ice mummification of a human body (which had been donated to science) shortly after the find and upheld to this day. The body is kept within a duplicate of the Iceman's storage chamber under the same temperature, humidity, and atmospheric parameters, away from public view at the archaeological museum of Bolzano. Any novel conservation techniques, such as rehydration or atmospheric modifications designed for the Iceman's chamber are first tested on "Ötzi 3" (as the experimentally mummified modern body is referred to), to avoid any potential damage to the Iceman. Furthermore, analyses carried out on the experimentally mummified body provide information on how long-term ice storage could affect soft tissue and biomolecular preservation.

131 *Experimental Archaeology for the Interpretation of Taphonomy Related to Bog Bodies: Lessons Learned from Two Projects Undertaken a Decade Apart*, **HEATHER GILL-FRERKING^{1*} and COLLEEN HEALEY²** (¹German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim,

Germany; ²Independent Conservator, Ottawa, Canada; Heather.Gill-Robinson@mannheim.de).

The taphonomic impact of an acidic peat bog environment on human bodies is not well understood. Although many publications speculate as to the importance of factors such as temperature, pH and water levels, very little experimental archaeology has been undertaken. This presentation reports not on the results of two sets of experimental burials of juvenile pig corpses in raised bog peat, but on the lessons learned from the research in terms of methodology and validity of this type of research for the interpretation of human peat bog bodies from northwestern Europe.

The first project, conducted in the mid-1990s in three peat bogs in England and Wales, involved the immersion of more than ten piglets in raised bog peat from periods ranging from six months to three years, with limited environmental monitoring. Analyses of these specimens consisted primarily of necropsy, radiography (X-ray), scanning electron microscopy of teeth and microCT of bone. The second project, conducted in 2008 and still in progress, involved three piglets in raised bog peat in Ireland for a period of 19 months, with no environmental monitoring. The purpose of this project was to replicate, as much as possible, bog body skin in order to determine their feasibility in experimental conservation procedures for long term preservation of bog bodies. Analyses of these specimens will include radiology (CT), necropsy and histology.

132 *Sheep and Cats and Cows, Oh My!: Experimental Mummification*, **SALIMA IKRAM** (American University in Cairo, P. O. Box 74, Road 90, Tagammu 5, New Cairo, 11825, Egypt; salimaikram@gmail.com).

This lecture will present the results of experimental mummification carried out on different animals in Egypt in 2010 and 2011, building on earlier mummification experiments on rabbits carried out by this author, as well as information gathered from the human mummification experiment executed of Drs. B. Brier and R. Wade. Discussion as to how close this might have been to actual ancient Egyptian mummification and queries raised about materials and technologies used will be discussed, together with the effects that mummification has on remains with regard to scientific testing.

Fragile X Syndrome: Advances In Our Understanding of a Common Cause of Retardation and Autism

Tuesday, starting at 1:30 p.m. in KIPJ Rooms H and I

133 *The Journey So Far*, **CINDY de GRUCHY** (Co-founder, The Fragile X Center of San Diego, 4653 Carmel Mountain Road Ste. 308-515 San Diego, CA 92130; cdegruchy@gmail.com).

A mother's perspective of raising her 21 year old son, Scott, who has Fragile X syndrome.

134 *Translating Fragile X*, **PETER W. VANDERKLISH^{1*}, JOHN B. FARNUM¹, JULIE PILOTTE¹, and VERONICA GALVÁN²** (¹Department of Neurobiology, The Scripps Research Institute, 10550 N. Torrey Pines Rd., La Jolla, CA 92037; ²Department of Psychological Sciences, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; pvanderk@scripps.edu).

Fragile X syndrome (FXS) is the most common inherited form of mental retardation and the leading known cause of Autism. From

a scientific perspective, it is also among the most illuminating areas of research in modern neurobiology. FXS results from the silencing of a single gene denoted *Fmr1*. The protein encoded by this gene, FMRP, is an RNA-binding protein that regulates the translation of potentially 100s of mRNAs in neuronal dendrites and synapses. Research into the molecular and synaptic deficits that arise when FMRP is absent has shed light on long-standing questions about the synaptic biology of memory formation, while providing the basis for potential therapies that may also benefit other neurodevelopmental disorders such as Autism. A brief overview of this research will be presented, and the relationship of key findings to pharmacological therapies currently under evaluation will be discussed.

135 OSWALD STEWARD* *et al.* (Department of Anatomy and Neurobiology, Gillespie Neuroscience Research Facility, University of California, Irvine, CA 92697-4265; osteward@uci.edu).

No abstract was provided for this talk.

136 Defective GABAergic Neurotransmission and Pharmacological Rescue of Neuronal Hyperexcitability in the Amygdala in a Mouse Model of Fragile X Syndrome, MOLLY M. HUNTSMAN^{1*}, JOSE LUIS OLMOS-SERRANO¹, SCOTT M. PALUSZKIEWICZ^{1,2}, BRANDON S. MARTIN^{1,2}, WALTER E. KAUFMANN³, and JOSHUA G. CORBIN¹ (¹Center for Neuroscience Research, Children's National Medical Center, Washington DC, 20010 USA; ²Interdisciplinary Program in Neuroscience, Georgetown University School of Medicine, 3900 Reservoir Road., NW, Washington, DC 20057; ³Center for Genetic Disorders of Cognition and Behavior, Kennedy Krieger Institute, Johns Hopkins, University School of Medicine, Baltimore MD, 21205; mhuntsman@cnmcresearch.org).

Fragile X Syndrome (FXS) is a neurodevelopmental disorder characterized by variable cognitive impairment and behavioural disturbances such as exaggerated fear, anxiety and gaze avoidance. Consistent with this, findings from human brain imaging studies suggest dysfunction of the amygdala. Underlying alterations in amygdala synaptic function in the *Fmr1* knockout (KO) mouse model of FXS, however, remain largely unexplored. Utilizing a combination of approaches, we uncover profound alterations in inhibitory neurotransmission in the amygdala of *Fmr1* KO mice. We demonstrate a dramatic reduction in the frequency and amplitude of phasic inhibitory postsynaptic currents (IPSCs), tonic inhibitory currents, as well as in the number of inhibitory synapses in *Fmr1* KO mice. Furthermore, we observe significant alterations in GABA availability, both intracellularly and at the synaptic cleft. Together, these findings identify abnormalities in basal and action potential-dependent inhibitory neurotransmission. Additionally, we reveal a significant neuronal hyperexcitability in principal neurons of the amygdala in *Fmr1* KO mice, which is strikingly rescued by pharmacological augmentation of tonic inhibitory tone using the GABA agonist, gaboxadol. Thus, our study reveals relevant inhibitory synaptic abnormalities in the amygdala in the *Fmr1* KO brain and supports the notion that pharmacological approaches targeting the GABAergic system may be a viable therapeutic approach toward correcting amygdala-based symptoms in FXS.

137 Impairments in the Pathways that Regulate the Spine Actin Cytoskeleton in a Mouse Model of Fragile X, JULIE C. LAUTERBORN^{1*}, GARY LYNCH^{1,2}, and CHRISTINE M. GALL¹ (¹Department of Anatomy and Neurobiology and ²Department of

Psychiatry and Human Behavior, University of California at Irvine, Irvine, CA 92697; jclauter@uci.edu).

The long held view that changes in dendritic spine and synapse size are associated with learning has given rise to the expectation that remodeling of the spine actin cytoskeleton plays a critical role in learning and memory. In accord with this, disruption of pathways that regulate the actin cytoskeleton disturbs the stabilization of synaptic long-term potentiation (LTP), a mechanism of memory encoding. Recent studies in our laboratories have investigated mechanisms of spine actin regulation in a mouse model of Fragile X syndrome (*Fmr1*-KO mouse), a disorder characterized by mental retardation and, in a portion of these individuals, by autism. Our studies have focused on two major Rho GTPase signaling pathways, the Rho > cofilin and the Rac > Pak cascades, that regulate polymerization and stabilization of filamentous (F-) actin in adult spines, respectively. Our work has shown that in the *Fmr1*-KO hippocampus, the Rho > cofilin pathway it engaged normally following stimulation that elicits LTP. By contrast, the Rac > PAK pathway is not engaged by the same stimulation indicating that in *Fmr1*-KOs newly formed F-actin fails to stabilize appropriately. We tested directly whether actin stabilization in spines was impaired in the *Fmr1*-KO and found that the timing associated with the stabilization process was prolonged in the mutants as compared to wild-type mice. These data indicate that the processes underlying LTP, and thus memory, are significantly perturbed in the Fragile X mouse model. These data also provide potential therapeutic targets and suggest intervention strategies for enhancing cognition in this syndrome.

138 Long-lasting Effects of Minocycline on Behavior in Neonatal and Adult Fragile X Mice, IRYNA M. ETHELL^{1*}, LORRAINE DANSIE¹, KELLY PHOMMAHAXAY¹, SARAH ROTSCHEFER², KHALEEL RAZAK², and DOUGLAS W. ETHELL³ (¹Division of Biomedical Sciences and ²Department of Psychology, University of California Riverside, 900 University Ave., Riverside, California 92521; ³College of Biomedical Sciences, Western University of Health Sciences, Pomona, CA 91766; iryna.ethell@ucr.edu).

Fragile X syndrome (FXS) is the most common single-gene inherited form of mental retardation, with behaviors at the extreme of the autistic spectrum. Patients with FXS display childhood seizures, hyperactivity, anxiety, developmental delay, attention deficits, and visual-spatial memory impairment, as well as a propensity for obsessive-compulsive behavior. Several of these aberrant behaviors are also seen in the FXS mouse model, fragile X mental retardation (*Fmr1*) gene knock-out mice (*Fmr1* KO). We have reported that minocycline promotes dendritic spine maturation in primary cultures of hippocampal neurons and in developing hippocampus of *Fmr1* KO mice, accompanied by improvements in behavioral performance in neonatal *Fmr1* KO mice (Bilousova et al., 2009). We have recently tested the effects of minocycline treatment on obsessive compulsive behavior (marble burying), the tendency to travel to the center of an open field (open field) and sensitivity to audiogenic seizures in both neonatal and adult *Fmr1* KO mice. Our new findings demonstrate that minocycline was effective in reducing obsessive-compulsive marble burying behavior and anxiety in both young and adult *Fmr1* KO mice, but showed the maintenance of the effect only in young *Fmr1* KO mice. Finally, our findings demonstrate that minocycline significantly reduces the number and severity of audiogenic seizures in *Fmr1* KO mice. These studies

further support a role for minocycline in improving aberrant behaviors in the Fragile X mouse model and indicate that minocycline treatment can maintain some effectiveness after the treatment.

This work is supported by a grant from the FRAXA Research Foundation.

Mummy Research in the Electronic Age Tuesday, starting at 4:15 p.m. in KIPJ Theatre

139 *Introduction: The New Age of Research: Digitization and Electronic Access*, **DAVID A. RAWSON** (Department of Humanities and Arts, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609; drawson@WPI.EDU).

The last twenty years have seen a transformation in historical research, especially here in the United States. The growth and spread of the Internet, driven by the development of graphical user interfaces (GUI), has generated an ever-increasing demand from researchers for digitization of both primary and secondary sources; materials that could then be easily accessed via that new electronic access. The simple convenience of such access may be the primary impetus for digitization efforts, by eliminating the need for expensive travel to archive collections, but there are also important new insights into the past emerging as a result of researchers' ability to both process larger quantities of material in their research and unearth scraps of information buried in the mass of source materials. This symposium presents elements of two projects that were built on digital resources. My introduction to them provides a context for their development. It begins with an overview of the types of materials that are available currently to researchers, before turning to the rationale for the digitization of particular materials and the methods used to create them. It also considers the strengths and weaknesses of the digitized resources discussed, as well as trends for the future. This presentation will suggest that the research possibilities of digitized materials have yet to be fully realized, and that the two projects that follow represent the innovations in research that are beginning to appear among researchers who understand the promises and limitations of this new resource form.

140 *The Mythology of Mummy Paper: Deconstructing an Urban Legend*, **S. J. WOLFE** (American Antiquarian Society, 185 Salisbury Street, Worcester, MA 01609; swolfe@mwa.org).

Long thought to be an urban legend, the existence of "mummy paper" has been both championed and denigrated by writers. Among the latter is a refutation by Joseph Dane, "The Curse of the Mummy Paper," in which he decried the reliability of newspaper accounts and personal recollections as valid historical sources; argued that the absence of the specific term "mummy rags" indicated that the practice did not exist; and complained about his inability to locate both supportive textual information on the topic and supposed actual examples of paper made from mummy wrappings.

Through the use of both basic and advanced electronic resources (some of which were available to Dane at the time of his writing), these refutations can be themselves rebutted and the reality of using mummy wrappings for paper making demonstrated and elucidated as a not uncommon practice in 19th-century America.

Beginning with the discovery of documents which explicitly state they are made from mummy wrappings, and including various newspaper and periodical accounts of the practice, and ending

with the descriptions of the Alexandrian warehouses where animal and human mummies were stripped of their wrappings for the international rag trade (the bodies being ground up for fertilizer) this presentation argues for the acceptance of "mummy paper" as a product of the industrialization of America and its innovative use of the mummy as commodity during the 19th century.

141 *The Mummy Speaks: An Interdisciplinary Study of the Mummy in Literature, Theatre and Politics*, **JASMINE DAY** (Discipline of Anthropology and Sociology, The University of Western Australia, 22 Coolidge Street, Como W.A. 6152, Perth, Australia; mummy-woman@hotmail.com).

The recent digitisation of nineteenth century periodicals has revealed that that many more creative literary works featuring Egyptian mummies were written than were previously known to scholars or the public. Anthologies of mummy fiction published to date are considerably incomplete and it will now be possible to anthologise mummy poetry and plays. With much more source material for study, scholars can begin to build a more comprehensive account of the evolution and social functions of fictional mummies in Britain and the United States. A chronological study of mummy poetry demonstrates the abiding influence of Horace Smith's seminal *Address to the Mummy* (1821) upon later poems and shows that poets gendered mummies as female in order to submit mummies to metaphorical interrogation. This use of a patriarchal vision of gender relations as a means to symbolise colonial and economic domination of Egypt was mirrored in mummy romance fiction, in which male explorers conquered female mummies – but recently discovered mummy curse fiction, authored by American women in the 1860s, reversed this motif: men who defiled female mummies were slaughtered by ancient magic. Digitised fiction reveals the proto-feminist origins of the "mummy's curse" and demonstrates that Conan Doyle's *Lot N^o. 249* (1892), upon which Hollywood's mummy films were apparently based, was derived from a genre already long established. New theoretical studies of mummymania made possible by the digitisation of Victorian source material will establish mummymania as a core subject within the History of Egyptology, an emerging subdiscipline of Egyptology.

aDNA and Associated Biomolecules Tuesday, starting at 5:15 p.m. in KIPJ Theatre

142 *Ancient DNA and Parasites from Korean Mummies*, **DONG HOON SHIN^{1*}, MYEUNG JU KIM², YI-SUK KIM³, CHANG SEOK OH¹, and MIN SEO⁴** (¹Anthropology and Paleopathology Lab, Department of Anatomy, Seoul National University College of Medicine, 28, Yongon-dong, Chongno-gu, Seoul 110-799, Korea; ²Department of Anatomy, Dankook University, College of Medicine, Choeran 330-715, Korea; ³Department of Anatomy, Ewha Womans University School of Medicine, 911-1, Mok-6-Dong, Yangcheon-gu, Seoul 158-710, Korea; ⁴Department of Parasitology, Dankook University College of Medicine, Cheonan, 330-715, Korea; cuteminjae@gmail.com or bbenji@naver.com).

For the past several decades, molecular biological studies on ancient DNA (aDNA) retrieved from archaeological samples have attracted attention from the paleopathology community. PCR-based analysis on aDNA has served as an effective way to develop molecular approach for the detection of parasite eggs in ancient samples. We, the paleopathologists in Korea, also tried to perform aDNA

analysis on the coprolites or sediments which could be obtained from Korean mummies. By our experiments, we conclude that PCR-based analysis could be applicable to the molecular detection of *Trichuris trichiura*, *Ascaris lumbricoides*, *Paragonimus westermani*, and *Clonorchis sinensis* in archaeological samples. Consensus sequence expressed 100% homology with modern genes of the species from GenBank. Applying PCR methods to further study on aDNA of various parasite species from geographically and temporally wider ranges will undoubtedly improve our understanding of evolution of the species.

This study was achieved with the support of a national R&D project hosted by the National Research Institute of Cultural Heritage of the Cultural Heritage Administration (NRICH-1107-B09F-1).

143 Mummy Response to Pathogens, GILA KAHILA BARGAL^{1*}, ANAT LICHTER-PELED¹, and MARK SPIGELMAN² (¹School of Veterinary Medicine, The Hebrew University of Jerusalem, Rehovot, Israel; ²Centre for Infectious Diseases and International Health, Department of Infection, Windeyer Institute of Medical Sciences, University College London, London, UK and The Kuvim Centre for the Study of Infectious and Tropical Disease, Faculty of Medicine, The Hebrew University of Jerusalem, Jerusalem 91120, Israel; bargal@agri.huji.ac.il).

In the last 30 years, over fifty newly identified human pathogens have emerged in the African continent. Therefore, Africa offers the greatest panorama of the interaction between human evolution and infectious diseases, and is of special relevance to the “emerging and re-emerging” diseases. The origin of a disease in Africa and its migration with man out of Africa is a common story in today’s emerging diseases. The main agents causing the diseases are zoonotic and are transmitted from animals to man either directly or via vectors.

Bacterial and viral diseases have made a heavy impact on our society in the past and are still part of our everyday lives today. The survival of humans and other species relies heavily on their ability to fight disease through the immune system. Genetic characterization of the immune response among ancient specimens, especially Nubian and Hungarian mummies known to be infected, makes it possible to study the genetic factors influencing human resistance/susceptibility to pathogens in historical times.

144 Analysis of Ancient Mummy DNA – Problems and Perspectives, ALBERT ZINK*, ANGELA GRAEFEN, CHRISTIAN MITTERER, and FRANK MAIXNER (EURAC – Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; albert.zink@eurac.edu).

The analysis of ancient DNA (aDNA) from mummies offers unique possibilities for the study of their origin, family relationships and diseases. Several reports have been published on the molecular investigation of ancient pathogen DNA in mummies, revealing important information on the occurrence, frequency and evolution of infectious diseases, such as tuberculosis and malaria. In other studies, the feasibility of aDNA for determining the genetic relationships of Royal Egyptian mummies have been demonstrated.

Nevertheless, the analysis of aDNA from mummies is often severely hampered by the presence of PCR-inhibiting substances either introduced during the mummification process, e.g. embalming material in Egyptian mummies, or from the environment during the course of natural preservation, such as the presence of humic acids in bog bodies. Therefore, many well-established protocols for

the extraction of aDNA from bone samples cannot be directly used for mummy tissues without additional working steps. Up to now, only a few studies have addressed the preservation of aDNA in soft tissue. Recently, we have tested several different extraction methods and are currently developing new protocols specifically adapted to preserved soft tissue, such as skin, muscle or inner organs and to overcome inhibition problems.

In summary, the excellent overall preservation of mummies makes them a valuable source for aDNA studies, but further research is necessary to understand the specific requirements for optimized mummy tissue aDNA extraction protocols.

145 Progress Report on the Progress of Scientific Studies of Three Large Mummy Collections: Results and Prospects, MARK SPIGELMAN (Centre for Infectious Diseases and International Health, Department of Infection, Windeyer Institute of Medical Sciences, University College London, London, UK and The Kuvim Centre for the Study of Infectious and Tropical Disease, Faculty of Medicine, The Hebrew University of Jerusalem, Jerusalem 91120, Israel; spigelman@btinternet.com).

We have for many years been studying scientifically three large mummy collections. Initially we started with the Hungarian collection of almost 250 mummies from Vac with the assistance of Ildico Pap and colleagues. Then we were able to study the 400 mummies from Kulubnarti in Northern Sudan located in Boulder Colorado with the assistance of Sue Sheridan and Dick Van Gervan. More recently we have commenced collaboration with Dong Hoon Shin on the Korean mummies.

Our studies started with simple identification of small pieces of DNA using PCR techniques to show the presence or absence of DNA of mycobacterium tuberculosis. This presentation will overview almost 20 years of studies and discuss how technology has advanced and allowed us to revisit time and again our collection and glean more and more data from the individuals concerned with the aid of numerous dedicated scientist. Furthermore, we have now branched out into areas other than DNA to gain more information in related fields and discuss the implications for the future as well as conveying our more recent results and how they can improve our knowledge base.

146 Panel Discussion on the Importance of aDNA and Biomolecules in the Study of Ancient Mummies, MARK SPIGELMAN^{1*} and DONG HOON SHIN^{2*} (¹Centre for Infectious Diseases and International Health, Department of Infection, Windeyer Institute of Medical Sciences, University College London, London, UK and The Kuvim Centre for the Study of Infectious and Tropical Disease, Faculty of Medicine, Hebrew University of Jerusalem, Jerusalem 91120, Israel; ²Anthropology and Paleopathology Lab, Department of Anatomy, Seoul National University College of Medicine, 28, Yongon-dong, Chongno-gu, Seoul 110-799, Korea; ²Department of Anatomy, Dankook University, College of Medicine, Choeran 330-715, Korea; spigelman@btinternet.com, radyds@dankook.ac.kr).

Ancient DNA and Associated biomolecules form an important and growing part of research associated with mummy studies. A panel discussion on the progress of the science as well as its future direction would help mummy researches better understand how this type of investigation can assist workers in the field to learn more about this research and how it can contribute to a better understanding of the life and death of mummies.

Princess Takabuti – Analysis, Interpretation, and Visualization
Wednesday, starting at 8:00 a.m. in KIPJ Theatre

147 Introduction to the Takabuti Project, JENEFER COCKITT* and A.R. DAVID (KNH Centre for Biomedical Egyptology, University of Manchester; Jenefer.Cockitt@manchester.ac.uk).

In 2009, a team of scientists from the Ulster Museum, Queen's University in Belfast, the KNH Centre for Biomedical Egyptology at the University of Manchester, and the University of Dundee undertook a multidisciplinary study of the Egyptian mummy Takabuti in the Ulster Museum. The mummy was first brought to Belfast from Egypt in 1834 by Thomas Greg, a wealthy young man who had bought the mummy at a 'mummy market' in Luxor, Egypt. On returning home to Belfast, he donated the mummy to the Belfast Natural History and Philosophical Society whose members carried out a multidisciplinary investigation of the body in the 1830s. Subsequently, the mummy was placed in the Ulster Museum in Belfast, Northern Ireland.

As part of the current investigation, the mummy was brought to the University of Manchester where various studies were undertaken to identify any evidence of disease, diet, lifestyle, lifespan, status and religious practices. Procedures undertaken included a CT-scan and endoscopic removal of minute samples of tissue for microscopic analysis, to attempt to identify any disease processes present in the mummy; the teeth were also studied and hair samples were analyzed.

The research on Takabuti is now presented as a permanent exhibition in the new gallery displays at the Ulster Museum; an important element of this is the three-dimensional scientific reconstruction of the head and face of Takabuti, produced by scientists at the University of Dundee.

The Belfast Mummy Project was the subject of a 60-minute BBC television documentary shown in 2009 and entitled '*Show me the Mummy: The Face of Takabuti.*'

148 The Mummy of the Ancient Egyptian Noblewoman, Takabuti of Thebes, WINIFRED GLOVER (Ulster Museum, Botanic Avenue, Belfast BT9 5AB, Northern Ireland, UK, retired curator of World Cultures; winifredglover@live.co.uk).

The mummified body and case of Takabuti was brought to Belfast in April 1834. She had been bought in Egypt by Mr. Thomas Greg of Ballymenoch House, Holywood, Co. Down, and he presented her to the Belfast Natural History and Philosophical Society.

Her arrival in Belfast caused a sensation and on 27th January 1835, she was unwrapped in the presence of the distinguished members of the Society, men only. The hieroglyphs on her case were deciphered by the Rev. Dr. Edward Hincks (1792-1866), the eminent Egyptologist and Assyriologist. He was able to say that she was between 20 and 30 years of age and the mistress of a great house in Thebes. Her father Nespere was a priest of Amun and her mother was called Tansenirit. He placed her in the Twenty-Fifth Dynasty. Recent research has produced some surprises.

149 Imagine Takabuti: Radiology and Osteology, JUDITH E. ADAMS¹* and EILEEN M. MURPHY² (¹Department of Clinical Radiology, Central Manchester University Hospitals NHS Foundation Trust, The Royal Infirmary, Oxford Road, Manchester, M13 9WL, UK; ²School of Geography, Archaeology and Palaeoecology, Queen's University Belfast, Belfast BT7 1NN, Northern Ireland,

UK; judith.adams@manchester.ac.uk).

This paper describes how the mummified remains of Takabuti were visualised in 3D through Computed Tomography. The results of the radiological analysis are discussed in relation to dental and osteological imaging.

150 Reconstruction of the Face of Princess Takabuti, CAROLINE WILKINSON, SARAH SHRIMPTON, and JANICE P. AITKEN (Forensic Art, Centre for Anatomy and Human Identification and Duncan of Jordanstone College of Art, University of Dundee, Dundee, DD14HN; c.m.wilkinson@dundee.ac.uk).

As part of a multi-disciplinary project to bring to life the Egyptian Princess, Takabuti, a facial reconstruction was produced to depict her living appearance. Virtual software with haptic technology was utilised to allow intuitive sculpture and a 3D model of the skull was isolated from the CT data. Princess Takabuti was female, aged between 20 and 30 years of age and her skull exhibited a mix of Caucasian and Sub-Saharan African features.

The anatomical structures of the face were modelled and modern Egyptian tissue depths were used as guides when adding the skin and subcutaneous fat layers. The facial features were determined using anatomical standards and anthropological measurements to create the finished facial appearance.

A 3D replica of the digital reconstruction was produced using stereolithography, eyes and a wig were added and the face was painted to create the final craniofacial depiction. The textures were based on information provided from research collaborators as to her skin colour, make-up and hair colour and style.

151 Show Me the Mummy – the Face of Takabuti, CAROLINE WILKINSON (Centre for Anatomy and Human Identification and Duncan of Jordanstone College of Art, University of Dundee, Dundee, DD1 4HN, Scotland; c.m.wilkinson@dundee.ac.uk).

Borderline Productions and BBC NI produced a 60-minute documentary on the history and analysis of the Egyptian mummy Takabuti, one of the most famous residents of the Ulster Museum in Belfast. A selection of clips from the original production will show how the team of experts from all over the world came together at Belfast Castle to unravel the mystery of Takabuti. The two mysteries were: where in Egypt did she come from, and could the experts recreate her face. Dr. Zahi Hawass, then head of the Supreme Council of Antiquities at the University of Cairo and the Curator at the Museum of Cairo, guides two of the experts through various Egyptian sites to set the stage for Takabuti's origin. In *Show Me the Mummy*, the audience is asked to join the experts in the discovery of the true *Face of Takabuti*.

United States and World Fairs
Wednesday, starting at 8:30 a.m. in KIPJ B

152 Writing the History of World's Fairs, JAMES G. GILBERT (Distinguished University Professor Emeritus, History Department, University of Maryland, College Park, MD 20742; gilbertj@umd.edu).

The history of World's Expositions might be divided into four loose temporal categories: 1) Victorian Fairs from 1851 to around the Beginning of World War I. 2) Fairs of the 1920s and 1930s including the failed Rome Exposition. 3) Postwar fairs up through perhaps Vancouver in 1986 and 4) Post-modern fairs. An

exploration of similarities within these eras might be helpful in constructing an overall history of World's Fairs.

My principal focus is on the much written about late Victorian American Expositions. The existing literature is fascinating, smart, and provocative, and dominated by, but not limited to, issues of race and imperialism. These were certainly important subjects for the elites who planned them and the anthropologists who sought confirmation of their new profession by lending academic rigor to the enormous and largely entertainment-focused ersatz villages and native pavilions. My approach is somewhat different and calls for an orientation that attempts to 1) examine the audience reaction to the various elements of the fairs, how they understood them, what they actually saw, and how they transformed this experience and 2) the contexts in which these fairs existed: the history of previous fairs and other expositions, the burgeoning cities that hosted them, the technology of travel and tourism and photography, important political and social issues of the day, and so forth. This perspective allows a different point of view than the reproduction of elite intentions.

153 *Asian Americans and Asian Nations at U. S. World Fairs, 1876-1915*, **BENNET BRONSON** (Chinese in Northwest America Research Committee, P. O. Box 19090, Bainbridge Island, WA 98110; Bronson@cinarc.org).

The nations of Asia, independent and colonized alike, treated international expositions as showcases for products and culture and as platforms for stating political positions. However, at a surprisingly early date, U.S.-based Asians focused on different objectives: promoting respect among white Americans, benefiting their own communities, and--not least important--making money. The existence of splits between Asian governments and Asians in the U. S. constitutes some of the first evidence we have of the growth of distinct Asian-American identities.

154 *Living 'Cliff Dwellers' at the 1893 World's Columbian Exposition: An Enduring Metaphor of a 21st Century Indigenous People*, **LARS KRUTAK** (Repatriation Office, Smithsonian Institution, National Museum of Natural History, 10th and Constitution Avenue, NW, MRC 138, Washington, DC 20013krutakl@si.edu. 202-633-0869).

At the end of the 19th century, new discoveries of prehistoric ruins and living "cave and cliff dwellers" in the Greater Southwest excited the imaginations of scientists, travel writers, and popular magazine readers alike. As this frontier world was revealed for the first time, a constellation of ideas, images, and cultural markers were selectively created to later "sell" the region and its peoples to tourists, including those individuals who visited the "Cliff-Dwellers" exhibition at the 1893 World's Columbian Exposition in Chicago.

Inhabited by members of Laguna Pueblo during the Fair, this 70-foot-tall diorama was modeled after the now-vanished Battle Rock ruin located in McElmo Canyon, Colorado. However, this paper will suggest that the Tarahumara (Rarámuri) of Northwest México probably were the original source of inspiration for the Cliff-Dwellers installation.

Since 1890, the Tarahumara had been described as "living cave and cliff dwellers" in a variety of scientific and mass-produced publications penned by writers including the pioneering archaeologist Adolph Bandolier, the explorer Frederick Schwatka, and the noted ethnologist Carl Lumholtz. Today, the "living cave dwellers" theme continues to be endorsed and exploited by Mexican state and federal tourism sectors to draw travelers to the homeland of the

Tarahumara: the remote Copper Canyon region which is promoted as the "Last Frontier" of México.

Drawing on the literary and ethnographic record of the late 19th century, this paper will explore the enduring legacy of the "living cave dwellers" trope and reveal how it is implicated in the commercialization of 21st century Tarahumara culture.

155 *A Publicly Ethereal Manifestation: Chicago, Anthropology, and the World's Columbian Exposition*, **STEPHEN E. NASH** (Curator, Department of Anthropology, Denver Museum of Nature and Science, 2001 Colorado Blvd., Denver, CO 80205; snash@dmns.org).

Although the 1893 World's Columbian Exposition (WCE) in Chicago has been heralded as a social, historic, political, economic, anthropological, and symbolic turning point in American history, publicly recognizable vestiges of the Exposition itself are remarkably hard to find on the city's landscape. Although the 50,000 ethnographic and archaeological objects on display at the Fair became the seminal collection of the Columbian Museum (now Field Museum) of Chicago, publicly visible acknowledgment of the Museum's auspicious origins are difficult to find.

During the Museum's first years, the World's Columbian Exposition collections were processed into hundreds of accessions in the Department of Anthropology; tens of thousands of catalog numbers were assigned in the process. In the ensuing decades, however, a remarkably large number of the original pieces were deaccessioned, lost, consigned to waste, sold, or exchanged, to a degree that suggests the WCE Collection was not considered an entity into and of itself. In a proud and pugnacious city that takes its history seriously, the publicly ethereal nature of the World's Columbian Exposition in general, and the Anthropology collection in particular, defies easy explanation.

156 *Mummies in Context: Displays of Human Remains at World's Fairs in the United States*, **SAMUEL REDMAN** (Ph.D. Candidate, Department of History, University of California, Berkeley; Academic Specialist, Regional Oral History Office, Bancroft Library, University of California, Berkeley, CA 94720; redman@berkeley.edu).

Numerous displays at international expositions exhibited human remains. The most popular of these were often exhibitions of mummified bodies. Mummified remains from Egypt and the Americas attracted massive audiences and forced visitors to reconsider ideas about race and human history. Displays of mummies, however, were not the only exhibits of human remains hosted by international expositions. This paper places the display of mummified remains into the broader context of the display of the human body at world's fairs in the United States.

157 *Platform for Immigration Battles: Chinese Americans at World Fairs before 1920*, **CHUIMEI HO** (Chinese in Northwest America Research Committee, P. O. Box 19090, Bainbridge Island, WA 98110; cmho@cinarc.org).

Chinese in America began to take part in U.S. World Fairs at the World Columbian Exposition in Chicago in 1893. Their primary motivation was to represent Chinese culture when the Chinese government had declined that role. A less obvious objective was to use the event to advocate for more favorable immigration laws. These goals lingered on through other world fairs during the following two decades. This paper will examine attempts to achieve those goals, their success and failure.

158 *Documenting the New Colony through its Objects: The Smithsonian's Philippine Collections from the early 20th Century International Fairs*, **PATRICIA O. AFABLE** (Research Associate, Asian Cultural History Program, Department of Anthropology, Smithsonian Institution, National Museum of Natural History, 10th and Constitution Avenue, NW, MRC 112, Washington, DC 20013; afablep@si.edu).

Soon after the U.S. annexation of the Philippines, numerous objects collected by government officials and military personnel began to reach the Smithsonian Institution. Two large collections were the result of exhibitions at the Pan-American Exposition in Buffalo in 1901 and the Louisiana Purchase Exposition in St. Louis in 1904. The intention of this paper is twofold: First, it will survey the major collectors and donors to the 1901 and 1904 Fairs, their motivations, institutional backgrounds, and collecting contexts. It will show how these accessions were part of a sustained effort to obtain knowledge about the peoples, the history, and the commercial potential of this recently acquired Pacific territory.

Second, I will examine the history of a basketry collection made by two women, the Massachusetts-born sisters, Elizabeth and Sarah Metcalf, who decided to go the Philippines after meeting Filipino participants at the St. Louis Fair. They acquired textiles and baskets over more than three decades, while they traveled, taught in primary schools, and became retailers of Philippine handicrafts. Through a study of the materials, techniques, and production sources of the Metcalf basketry collection, I explore the intersection of goals among government-sponsored science, business corporations, and the U. S. insular administration in the long-term project to document the Philippine colony through its objects. The Philippine Bureau of Education exhibition in the 1915 Panama Pacific Exposition provides a pertinent illustration of this confluence of interests.

159 *Performers, Interpreters, and the Showman Onstage and Offstage at the Pay Streak's 'Igorrote Village'*, **DEANA WEIBEL¹ and PATRICIA O. AFABLE²** (¹Associate Professor of Anthropology, Department of Anthropology, 1149 AuSable Hall, Grand Valley State University, Allendale MI 49401, weibeld@gvsu.edu; ²Research Associate, Asian Cultural History Program, Department of Anthropology, Smithsonian Institution, National Museum of Natural History, 10th and Constitution Avenue, NW, MRC 112, Washington, DC 20013; afablep@si.edu).

The "Igorrote Village" in the Alaska-Yukon-Pacific Exposition's Pay Streak showcased the cultural activities and performances of about 40 people from the Bontoc region of the northern Philippine highlands. They arrived in Seattle in early 1909 with a showman from Detroit, Richard Schneidewind, who had contracted with them and arranged for their journey from the Philippines. For most of that year, the "Igorrotes" built their "Village," including thatched-roof houses imitating their own homes, and stone-walled terraces that were said to resemble the irrigated rice fields of their home region. On a stage and in adjoining grounds, they performed traditional dances and gong music, and staged ceremonies, mock battles, and trials. As part of their daily routine, they displayed their weaving techniques, cooking practices, and other portrayals of (as one brochure put it) "the life, manners, customs and industries of these remarkable children of nature" to the Pay Streak audience. This account, by two anthropologists, attempts to recover some of the lives and historical experiences of the indigenous participants in the 1909 "Igorrote Village" at the AYPE and their showman,

Richard Schneidewind.

Family stories and the body of documents taken as a whole also reveal to us how, during the long journeys to the Fairs, the Bontoc performers developed viable working relationships with Richard Schneidewind and his family that made life "onstage" and "offstage" comfortable and stimulating collaborative experiences.

160 *Defining a Californian: Visions of California at the Panama-Pacific International Exposition*, **ABIGAIL MARKWYN** (Assistant Professor of History, Carroll University, 100 North East Avenue, Waukesha, WI 53186; amarkwyn@carroll.edu).

The fair directors of San Francisco's 1915 Panama-Pacific International Exposition promoted a vision of California history that glorified the white male pioneer's conquest of the state's native population and that denied the participation of other nonwhite peoples. Yet, many different organizations and individuals produced the spectacle of the exposition, and although exposition directors maintained some control over exhibits, they could not control all events on the grounds. Local residents, including woman suffragists, Catholics, Chinese and African Americans staged parades to celebrate their ethnic heritage, hometown, or county; and fraternal, political and religious groups created pageants, speeches, and processions to assert their particular place in local and national society. The fair therefore became a stage for these groups to assert, and at times, debate, their place in American society. This paper will examine the visions of California – and Californians – created at the PPIE, both through official art and rhetoric, as well as through unofficial activities and debates sponsored by local residents.

161 *The Legacy of an Ainu Activist, Kayano Shigeru: His Lifelong Efforts to Save Ainu Heritage*, **YOSHIKO YAMAMOTO** (Curator, Treganza Anthropology Museum Archives, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; yamamoto@sfs.edu).

Kayano Shigeru was a political activist, born at Nibutani, an Ainu village known to the world since the 19th century. He dedicated his life to documenting Ainu culture in the face of exposure of this village to curious visitors, historians, linguists, geographers and folklorists from Japan and abroad. Nibutani is where Neil Gordon Munro shot "Iyomande: The Ainu Bear Festival" in 1935, a film which brought the Ainu to world attention. Kayano's father was an actor in this film and he himself took a small part. Nibutani is also known for the large number of archaeological sites in the vicinity, many of which have been excavated.

Kayano learned the Ainu language from his grandmother, mastering the idiom through listening to her narration of traditional oral literature. His father was a traditional religious man who performed rituals for the villagers.

The Nibutani Ainu had been chosen as participants in the 1904 St. Louis World Fair. At this time a considerable number of cultural treasures from the village were brought to the U.S. Concomitantly, the exposure of Ainu to the outside world brought changes to the village as well. Kayano realized how urgent it was to protect the Ainu heritage before it was lost. He became a strong advocate of the Ainu's rights as the original settlers of Japan. Kayano published many works on Ainu heritage, showing the richness of their culture and how necessary it was to respect and to know of this cultural heritage in the generations to come.

162 *World's Fairs as Special Collections*, **TAMMY LAU** (Head, Special Collections Research Center, California State University, Fresno, 5200 North Barton Avenue, ML34, Fresno, CA 93740; tammyL@csufresno.edu).

This will be a brief description of the Donald G. Larson Collection on International Expositions and Fairs, the largest world's fair collection on the West Coast as well as a discussion of the challenges of documenting all world's fairs from 1851 to the present, the promise of working with scholars and researchers in developing a collection, the importance of collecting primary sources and the future of the field in world's fair research and collection development.

Facial Analysis and Depiction of Preserved Remains **Wednesday, starting at 9:15 a.m. in KIPJ Theatre**

163 *The Craniofacial Analysis of the Possible Skull of Arsinoe, Sister of Cleopatra*, **CHRISTOPHER RYNN¹*, **CAROLINE WILKINSON¹**, **FABIAN KANZ²**, and **JANICE P. AITKEN¹** (¹Centre for Anatomy and Human Identification, College of Life Sciences, University of Dundee, DD1 5EH, Dundee, Scotland, UK; ²Unit of Forensic Anthropology, Medical University of Vienna, Department of Forensic Medicine, Austria; chrisrynn@gmail.com).**

The remains of a teenage female, dated to between 210 and 20BC, were discovered in 1926 by Josef Keil (Austrian Archaeological Institute) at the "Oktogon" - a Heron tomb in the centre of ancient Ephesus. Thought to belong to Arsinoe IV of Egypt, the exiled and murdered younger sister of Cleopatra VII, the skull has been lost for over 50 years.

Photographs taken of the skull in anatomical planes were scaled and imported into SensAble Freeform 3D modelling software. Each photograph formed one wall of a 3D cuboid shape, into which the 3D model of a skull of similar biological profile was imported, aligned, and subsequently manually distorted to fit each image in the appropriate elevation. Detailed craniometric measurements taken before the skull's disappearance in 1953 were employed to improve the accuracy of the virtual skull model. The absent mandible was estimated using roentgenographic cephalometric analysis, and modern forensically-tested methods were used to reconstruct the face.

164 *Facial Analysis of a Tsantsa: A Shrunken Head from the Shuar Tribes of South America*, **TOBIAS HOULTON** (College of Anatomy and Human Identification, MSI/TMW Complex, Dow Street, University of Dundee, DD1 5EH, Scotland; tobias.houlton@hotmail.com).

Original MSc research was on a *tsantsa* (shrunken head) from the McManus Museum in Dundee and thought to be from the Shuar Tribes in South America. It challenged recent speculation that the head was simian, and not an authentic example of human head shrinking. The *tsantsa* was assessed for sex and age and the effects of shrinking on facial morphology, studied using pig heads. A 3D facial approximation was attempted using a laser scanner (Fast-SCAN Scorpion) and 3D modelling software (FreeForm Modelling Plus).

To establish the identity of the McManus *tsantsa*, morphologies of extant authenticated human *tsantsa*, a shrunken monkey

head, and living simian morphologies were assessed. Microscopic hair analysis confirmed the *tsantsa* as human, of Mongoloid ancestry. Population demographics resulted in the head being estimated as male, age 20-30 years.

The *tsantsa* scan was constructed utilizing craniofacial measurements, obtained from the McManus *tsantsa* and superimposed subject photographs. A scanned template cranium was manipulated in FreeForm to conform to extant Peruvian craniofacial measurements, and a template mandible developed using Sassouni Analysis, providing a hypothetical scaffold for reconstruction. Texturing and tribal decoration was applied with Autodesk Maya 2010. Verification of the reconstruction was not possible due to the absence of ante-mortem photographs.

165 *The Texturing of a Facial Depiction of Clonycavan Man – A Bog Body from Ireland*, **JANICE P. AITKEN¹*, **CAROLINE WILKINSON²**, and **C. D. EROLIN²** (¹Duncan of Jordanstone College of Art and Design, University of Dundee, Perth Road, Dundee, Scotland, DD1 4HT; ²Center for Anatomy and Human Identification, MS1/TMW Complex, Dow Street, University of Dundee, Scotland, DD1 5EH; j.z.aitken@dundee.ac.uk).**

The facial morphology and proportions of the bog body 'Clonycavan Man' were established from CT scans, including a 3D model of the preserved soft tissues, and high quality photographs taken at the time of discovery. The soft tissue model was used to recreate the facial appearance whilst referring to the skeletal material for basic proportions. The digital 3D facial model was manipulated in Freeform Modelling Plus software to produce a head.

Skin textures, eyes and hair were added to the 3D model using Maya 3D animation software and Adobe Photoshop. Digitally painted images or 'texture maps' were added to the model using a subsurface scattering shading group designed to simulate the appearance of the translucence of skin. The texture of the skin was simulated by adding a 'bump map' which gives the appearance of pores, wrinkles and marks. The bump map simulated textures in a relatively shallow depth and the geometry of the model was not changed and so retained the integrity of the original forensic facial reconstruction.

Eyes were created as 3D models and colour added according to that estimated by the National Museum of Ireland. Hairstyle and facial hair were created using the 'Paint Effects' tool within Maya to the style and colour suggested in the report provided by the Museum of Ireland. A final rendered animation was created of a rotation of the head to allow the viewer to see the model from a range of angles.

166 *Body Snatchers – The Analysis of a Mummified Human Child as an Anatomical Specimen*, **CAROLINE WILKINSON**, **SUE BLACK**, **XANTHE MALLETT**, and **WOLFRAM MEIER-AUGENSTEIN** (Centre for Anatomy and Human Identification and Duncan of Jordanstone College of Art, University of Dundee, Dundee, DD1 4HN, Scotland; c.m.wilkinson@dundee.ac.uk).

This paper describes the analysis of a dissected and preserved child thought to be a 19th century anatomical specimen. The analysis included historical research, stable isotope assessment, resin content assessment and facial depiction. The research follows an interesting path in darkest Victorian Britain, and the story leads to a possible murder victim.

167 *Historical/Archaeological Digital Forensic Facial Reconstruction from CT Scans*, **JOSHUA HARKER** (2017 W. Warner, Chicago, IL 60618, info@joshharker.com).

Putting a face on the skull of a long deceased individual has the innate ability of helping connect us to the subject in a significant way that humanizes the remains. The face is arguably our most recognizable attribute. From birth we are programmed in facial recognition and much of our communication is based on how we identify with the faces of others. By reconstructing the face of a mummy from digital scans we are able to peer into the eyes of a past life without disturbing the remains. A host of new technologies brings us closer than ever without ever having to touch the physical body. Forensic artist Joshua Harker will be discussing digital facial reconstruction from CT Scan/DICOM data. The presentation will specifically address techniques, related technologies, process reliability, benefits, and reconstruction results. His recent depictions of the Oriental Institute's Mummy Meresamun (800 B.C.) and University of Belgrade's Mummy Nesmin (300 B.C.) will be referenced. Time allowing, a short software demonstration will be given highlighting the digital reconstruction process.

The Second Law of Thermodynamics: Status and Challenges, Part II

Wednesday, starting at 9:30 a.m. in KIPJ Rooms C and D (Continuing from Tuesday; please refer to page 83 in these Proceedings for Tuesday's abstracts.)

168 *Relaxation Phenomena in the Adiabatic Phase Transition of Type I Superconductor Particles*, **PETER D. KEEFE** (University of Detroit Mercy, 24405 Gratiot Avenue, Eastpointe, MI 48021 USA; www.Keefengine.com; PDK@ix.netcom.com).

The first order phase transition of a Type I superconductor involves thermal and electrodynamic relaxation processes of the control variables for which the relaxation time of the electrodynamic relaxation process proceeds from an initial state to a final state about three orders of magnitude faster than the caloric relaxation process proceeds. In the first order adiabatic phase transition of macroscopically sized specimens, ensemble averaging results in relaxation time differences of the control variables being unobservable, the relaxation processes being considered coupled and simultaneous; the phase transition is isentropic. In the first order adiabatic phase transition of mesoscopically sized particles, volume-wide coherence results in relaxation time differences of the control variables being observable, the relaxation processes being considered decoupled and non-simultaneous; the phase transition is not isentropic.

169 *The Production of Electricity Out of a Heat Bath*, **RODERICH W. GRAEFF** (Private Scholar, Domagkweg 7; D-78126 Koenigsfeld, Germany and 102 Savage Farm Drive, Ithaca, NY 14850; rwgraeff@yahoo.com).

The author reports a negative temperature gradient in carefully-insulated vertical columns of gases, liquids and solids, cold at the top and warm at the bottom. This is caused by the effects of gravity. The surrounding environment showed a positive gradient. The temperature difference between top and bottom of a vertical column allows the production of electricity out of a heat bath.

The author will demonstrate this effect with a "Gravity

Machine," using a single crystal silicon rod and water as the heat bath. This represents a Perpetuum Mobile of the Second Kind. It strengthens the position of J.Loschmidt, who believed and declared in 1876 that a vertical column of a solid in an isolated system would show a temperature gradient under the influence of gravity, being cold at the top and warm at the bottom.

170 *On Entropy in Eulerian Thermodynamics*, **CHRISTIAN FRONSDAL and ABHISHEK PATHAK*** (Department of Physics and Astronomy, University of California Los Angeles, 475 Portola Plaza, Box 951547, Los Angeles, CA 90095; abhishepathak@ucla.edu).

To the student of thermodynamics the most difficult subject is entropy. In this paper we examine the actual, practical application of entropy to two simple systems, the homogeneous slab with fixed boundary values of the temperature, and an isolated atmosphere in the presence of the static gravitational field. The first gives valuable insight into the nature of entropy that is subsequently applied to the second system.

It is a basic tenet of thermodynamics that the equilibrium of an extended, homogeneous and isolated system is characterized by a uniform temperature distribution and it is a strongly held belief that this remains true in the presence of gravity. We find that this is consistent with the equations of extended thermodynamics but that entropy enters in an essential way. The principle of equivalence takes on a new aspect.

171 *A Generalized Second Law for Heterogeneously Coupled Energy Systems that Exhibit Equilibrium Temperature Differentials and Comments on Time Reversibility and Entropy*, **CHRISTOPHER G. JESUDASON** (Department of Chemistry, Science Faculty, University of Malaya, Pantai Valley, 50603 Kuala Lumpur, Malaysia; jesu@um.edu.my).

The development of the Zeroth and Second laws were modeled on homogenous mechanical systems defined as possessing mass and conforming to Newton's laws of motion and the First law of thermodynamics. The deductions and theorems derived from considerations and observations of these mechanical systems were presumed to obtain for other bodies or systems not sharing all of the characteristics of these mechanical systems and interactions, such as electromagnetic (EM) radiation, where its material equivalent pressure is half of that of Newtonian corpuscles for the same kinetic energy flow.

One could conceivably in principle observe temperature differentials -violating the Zeroth law in standard form- if one could couple this form of energy interaction with those for purely mechanical interactions, if equality of pressure at the system interfaces is a stipulated condition. A simple experiment conducted about 15 years ago under vacuum conditions seems to suggest such possibilities. The Kirchhoff radiation, Second and other laws are generalized to accommodate this possibility.

Based on an analysis of the dynamical equations of motion, it is shown that these equations are not reversible in the sense as defined, despite the conviction of many over the centuries in framing thermodynamical equations based on the reversibility principle, and some of these equations will be discussed. It is concluded that entropy evolves according to the irreversible mechanical laws.

172 *Revisiting The Second Law of Energy Degradation and Entropy Generation: From Sadi Carnot's Ingenious Reasoning to Holistic Generalization*, **MILIVOJE M. KOSTIC** (Department of Mechanical Engineering, Northern Illinois University, Dekalb, IL 60115 USA; kostic@niu.edu).

Sadi Carnot's ingenious reasoning of reversible cycles (1824) laid foundations for the *Second Law* before the *Fist Law* of energy conservation was even known (Joule 1843) and long before Thermodynamic concepts were established in 1850s. A century later, Bridgman (1941) "complained" that "there are almost as many formulations of the *Second Law* as there have been discussion of it." Even today, the *Second Law* remains so obscure, due to the lack of its comprehension, that it continues to attract new efforts at clarification, including this one.

The *Laws of Thermodynamics* have much wider, including philosophical significance and implication, than their simple expressions based on the experimental observations. The *Fundamental Laws of Nature: The Zeroth* (equilibrium existentialism), *The First* (conservationism), *The Second* (directional transformationalism), and *The Third* (unattainability of emptiness), are defining and unifying our comprehension of all existence and transformations in the universe. The forces, causing the mass-energy displacement, thus defining the process direction, are manifested by tendency of mass-energy transfer in time towards common equilibrium due to non-equilibrium of mass-energy in space. It should not be confused with local creation of non-equilibrium or "organized structures" on expense of "over-all" non-equilibrium, by spontaneous and irreversible conversion (dissipation) of other energy forms into the thermal energy, always accompanied with increase of entropy (randomized *equi-partition* of energy per absolute temperature level).

The fundamental laws of nature are considered to be axiomatic and many believe they could not be explained, proven or questioned. However, everything may and should be questioned, reasoned, explained and possibly proven. The miracles are until they are comprehended and understood.

The Rio Muerto Project: Mummies of the Tiwanaku Culture from Moquegua, Peru Wednesday, starting at 11:00a.m. in KIPJ Theatre

173 *The Rio Muerto Project 2006-2010: Mummy Preparation, Mortuary Practice, and Social Identity in the Tiwanaku State (AD 500-1000)*, **PAUL S. GOLDSTEIN^{1*}, ULRIKE M. GREEN¹, ALICIA BOSWELL¹, SARAH BAITZEL¹, and PATRICIA PALACIOS²** (¹Department of Anthropology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0532; ²Museo Contisuyo, Plaza de Armas, Moquegua, Peru; psgoldstein@dssmail.ucsd.edu).

Mortuary excavations at the Rio Muerto site in Moquegua, Peru, perhaps the best preserved Tiwanaku site in South America, have produced an important sample of Tiwanaku mummified remains and a trove of data on mortuary practice. The Tiwanaku rituals of death and mourning indicate enduring cultural and social ties between lowland colonies and the civilization's homeland in the high altiplano. Shared mortuary elements include widely shared practices of body preparation, wrapping and positioning, tomb construction, and burial offerings. At the same time, more subtle variability in Tiwanaku mortuary practices, mourner's rituals and

ethnic diacritics such as cranial deformation between distinct cemetery sectors may align with distinct subgroups or cultural identities within the larger Tiwanaku civilization.

174 *Dress, Death, and Identity in Moquegua Tiwanaku: Textile Evidence from the Rio Muerto Mummies, Moquegua, Peru*, **ELIZABETH M. PLUNGER* and PAUL S. GOLDSTEIN** (Department of Anthropology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0532; psgoldstein@dssmail.ucsd.edu).

Dress is among the most important means of communicating roles and relationships, both in life and death. The mummies and other well-preserved interments from the Tiwanaku cemetery sites at the Rio Muerto archaeological complex (M43 and M70) in Moquegua, Peru, offer a rare opportunity to examine the construction of the identities of Middle Horizon people as they are mourned and interred by family and friends. Information from the examination of the garments from these sites has provided unprecedented information on ideas of status, gender and sex roles, and the roles and importance of children, in this ancient community.

175 *Unwrapping Tiwanaku Diet: Carbon and Nitrogen Isotope Data from the Mummies of Rio Muerto, Moquegua, Peru*, **ANDREW D. SOMERVILLE*, PAUL S. GOLDSTEIN, SARAH I. BAITZEL, MARGARET J. SCHOENINGER, SARAH RAUBENHEIMER, and LINDA YZURDIGA** (Department of Anthropology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0532; psgoldstein@dssmail.ucsd.edu).

The superb preservation of human remains at Rio Muerto permits an unusual opportunity for new bioarchaeological research on Tiwanaku society. As markers of individual and group identity, dietary practices convey valuable information on ethnicity, gender, and status-based differences within archaeological populations. Through analysis of bone carbon and nitrogen stable isotope ratios, we reconstruct the paleodiet of the Middle-Horizon Tiwanaku from Rio Muerto in the Moquegua Valley of Southern Peru. Working with mummified remains permits analysis of both traditional bone isotope ratios as well as human hair, allowing comparison between long and short-term dietary intake. Our results are compared to previously generated data from the earlier Huaracane, and succeeding Tumilaca and Chiribaya populations, and to highland Tiwanaku data to assess dietary changes in relation to political and demographic changes across the Tiwanaku core and peripheral regions. Additionally, we investigate gendered food behaviour in the peripheral Tiwanaku colony.

176 *Labor, Gender, and Identity: Bioarchaeological Activity Patterns in Mummified and Skeletonized Individuals from the Tiwanaku State (AD 500-1000)*, **SARA K. BECKER** (University of North Carolina, Chapel Hill, Department of Anthropology, 301 Alumni Building CB#3115, Chapel Hill, NC 27599; Sara.Becker@unc.edu).

Organized labor is a known key component to the development of state-level societies. However, concepts of labor in prehistoric societies can sometimes be reduced to a one-dimensional idea, overshadowing the actual individuals involved in activity and production within an emerging complex society. Within this paper, I provide a comparative framework of specific skeletal evidence to the archaeological record by using biological markers to infer how habitual activity varies within Tiwanaku state formation both in the Titicaca Basin, Bolivia and the Moquegua Valley, Peru. The

excellent preservation at these sites including mummified or partially mummified remains along with these bioarchaeological activity data add specific insight into the routine of individuals and their contributions to the social groups in which they live, revealing divisions of labor such as status or gender differences.

Osteoimmunology: Fundamental, Clinical and Translational Implications in Temporomandibular Disorders
Wednesday, starting at 1:15 p.m. in KIPJ Room G

177 Fundamental Osteoimmunology: From Stem Cells to Bone-immune Metabolism, ANDRE BARKHORDARIAN* and FRANCESCO CHIAPPELLI, (UCLA School of Dentistry, Division of Oral Biology and Medicine, Los Angeles, CA 90095-1668; andreucs@hotmail.com).

Osteoimmunology refers to the regulating interplay, interaction, and (or) interconnectivity between bone and immune biology. The interplay begins when bone provides the microenvironment that is critical for the development of the hematopoietic stem cells from which all cells of the mammalian immune system derive, and they in turn produce various immunoregulatory cytokines that influence the fate of bone cells. Besides sharing signaling molecules, bone and immune cells have a common site of origin. They influence each other not only after maturation and activation, but also at the formation stage as apparent in the role of osteoblasts in the establishment of hematopoietic stem cell niches and their maintenance in bone marrow. Abnormalities in immune system cause skeletal damages that eventually lead to osteoimmunopathologies. Various inflammatory mediators and cytokines influence the pathogenic mechanisms involving interactions between immune cells and bone. T-cell mediated immunity as well as T-cell regulation play an important role in this check and balance interaction. Central regulatory mechanisms of the immune system are key players and the link between immune system and bone as it relates to regulation of immune activation and bone resorption.

178 Psychoneuroendocrine-osteoimmunology and Temporomandibular Disorders, FRANCESCO CHIAPPELLI* and ANDRE BARKHORDARIAN (UCLA School of Dentistry, Division of Oral Biology and Medicine, Los Angeles, CA 90095-1668; fchiappelli@dentistry.ucla.edu).

Osteoimmunology refers to the study of the interface between the skeletal and immune systems. The “osteo-immune system” pertains to the complex interactive communication between the physiology of bone and of immunity, that is the finely articulated interacting systemic, cellular and molecular regulatory pathways between the cell populations that sustain bone metabolism, the osteoblasts and the osteoclasts, and the myeloid and lymphoid cell populations that bring about cell-mediated immune surveillance. Immune and bone cells share a variety of mutually cross-regulating signaling molecules, growth factors and signaling pathways. Bone and immune cells arise from a common site of origin, namely the bone marrow, which is rich in blood supply, and autonomic innervation, that ensures well-distributed neuroendocrine modulation of bone, immune, and osteoimmune events. Osteoimmunopathology refers to the wide spectrum of pathological conditions that range from autoimmune, to inflammatory, neoplastic diseases, and joint

pathologies. We will explore the fundamentals of the psychoneuroendocrine-immune-bone crosstalk, particularly as it pertains to inflammatory processes proximal to, and detrimental to the temporomandibular joint, which forms the articulation the upper temporal bone superiorly, and the mandibular bone (i.e., mandible, “lower jaw”) inferiorly. This ginglymoarthrodial synovial joint is a complex structure, which is controlled by the powerful muscles of mastication, and the support provided by the posterior dentition. States of physical or psycho-emotional stress or anxiety can have serious impact on the anatomy and the functioning of this joint. The proximity of the joint to critical anatomical structures contributes to explaining some of the psychoneuroendocrine-osteoimmunopathology observed in temporomandibular joint disorders.

179 Systemic Correlates of Temporomandibular Joint Disorders, GARY DEMERJIAN (2701 W. Alameda Ave. Suite 606, Burbank, CA 91505; drdemerjian@yahoo.com).

The temporomandibular joint (TMJ) articulates the mandible with the maxilla. Temporomandibular joint disorders (TMD) are dysfunctions of this joint, which range from acute to chronic inflammation, trauma and dislocations, developmental anomalies, neoplasia and arthritis. TMD manifest as signs and symptoms that involve the surrounding muscles, ligaments, bones, synovial capsule, connective tissue, teeth and innervations proximal and distal to this joint. TMD induce proximal and distal, chronic and acute, dull or intense pain and discomfort, muscle spasm, clicking/popping sounds upon opening and closing of the mouth, and chewing or speaking difficulties. The trigeminal cranial nerve V, and its branches provide the primary sensory innervation to the face and TMJ. Our clinical work suggests that the auriculotemporal (AT) nerve, a branch of the mandibular nerve, the largest of the three divisions of the trigeminal nerve, plays a critical role in TMD sequelae. As the three divisions of the Trigeminal meet at the Gasserian Ganglion, the Trigeminal bundle enters the brainstem and forms the Trigeminal Nucleus of the Spinal Tract. The AT nerve provides the somatosensory fibers that supply the joint, the middle ear, and the temporal region. The AT nerve establishes an important bridge to the sympathetic system. As it courses posteriorly to the retro-discal tissues of the condylar head of the TMJ, compression, injury or irritation of the AT nerve can lead to significant neurologic and neuro-muscular disorders, including Cervical Dystonia (Torticollis), Blepharospasm, Strabismus, gait or balance disorders and Parkinson’s disease.

Here, we propose that a proteomic signature of TMD can be obtained by assessing certain biomarkers in local (e.g., synovial fluid at the joint) and distal body fluids (e.g., saliva, cerebrospinal fluid), which can aid TMD diagnosis and prognosis.

180 Osteoimmunology I: Integrating Fundamental Osteoimmunology Research in Clinical Practice, JAY SISON (10921 Wilshire Blvd Suite 611, Los Angeles, CA, 90024; jaysison@aol.com).

Periodontal disease affects 30-50% of the population. The disease is characterized by the colonization of specific bacterial strains around the supporting structures of the teeth. This infection elicits a host immune response resulting in inflammatory changes affecting the surrounding tissues. The resulting inflammation can lead to bone destruction. The loss of bone reduces support for the teeth and can result in tooth loss. The inflammatory process that leads to the destruction of the bone supporting the teeth has also been linked to the progression of other diseases including cardiovascular disease.

This disease process highlights the importance of the interplay between the immune and skeletal systems. The field of osteoimmunology is becoming increasingly important in understanding those systems separately and the biology that permits crosstalk between them. The history and recent advances in the field of osteoimmunology in oral biology are reviewed here.

**State-of-the-Art Ancient Mummy Research
Wednesday, starting at 1:30 p.m. in KIPJ Theatre**

181 *Introduction to State-of-the-Art Ancient Mummy Research*, **FRANK J. RÜHLI^{1*}, ALBERT ZINK², and NIELS LYNNERUP³** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ³Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; frank.ruhli@anatom.uzh.ch).

Ancient mummies have been examined for centuries. The enormous ongoing advance of examination modalities allow us to expand research issues. The aim of this symposium is to review the current “gold-standard” for scientific studies of ancient mummies and to predict future developments, both in terms of examination standards as well as possible “high-end” single case methodologies.

182 *Macroscopic Investigation of Mummies*, **SALIMA IKRAM** (American University in Cairo, New Cairo, Egypt; salimaikram@gmail.com).

Traditional macroscopic investigations of mummies remain a crucial way of studying these artefacts. The sensory perceptions of the examiner often elicit new data from the mummy that is not available through radiography or CT scans. This form of analysis should always be the first step in engaging with the mummy. Such studies provide cultural and conservation information, as well as help formulate research questions that might be answered by more technical analyses, including digital imagery and chemical tests.

183 *CT and MR Imaging of Ancient Mummies*, **FRANK J. RÜHLI^{1*} and NIELS LYNNERUP²** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; frank.ruhli@anatom.uzh.ch).

One of the gold-standards in paleopathological investigation of mummies is the radiological examination using both conventional X-rays and more advanced methods. Computed tomography (CT) represents the gold-standard of X-ray based 3D-imaging systems, however more sophisticated methods of radiological analysis, such as magnetic resonance imaging (MRI) offer new diagnostic possibilities. In the last decades, these major imaging modalities show remarkable technological advances. The aim of this presentation is to give an overview of the current impact and pitfall of ancient mummy imaging, particularly focusing on CT and MRI. Various case reports of natural and artificial mummies examined by CT and MRI will highlight the diagnostic sensitivity and specificity of these modalities. Also, the best practice (technical parameters, diagnostic indications) in using these two major radiological techniques will be briefly addressed.

184 *State-of-the-Art of High Resolution Imaging of Ancient Mummified Tissue*, **FRANK J. RÜHLI^{*} and JOHANN WANEK**

(Centre for Evolutionary Medicine, University of Zürich, Switzerland; frank.ruhli@uzh.ch).

The diagnostic analysis of mummified tissue using computed tomography (CT) or planar X-ray imaging is often accompanied by histological work. However, resection and rehydration processes destroy valuable skeletal remains. Therefore, three dimensional imaging techniques such as synchrotron-based tomographic imaging, microCT or the nuclear magnetic resonance (NMR) method have become increasingly important in the investigation of the inner structure of the shrunken tissue. Such sophisticated imaging techniques with a spatial resolution between 0.4 to 500 microns allow the investigation of micro cracks, calcifications or muscle fibres, which are invisible with conventional clinical imaging systems.

Beside the application of ionizing imaging techniques increasing, research activities are now being performed using a non-ionizing approach (e.g. NMR) to preserve ancient DNA. Previous studies have indicated that the application of different nuclei such as ¹H and ²³Na may improve anatomical information of salt mummies.

185 *3D-Analyses and 3D-Visualisations*, **NIELS LYNNERUP** (Laboratory of Biological Anthropology, Department of Forensic Medicine, University of Copenhagen, Denmark; NLY@sund.ku.dk).

CT-scanning has emerged as a powerful instrument for the study of mummies. As a completely noninvasive procedure, it enables a “look inside.” Basically, the CT-scanner renders the studied object as a series of slices. These slices may be “re-stacked,” making multiplanar visualisation, i.e. viewing from different slice planes, as well as full 3D visualisations possible. However, there are some pitfalls. These are partly due to the nature of X-rays as well as the workings of the CT-scanner. Furthermore, there are issues concerning the image building process, including significant data loss. To work around these problems one may apply certain software which allows interactive, single-slice manipulation and editing, but there is some subjectivity involved. Bias in viewing CT-scan images and derived 3D visualisations is thus introduced, which may have a bearing on interpreting pathologies and pseudopathologies.

186 *Histological Investigation of Human Mummified Remains – Potential and Drawbacks of the Analysis of Ancient Soft Tissue Material*, **FRANK MAIXNER^{1*}, ASTRID GRUMER¹, BARBARA PICHLER¹, DARIO PIOMBINO-MASCALI¹, FRANZ SCHROFFENEGGER², EDUARD EGARTER VIGL², and ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ²Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; frank.maixner@eruac.edu).

Histology, the microscopic study of differentially stained tissue sections has become an essential tool in various biological and medical scientific fields. The application of this valuable technique ranges from basic tissue typing and pathological diagnostics to the identification of trace elements in the sample such as iron or calcium. Like other techniques in medicine, tissue histology was also applied to mummy research for its potential to determine the degree of tissue conservation and to identify possible pathological changes. However, compared to modern tissue material, ancient specimens require special re-hydration steps prior to paraffin embedding and often display different staining characteristics. Based on a study of Mekota and Vermehren (2005) we re-investigated various

re-hydration solutions with skin tissue samples from different mummy types. Results indicate a high variability of the methods in question in terms of re-hydration efficiency, preservation of tissue details and staining characteristics. Mekota, A.M., Vermehren, M. (2005) Determination of optimal rehydration, fixation and staining methods for histological and immunohistochemical analysis of mummified soft tissues, *Biotechnique and Histochemistry* 80(1), 7- 13.

187 Molecular Investigations of Microbial Communities in Mummified Human Remains, FRANK MAIXNER^{1*}, THOMAS RATTEI², GUADELUPE PINAR³, KATJA STERFLINGER-GLEIXNER³, DARIO PIOMBINO-MASCALI¹, GIOVANNA CIPOLLINI¹, and ALBERT ZINK¹ (¹EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ²Department of Computational Systems Biology, University of Vienna, Austria; ³Institute of Applied Microbiology, University of National Resources and Applied Life Sciences, Vienna, Austria; frank.maixner@eurac.edu).

Mummified human remains can be regarded as an independent “ecosystem” in which, on the one hand, highly specialized microorganisms thrive, some of which are involved in degradation processes. On the other hand, traces of ancient DNA in these specimens could provide detailed insight into the past microbiome of this mummy consisting of beneficial and potentially pathogenic bacteria. Until recently, the vast majority of complex microbial communities were largely underestimated due to major technical, time, and financial constraints. Therefore, our knowledge of mummified bodies as “ecosystems” is limited. However, advancements in high-throughput next-generation sequencing technology have yielded powerful new tools in terms of cost effectiveness, time saving and data recovery. “In-depth” sequencing of phylogenetic marker genes will shed light into the spectacular microbial diversity in various habitats in and on mummies.

188 State-of-the-Art Ancient Mummy Research: Coprolites, KARL J. REINHARD (School of Natural Resources, Hardin Hall 719, University of Nebraska, Lincoln, NE 68583-0987; kreinhard1@mac.com).

Coprolites are a source of a diversity of data regarding infection, medicine, diet, and environment of the decedent. New methods are introduced yearly for each of these topics. Highlighted in this presentation are several issues. Refined parasite diagnosis is offered by molecular and chemical methods. The analysis of starch represents the latest revolution in paleonutrition and is immediately applicable to mummy studies. Starch grains not only show what starch sources were eaten, but also the manner of preparation of specific foods. Diatom studies of coprolites are on the horizon. Diatoms reveal different aquatic environments exploited by ancient peoples. By applying aeropalynology data regarding season variations in natural pollen rain, it is possible to determine in what month of the year an individual died.

When ecological and parasitological data are combined, patterns of climate variation, diet, and infection can be discerned. For example, *El Niño* events at the coast of Chile caused variation in Chinchorro exploitation of fish species. This in turn affected prevalence of tapeworm infection.

Taphonomy is a concern. The preservation of remains from mummy coprolites is variable. By analysis of insects, mites, and the ecology of preservation, one can assess the preservation potential

of the microfossils from coprolites. This will allow one to interpret whether the absence of a class of microfossils is due to poor preservation conditions. In conclusion, a holistic approach to coprolite analysis results in the placement of pathological conditions in behavior and environmental contexts.

189 Preservation of Human Mummified Remains, ALBERT ZINK^{1*}, MARCO SAMADELLI¹, DARIO PIOMBINO-MASCALI¹, and EDUARD EGARTER VIGL² (¹EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ²Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; albert.zink@eurac.edu).

The preservation of human mummified remains often represents a major problem, both in the original find sites as well as in secondary depositories, such as collections or museums. Changes of the microclimate surrounding mummy burials that can be caused by excavation or building activities, tourism exploitation or natural influences often lead to a decline of the natural preservation conditions. In particular, the increase of humidity and insufficient ventilation enhance the growth and spread of microorganisms that could result in major damage to mummified remains. The storage of mummies in museums or collections faces the specific challenge of recreating the natural climatic conditions. This often proves problematic, as the optimal preservation conditions for mummies from different geographic areas are not always fully understood, and also due to the high costs required for maintaining and displaying the human remains.

We present examples of different mummy find sites, such as in Egypt and Sicily, where the natural preservation conditions have changed and how this has influenced the natural storage of these mummies. Moreover, different solutions for the conservation of mummies in museums will be discussed. As an example, the Tyrolean Iceman is stored in a specially designed cooling chamber that emulates the cold and humid environment in which he was naturally preserved for more than 5000 years. Modern showcases allow the use of nitrogen and a precise control of temperature and humidity. In this context, possible solutions for more efficient and less expensive preservation systems will be considered.

190 Dental Studies, ROGER SEILER* and FRANK J. RÜHLI (Centre for Evolutionary Medicine, University of Zürich, Switzerland; rogerseiler@bluewin.ch).

For many years, mummies have been systematically examined, e.g. in Switzerland. We are currently completing the inventory of Swiss mummies with a special emphasis on oral findings. When it is interpreted mummy oral pathologies in more detail. These pathologies are dental wear such as abrasion, attrition, erosion, and the combination thereof; caries, periodontal destruction and apical lesions of the alveolar bone. In addition, possible postmortem changes in the dentition relative to the mummification process may be found. The use of 3D-reconstructions alone has in many cases limited informative value. Therefore, axial images and 2D-panoramic reformatted images are necessary in order to obtain additional information for the diagnosis of caries and periodontal destruction in mummies. We are also trying to estimate the clinical relevance of these pathological findings in mummies in general.

191 *Advancing the Stable Isotopic Analysis of Mummies: Some Suggested Future Directions*, **CHRISTINE D. WHITE^{1*} and FRED J. LONGSTAFFE²** (¹Department of Anthropology, The University of Western Ontario, Canada; ²Department of Earth Sciences, The University of Western Ontario, Canada; white2@uwo.ca).

This paper reviews the current methodological state of stable isotopic analyses on mummy tissues and their usefulness in: 1) understanding pathological and physiological processes, and 2) reconstructing diet, geographic mobility, long- and short-term environmental change in past populations. The potential of research designs that involve use of the tissue clock through multiple and incremental tissue analyses, combinations of different isotopes, the integration of isotopic data with other forms of data, and forms of instrumentation that provide highly specific data are discussed in light of future directions

192 *Using Rapid Prototyping in Mummy Studies – Bridging Science and Public Presentation*, **HEATHER GILL-FREKING* and WILFRIED ROSENDAHL** (German Mummy Project, Reiss-Engelhorn Museums, Mannheim, Germany; Heather.Gill-Robinson@mannheim.de).

The application of medical imaging in mummy studies is common, and the importance of these methods for the analysis of mummies is clear. Aside from the analysis of the 2D images, and the reconstruction of virtual 3D models, data from medical imaging can be used to create physical 3D models through the use of various rapid prototyping techniques. The models, which can be made to scale to create a replica of an object or skeletal element, can be used to assist in the non-destructive analysis of the mummy and accompanying artifacts, or to create a model of the skull for facial reconstruction, for example.

This paper discusses the use of rapid prototyping in the German Mummy Project. Specifically, we present two cases of South American mummies, in which objects associated with the mummies, but not visible for analysis, were reproduced using binder jet printing. Through the creation of the physical 3D models, identification of objects was possible, which enabled a more accurate contextual interpretation of each of the mummies. The replicas of the objects were then displayed with the mummy during exhibition, in order to help the visitor understand the mummy as a person, and recognize the importance of non-destructive methods of analysis in mummy studies.

193 *Next Generation Sequencing Technology in Mummy Studies: The Genome of the Tyrolean Iceman*, **ANGELA GRAEFEN^{1*}, ANDREAS KELLER², MARKUS BALL³, MARK MATZAS⁴, VALESCA BOISGUERIN⁴, FRANK MAIXNER¹, PETRA LEIDINGER², ANDRE FRANKE⁵, JENS MAYER², RABAB KHAIRAT³, JESSICA SPANGLER⁶, STEPHEN McLAUGHLIN⁶, MINITA SHAH⁶, CLARENCE LEE⁶, TIMOTHY HARKINS⁶, ALEXANDER SARTORI⁶, JAN HAAS⁷, HUGO KATUS⁷, BENJAMIN MEDER⁷, NIKOLAUS BLIN³, ECKART MEESE², CARSTEN PUSCH³, MARCO SAMADELLI¹, EDUARD EGARTER VIGL⁸, and ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²Department of Human Genetics, Saarland University, Homburg, Saar, Germany; ³Division of Molecular Genetics, Institute of Human Genetics, University of Tübingen, Germany; ⁴Febit Biomed GMBH, Heidelberg, Germany; ⁵Institute of Clinical Molecular Biology, Christian-Albrechts-University Kiel, Germany; ⁶Lifetech/Applied

Biosystems, Beverly, MA 01915, Foster City, CA 94404; ⁷Department of Internal Medicine III, University of Heidelberg, Heidelberg, Germany; ⁸Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; angela.graefen@eurac.edu).

Whole genome sequencing approaches are rapidly gaining in popularity within the field of ancient DNA. However, most human palaeogenomic studies have been carried out on skeletonised human remains (or other remains such as hair), so that the opportunities of comparing genomic and physical data (such as phenotypic appearance or non-skeletal afflictions) are strictly limited. We present here the preliminary results of the whole-genome analysis of the 5300 year-old Tyrolean Iceman, carried out using Applied Biosystems/Lifetech SOLiD4 sequencing technology, and outline the methods used for sample preparation and sequencing. Success rates on genome coverage and depth proved to be very high, despite the small sample size used for library preparation. Genomic data was analysed with regard to functional and clinically relevant polymorphisms, as well as phylogenetic implications. Clinically relevant SNPs were compared with existing radiological, pathological, and morphological insights from previous studies to evaluate the possibility of a potential genetic predisposition. Furthermore, the genomic data serves as a reference database for significant genetic polymorphisms identified in future genome-wide association studies.

The Changing Role of the Research University in K–12 Science Education Wednesday, starting at 2:00 p.m. in KIPJ Room A

194 *UC Berkeley's Response to The Gathering Storm: Cal Teach and MEA Berkeley*, **NICOLE NUNES**, (College of Letters and Science, University of California, Berkeley, 367 Evans Hall, MC 3860, Berkeley, CA 94720-3860; nunesn@berkeley.edu).

Improving science and math education is a national imperative, and it is widely acknowledged as a critical engine for careers in science, technology, engineering and math (STEM) fields, innovation, economic growth and U.S. competitiveness. In response to this need, UC Berkeley has launched two complementary programs to address the recruitment and retention of quality teachers – Cal Teach and Math for America (MfA), Berkeley. Cal Teach Berkeley is a new undergraduate teacher credential program that promotes teaching as a career through coursework and field placements in local schools. The program allows undergraduates to obtain a teaching credential along with their undergraduate degree in science, math or engineering. MfA Berkeley offers Master Teacher Fellowships to secondary math and science teachers to help them continue to develop the skills, commitment, professional support, and leadership development they need to continue teaching in urban schools. Both programs focus on developing quality teaching practices through the integration of strong content knowledge, an inquiry approach to teaching informed by experience doing scientific research, and extensive experience working in urban classrooms. Through collaboration between the Graduate School of Education and STEM faculty, these two programs leverage the strengths of the university to support K-12 math and science education.

195 *Content-Intensive Courses in UC San Diego's Science Education Minor: Preliminary Results on Their Effects on Pre-Service*

Science Teachers, **JOHN CZWORKOWSKI** (Department of Chemistry and Biochemistry, University of California, San Diego, 9500 Gilman Drive # 0303, La Jolla, CA 92093-0303; jczworkowski@ucsd.edu).

The California Teach Program at the University of California is the product of a state-wide initiative to increase the number of highly-qualified science and math teachers in the state. At UC San Diego, the Program spurred the creation of a Science Education Minor, designed through a cooperative effort of faculty in the sciences, mathematics, and education, which offers students academic work and field experiences that provide a holistic preparation for their future work as science and math teachers, including integration of significant science content with theories of learning and teaching in several innovative courses. The content-intensive courses in the Minor, and preliminary results on outcomes for the participating students, will be described in the presentation. There are strong indications that the courses are positively influencing students' attitudes toward teaching, that students' own learning of science has become more sophisticated, and that a foundation is being laid for development of the students' pedagogical content knowledge.

196 *Growing a Culture for Science Education in the University of Arizona's College of Science*, **DEBRA TOMANEK** (Office of Instruction and Assessment and the College of Science Teacher Preparation Program, University of Arizona, 1500 E. University Blvd., Bldg. 70, Tucson, AZ 85721; dtomanek@email.arizona.edu).

Colleges of science at many research universities have long histories of engagement in science education outreach activities. This is especially common at land-grant research institutions like the University of Arizona (UA). However, in recent years, the UA has been a leader in developing a culture for science education that goes beyond its outreach mission. The development of this culture has resulted in a science teacher preparation program for undergraduate science majors who wish to become secondary level science teachers, a College of Science based promotion and tenure system that values scholarly productivity in the areas of teaching and learning, and the preparation of doctoral students who pursue research on science teaching or learning while earning their degrees in science. These products of the UA College of Science culture for science education have also resulted in unexpected outcomes such as increased collaborations between scientists and science educators in funded grant projects, greater awareness by scientists of research on teaching and learning, and higher cumulative GPAs for science majors in the College of Science based program than the national GPA average for students majoring in education-based teacher preparation programs.

197 *Leveraging a Collaborative Partnership to Achieve High Quality Professional Development for Science Teachers*, **KENT J. CRIPPEN** (Department of Curriculum and Instruction, University of Nevada, Las Vegas College of Education, 4505 S. Maryland Parkway, Box #453005, Las Vegas, NV 89154-3005; kcrippen@unlv.nevada.edu).

The unique attributes of an urban environment, such as issues of diversity and large student populations learning English as a second language, necessitate unique solutions for improving K12 STEM education. By breaking down traditional barriers and leveraging collaborative partnerships, the nation's research universities have an important role to play in this endeavor, including

teacher professional development. This presentation describes a professional development model that uses a learning community approach with a collaborative partnership that includes a university, school district, and regional professional development organization in order to improve current K-12 teachers and STEM education. This approach leverages each institution's attributes and resources in order to overcome institutional barriers and provide high quality professional development for teachers. Evaluation results from a recent project, Project PASS are used to characterize the model and its effectiveness for increasing teacher content knowledge, reforming the classroom characteristics of teacher participants, and improving student performance.

198 *More Than Outreach: Starting a Charter School on a Research University Campus*, **BARBARA SAWREY** (Academic Affairs and Department of Chemistry and Biochemistry, University of California, San Diego, 9500 Gilman Drive # 0001, La Jolla, CA 92093-0001; bsawrey@ucsd.edu).

How does a charter school fit into the mission of a research university, and how do the two institutions sustain a relationship? In 2000 The Preuss School@UCSD opened its doors on the UC San Diego campus. Today it serves 826 diverse students, all of whom are from low-income, first-generation college families. The school teaches grades 6-12, with a longer school day and a longer school year than other San Diego public schools. Ninety four percent of the 2010 graduating class was accepted at a four-year college or university. The challenges of creating the school were many, but the success has been even greater than expected, often in unforeseen ways. Many of the outcomes and challenges will be highlighted in the session.

Mexican Mummy Studies **Thursday, starting at 8:00 a.m. in KIPJ Theatre**

199 *Incidents in the Sierra Tarahumara*, **ENRIQUE CHACÓN SORIA** (Centro INAH Chihuahua, Paseo Bolívar No. 608, Col. Centro, Chihuahua, CP 31000; chaconsoria@gmail.com).

While searching for Francisco Villa's body in the "Cueva del Gigante" in the Alta Tarahumara near the town of Guerrero, Chihuahua, México in January 2010, a group of 20 infant bodies, including nine mummies, were found and illegally extracted. One of the skulls showed a bullet sized hole and, due to the actual violent regime in the area, the excavation site was believed to be a "narco fosa" (narco mass grave). Authorities were informed of this; preliminary forensic and contextual studies indicated that the bodies were not modern but historic, if not pre-Hispanic, and so the Chihuahua INAH (*Instituto Nacional de Antropología e Historia*) office took responsibility of the discovery and classified it as illegal destruction of cultural heritage. The analysis on the associated artifacts, such as pottery, corn, cloth made up of vegetable fibers, cords, wooden artifacts, etc., indicated that "Cueva del Gigante" was a Tarahumara burial ground of approximately 1200 to 1500 A.D. In order to address the questions "what is the economic and cultural value of a mummy from the Sierra Tarahumara?" and "what is the purpose of looting?" this study analyses all the previously registered cases of mummies in the Sierra and integrated several points of view from different social actors (First Nations and Mestizos) on looting and preservation of human burials and their associated cultural material.

200 *The “Why” of the Mortuary Context of Mexican Mummies*, **ILÁN LEBOREIRO*** and **JOSEFINA MANSILLA** (Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F. 11560; ilanleboeiro@hotmail.com).

The cultural practices around death expressed by ancient human groups through the bioarchaeological context, has been of great interest to anthropology since the nineteenth century. Without a doubt, those practices imply the manipulation of the cultural material, reflecting social relations and cultural ideals, being the human body the principal element to consider in the mortuary context. The vast majority of mummified bodies found in México have been the result of donations, looting, or archeological rescues. Nevertheless, even when the mortuary context from which those mummies come from is modified or destroyed, it is sometimes possible to reconstruct that context, meaning that we can have an idea of the “how” of a burial site. But to be able to understand the “why” of a mortuary context, implies a different methodology. In this study we integrate the interdisciplinary analysis around the mortuary contexts appealing to the ethnohistorical testimonies that describe the cultural aspects of the ethnic groups from Northeast México, and contrasted the bioarchaeological evidences with the available data from burial ritual practices.

201 *Brief Overview about the Mexican Mummies*, **JOSEFINA MANSILLA*** and **ILÁN LEBOREIRO** (Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F. 11560; dra_mansilla@yahoo.com).

Mummified bodies in México have been documented since the pre-Columbian, this phenomenon is mostly due to the dry or semiarid environment of some caves, crypts, underneath churches’ floors, or other places where the corpses quickly suffer dehydration, therefore avoiding the natural process of decomposition changes attributed to microbial and autolytic actions. The aim of this paper is to describe and compare the different bioarchaeological characteristics of some of these corpses through different epochs in México.

202 *México’s Most Ancient Mummy: Tm-c-247 at Romero’s Cave*, **JOSEFINA MANSILLA*** and **ILÁN LEBOREIRO** (Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, Col. Polanco, México, D.F., 11560; dra_mansilla@yahoo.com).

Back in the 1950’s the archeological research conducted by Richard McNeish in the South of Tamaulipas has been of great significance for the modern Mexican archaeology. His methodical excavations in the region unraveled the history of the Prehispanic groups that inhabited that area. In the Southwest zone of the state, in 1955, McNeish excavated the caves at the Infiernillo Canyon, particularly the Romero, Valenzuela and Ojo de Agua. He established a stratigraphical cultural sequence based on food remains and archaeological material, covering approximately from 7000 B.C. to 1500 A.D. In the Romero cave at the Ocampo region, catalogued as Tm-c-247, he reports nine human burials found among the sixteen settlements in that cave. Even when he doesn’t refer to them explicitly as mummies, he thoroughly details the cultural material associated to each one of these burials. Once he concluded with the excavations and until the last five years, the “McNeish Mummies” were believed as vanished. Fifty years went by until the re-discovery of these mummies; we have recently studied them and

here are some bioarchaeological results, such as the radiocarbon analysis which determined that of one of the mummies is the most ancient Mexican mummy.

203 *Ancient DNA from Mummified Tissue in México: A Case Study for the Early Colonization of the Americas*, **CRISTINA VALDIOSERA^{1*}**, **COLIN SMITH¹**, **MORTEN RASMUSSEN¹**, **VICTOR MORENO¹**, **ESKE WILLERLEV¹**, **ILÁN LEBOREIRO²**, and **JOSEFINA MANSILLA²** (¹Center for GeoGenetics, Geologiske Museum, Oster Voldgade 5-7; 1350, Copenhagen K, Denmark; ²Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México D.F. cvaldioser@yahoo.es; ilanleboeiro@hotmail.com; dra_mansilla@yahoo.com).

Ancient DNA can be obtained from several different sources such as bone, teeth, hair, seeds, coprolites and soil, of different ages and environments. Mummified material represents an excellent source of DNA due to its exceptional molecular preservation. Moreover, mummy hair provides one of the best possible sources of ancient DNA as hair is robust to human contamination that blights such studies and hair sampling is less destructive than sampling teeth or bones. Here we present preliminary results obtained from ancient DNA analysis of pre-Columbian mummies from México. As part of an ongoing project, this data is combined with the anthropological context, radiocarbon dates, and novel stable isotopic techniques to provide information about the genetic diversity of Amerindian populations in México and palaeodietary preferences of these individuals. This data will be integrated further into a larger study of ancient DNA with samples spanning both the North and South American continents and the time range of the earliest colonizers. Within this continental and temporal framework the Mexican samples discussed here represent an optimal case study to analyze the genetic diversity in the Americas right before European contact at approximately 500 years ago. Part of these populations are thus some of the latest samples (i.e. longest surviving lineages) and they represent an important location in the continent where gene flow will almost certainly have taken place.

204 *Traditions of the Ancient Northern Mexican Desert: Fur-wrapped and Flexed Positioned Mummies of Infant Cadavers*, **LETICIA GONZALEZ^{1*}**, **JOSEFINA MANSILLA²**, **SANDRA POMPA³**, **MARCO ANTONIO RODRIGUEZ⁴**, and **ILÁN LEBOREIRO²** (¹Museo Regional de La Laguna, Bosque Venustiano Carranza s/n, Torreon, Coahuila, C.P. 27000; ²Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México, D.F.; ³Universidad Nacional Autónoma de México, Instituto de Ecología, Laboratorio de Ecología y Conservación de Fauna Silvestre, Ciudad Universitaria, C.P. 04510, México D.F.; ⁴Universidad Nacional Autónoma de México, Instituto de Ecología, Laboratorio de Evolución Molecular y Experimental, Ciudad Universitaria, C.P. 04510, México, D.F.; legoar@yahoo.com).

In the northern Mexican desert, several infant mummies, flexed-positioned, wrapped in animal skin and woven mat (*petate*), have been found buried or in caves. From these, two cases from the *Cuatrociénegas* region with these features are described and analyzed. We also discuss the one published by Walter Taylor (1968) in the same region. These two Mexican cases are compared and discussed with the ones described in Texas, being these sites are ecologically similar and were used by the same hunter/collector tribes

culturally. One of the infants was radiocarbon-dated to be 918 ± 26 B.P. Samples from the fur used to flex and wrap the infant were collected in order to determine if it is mule, white-tailed deer or other animal. Using Pääbo technique and Quiagen Kit modified to isolate DNA, we amplified the third variable region of mitochondrial gene D-Loop and sent it to sequencing. Sequences obtained were analyzed to determine at least the genus of the organism's sample. The geographical ranges of both species of deer overlap in the *Cuatrociénegas* region, and several authors mention the almost perfect DNA similarity between species, mainly in the border region of México and the United States. We also identified the principal plant component of the "petate" and other elements of the burial bundle.

205 Characterization of Mummy Hair at Nanometric Level Through Atomic Force Microscopy, CARMEN PIJOAN¹*, PEDRO BOSCH², CARLOS FLORES², JOSEFINA MANSILLA¹, ILÁN LEBOREIRO¹, and MARÍA TERESA MENENDEZ-TABOADA³ (¹Dirección de Antropología Física, Instituto Nacional de Antropología e Historia, Reforma y Gandhi s/n, C.P. 11560, México, D.F.; ²Universidad Nacional Autónoma de México, Instituto de Investigaciones en Materiales, Ciudad Universitaria, C.P. 04510, México D.F.; ³Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030 México, D.F.; cmpijoan@yahoo.com).

The characterization of human hair has been usually reduced to morphology at a micron level through scanning electron microscopy images. However, nowadays atomic force microscopy has been shown to be an adequate technique to study hair. The main advantage of such method is that it does not require any pretreatment of the sample, i.e. no covering with a conductor material or high vacuum. The disadvantage is that it does not have high focus depth. Results obtained with atomic force microscopy have been reported for contemporary hair, but none can be found in the bibliography for mummy hair. Only, in a previous work, we have shown how scanning electron microscopy and atomic force microscopy are complementary techniques in the characterization of mummy and contemporary hairs, mummy materials came from adults and children found in La Ventana cave, North México. In this study, we compare mummy hair (adult female) and the corresponding contemporary hair images obtained by atomic force microscopy at a higher amplification. The alterations, easily observed at a macroscopic level, respond to modifications of the nanometric structure.

206 Trace Elements in Ancient Tarahumara Mummy Hair, MARÍA TERESA MENENDEZ-TABOADA (Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030, México, D.F.; terehueza@hotmail.com).

This study integrates a variety of techniques that help determine the concentrations of trace elements in Prehispanic mummy hair. Human recent hair samples and from Tarahumaran mummies were analyzed; results were obtained using X-ray Fluorescence (FRX), Scanning Electron Microscopy (SEM), Energy Dispersive X-ray Spectroscopy (EDS), Neutron Activation Analysis (NAA), Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy (ATR-FTIR) and X-ray Diffraction (DRX); these results give a great approach of the diet and the environment of these individuals, and their population. Another important finding was the contamination and preservation hair level. Also a comparison between ancient hair, modern hair and burial soil was made. The Prehispanic samples showed higher concentrations in trace elements related

with the environment, such as aluminum, potassium and silicon; later with the ancient washed hair, the results revealed a higher vegetable food intake than those of contemporary samples; this was principally demonstrated with the magnesium and zinc concentrations in both kinds of samples.

207 Analysis of the Genetic and Historical Context of Two Prehispanic Mummies from México: Phylogeography as an Approach to Complement the Understanding of Past Populations, ANA SER-RANO* and MARIEL DURÁN (Escuela Nacional de Antropología e Historia, Periférico Sur y Zapote s/n. C.P. 14030 México, D.F.; banana_kaiser@hotmail.com; marielgeinfisher@msn.com).

The study of indigenous populations, whether contemporary or extant, in México and the south of United States is based mainly in three cultural areas defined as Mesoamerica, Aridoamerica and Great Southwest. The analysis of the populations around these areas is mainly supported by their geography, family or linguistic group and cultural traits. But, what about biology? Physical Anthropology, through Phylogeography, allows us to understand the human being from a bio-cultural perspective. This work took as reference this perspective with the purpose of visualize the different relationships between two mummified individuals from south Tamaulipas, discovered by Richard MacNeish during his expeditions between 1955 and 1956, and the relationships of these with other populations from México and the south of United States. We look forward to make a characterization of the mtDNA Haplogroups in prehispanic populations from the north part of México to obtain information that contextualize archaeological and historical data from groups which populated the area to draw different kinds of comparisons. Our results indicated that the most ancient of the mummies belong to Haplogroup A (d13C=-12.8 2583 ± 38), meanwhile the other belongs to Haplogroup C (d13C=-9.4 870 ± 29). Both mummies differ in their Haplogroup and in their antiquity; there is a gap of almost 2000 years between them. Furthermore, genetically Sample 2 (hap C) is related to populations from north México and south United States. On the other hand Sample 1 (hap A) is associated with populations from the central part and south of México.

Studies on an Old Kingdom Mummy Thursday, starting at 10:30 a.m. in KIPJ Theatre

208 Introduction: Studies on an Old Kingdom Mummy, BOB BRIER (C.W. Post Campus, Long Island University, Greenvale, NY 11548, USA; Mummy123@aol.com).

Although much has been written about mummification practices in ancient Egypt, little of this deals with mummies of the Old Kingdom. Part of the reason for this lack of research is the relative scarcity of mummies from the Pyramid Age. In the Americas, the only Old Kingdom mummy that we know of is in the Michael C. Carlos Museum in Atlanta, Georgia. A recent exhibition, "Life and Death in the Pyramid Age: The Emory Old Kingdom Mummy" gave us an opportunity to study this mummy, which has never been on display before. This symposium presents the preliminary findings of this study

209 A History of the Oldest Egyptian Mummy in the Americas, PETER LACOVARA¹ and BOB BRIER²* (¹Michael C. Carlos Museum, Atlanta, GA; ²C.W. Post Campus, Long Island University, Greenvale, NY 11548, USA; mummy123@aol.com).

The Michael C. Carlos Old Kingdom mummy was purchased in the beginning of the 20th century by Emory theology Professor William Arthur Shelton. This paper presents a history of his buying trip, discusses the practice of purchasing mummies, during this period, and then discusses the significance of an Old Kingdom mummy to current mummy studies.

210 *Interpreting the Life of the Carlos Museum's Old Kingdom Mummy*, **MONIQUE OSIGBEME^{1*}, CHENERE PIERCE RAMSEY², MALU TANSEY³, JOSHUA ROBINSON⁴, JOHN KINGSTON⁴, and ARRI EISEN⁵** (¹Undergraduate Class of 2012, Emory University, Atlanta, Georgia; ²School of public Health, Emory University, Atlanta, Georgia; ³School of Medicine, Emory University, Atlanta, Georgia; ⁴Anthropology Department, Emory University, Atlanta, Georgia; ⁵Biology Department, Emory University, Atlanta, Georgia; mosigbe@emory.edu).

The comprehensive conservation project undertaken in 2010-11 afforded an unprecedented opportunity to examine, analyze, and document the preserved human remains. Physical evaluation, radiographic imaging, microscopic examination, and stable isotope analysis of the bones and teeth were undertaken to gather clues about the individual's life and death, including diet and health. A sample from what was presumed to be the brain was studied with the hope of confirming the tissue, typing blood, and obtaining genetic information.

211 *Project Update on the Conservation Treatment of the Carlos Museum's Old Kingdom Mummy*, **MIMI LEVEQUE^{1*} and RENÉE STEIN²** (¹Conservator, Peabody Essex Museum and Archaea Technica Conservation; ²Conservator, Michael C. Carlos Museum, Emory University, Atlanta, Georgia; mimileveque@msn.com).

In preparation for exhibition, the wrappings and remains were examined for evidence of mummification procedures and burial practices. Samples from the linen wrappings and coffin were radiocarbon dated; salts and resins associated with the body were characterized; and the wood species used for the coffin was identified. The weave structures, construction details, and layering methods of the linens were recorded through photographs and drawings. Dust, debris, and old packing materials were gently removed. Through careful manipulation, bones were re-aligned and contoured supports were created to relieve stress on the weak skeleton and fragile wrappings. Linens with extensive insect damage were stabilized and reinforced. Missing sections of the wrappings were fabricated and integrated with the existing ancient wrappings to present a unified appearance for exhibition.

Heart Disease and Atherosclerosis in Ancient Egyptian Mummies

Thursday, starting at 11:30 a.m. in KIPJ Theatre

212 *Introduction: An Overview of the HORUS Study*, **RANDALL C. THOMPSON** (The Mid American Heart Institute and Professor of Medicine, University of Missouri, Kansas City, MO; rthompson@cc-pc.com).

The HORUS study investigators have been provided an exceptional opportunity to investigate the medical history of ancient humans. The generosity of the Egyptian Supreme Council

of Antiquities and more recently, museums across the US, have allowed the team to delve inside the remains of Egyptian mummies dating as far back as 1981 BCE. In addition to imaging 45 mummies at the Egyptian Museum of Antiquities, the team has received the CT images of 13 mummies from the Metropolitan Museum of Art in New York, five from the Bowers Museum in Santa Ana, CA, two from the University of Pennsylvania Museum of Archaeology and Anthropology, and one each from the Nelson-Atkins Museum in Kansas City and the Museum of World Treasures in Wichita. Focusing on atherosclerosis, the team found it to be commonplace in ancient Egypt. This finding raises the potential that our current understanding of the etiology of atherosclerosis may be strikingly incomplete. For example, Finch and others have suggested that infection could play an important role. Could atherosclerotic lesions be infectious, analogous to H pylori in the gut? Could it be analogous to rheumatic heart disease, a post inflammatory response to a specific infection or a burden of infections, parasitic, or otherwise, in a less than hygienic ancient environment? Could such a nonhygienic environment over the course of human evolution have stimulated a pleiotropic response - predisposing to a genome effective at fighting infection early in life but reacting against itself within the vessel wall later in life?

213 *The HORUS Study – The Hunt for Atherosclerosis*, **L. SAMUEL WANN** (The Wisconsin Heart Hospital, Milwaukee, WI; samuelwann@gmail.com).

We have previously shown that ancient Egyptians had atherosclerosis. The aim of this study was to determine the incidence, predictors, and severity of atherosclerosis among ancient Egyptian mummies. We used modern X-ray computed tomography to study 52 ancient Egyptian mummies, searching for evidence of arterial calcification as a marker for cardiovascular (CV) disease. The mummies were selected from a variety of eras and were chosen on the basis of their good state of preservation and the likelihood that CV tissue could be present. Images were interpreted by a consensus of seven imaging physicians and historical data of the individual mummies. Age at the time of death was determined by Egyptologists, preservationists, and an anthropologist from the HORUS investigators.

Of the 52 mummies, the mean age at time of death was 38.1 ± 12 y. (17 females, 33 males and 2 undetermined). Identifiable CV tissue was found in 44 mummies, and 20 (45%) of these had either definite atherosclerosis (defined as calcification within the wall of an identifiable artery, n=12) or probable atherosclerosis (defined as calcifications along the expected course of an artery, n=8). The 20 mummies with definite or probable atherosclerosis were older at time of death (mean 45.1 ± 9.2 y) than the mummies with CV tissue but no atherosclerosis (34.5 ± 11.8 y), (p<.002). Calcifications were found in the aorta as well as the coronary, carotid, iliac, femoral and peripheral arteries. Over a span of 2000 years definite or probable atherosclerosis was present in mummies who lived during virtually every era of ancient Egypt. Our study confirmed the occurrence of atherosclerotic CV disease among ancient Egyptians and showed that severe forms of this disease did exist early in human history.

214 *Comparative Studies of Atherosclerosis in Communities in the Preindustrial World*, **CALEB E. FINCH** (Andrus Gerontology Center, University of Southern California, Los Angeles, CA 90089; cefinch@usc.edu).

Did ancient Egyptians age faster than modern populations?

Since the 18th century, lifespans have increased globally from a life expectancy at birth (LE_0) of 25-40y, to >80y in healthy countries; the LE_{70} has also more than doubled. Although the demographics of ancient Eurasia are incompletely documented, life expectancies may be approximated by those of 18th century Sweden and the 20th century Tsimane. The Tsimane are an indigenous forager-farming people of the lowland forest and savannas of Amazonian Bolivia. Thus for ancient Egypt and Greece, the LE_0 is estimated at about 30y. Those reaching age 30 lived 25 more years, i.e. about 50% less than today. Infections are likely to have been the main cause of death in ancient Egypt as in the Tsimane and other pre-industrial peoples. Nonetheless, advanced atherosclerosis with calcification is documented in Egyptian mummies, e.g. 18th Dynasty, (ca 1550 BCE), and indicated for the Tyrolean Iceman (3300 BCE), estimated to be age 40-50. The apparently premature calcification suggests aging was accelerated, commensurate with the shorter adult life span. Environmental interactions with vascular pathology merit consideration in premature mortality in ancient Egypt, e.g. in modern Europe, cardiovascular pathology increases risk of heart attack during infections and dust storms.

A model for ancient Egyptians may be the Tsimane which have LE_0 of 42 y and prevalent chronic infections with elevated blood C-reactive protein, but few other risk indicators of vascular disease. Comparisons of the meager Tsimane diet with that of ancient Egyptians may give insights about heart disease and rates of vascular aging.

215 *Demonstration of Cardiovascular Disease on CT Scans in Egyptian Mummies – Examples from 52 Mummies*, **RANDALL C. THOMPSON** (The Mid America Heart Institute and Professor of Medicine, University of Missouri, Kansas City, MO; rthompson@cc-pc.com).

CT evidence of ancient heart disease has never been described. In ancient Egypt, hearts were often removed during mummification, but the process varied over 3000 years and sometime cardiac structures were left intact. We performed whole body CT scanning on 52 ancient Egyptian mummies (Siemens Emotion 6, GE Lightspeed) systematically looking for cardiovascular diseases. Of the 52 mummies, intact hearts were present in 15, and cardiac remnants were present in 15. Although the cardiac structures were often distorted, in two mummies heavy coronary calcifications were present, a man from the Ptolemaic period circa 2300 years ago (ya), and a woman from the 17th dynasty period, 3550 ya. The coronary calcium score in the former was > 1000 AU. Three other mummies had probable coronary calcifications. Very heavy mitral annular calcifications were found in a woman from the new kingdom period (3150-3350 ya). A woman from the 18th dynasty (3350 ya) had dense calcifications in the inferior left ventricular myocardium highly suggestive of calcified old MI. All of these eight mummies had evidence for generalized atherosclerosis with calcifications in other arterial locations. Mummies with intact hearts were more likely to have atherosclerosis ($p < .022$) and had more vascular bed involvement ($p < .002$) than mummies with no hearts or only heart remnants.

Heart disease was present in ancient Egyptians. These data may provide insight into the causes of cardiac disease in modern man.

Mummies as Cultural Heritage

Thursday, starting at 1:30 p.m. in KIPJ Theatre

216 *Introduction to Mummies as Cultural Heritage*, **DARIO PIOMBINO-MASCALI** (EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100, Bolzano, Italy; dario.piombino@eurac.edu).

Human and animal mummified remains are an excellent biomedical source for identifying the state of health, disease, and lifestyle of past societies. However, due to the lack of basic guidelines for researching these special objects, mummy investigations have often provoked debate among both specialists and non-specialists. Specifically, criticism has been focused on an all too prevalent invasive approach, which, despite the real scientific benefits gained from such ‘thorough’ investigations, has permanently damaged a significant number of remains and resulted in the irretrievable loss of potentially valuable data.

In recent times the understanding that preserved biological remains represent an important cultural heritage has grown considerably, through an increasing sensibility to the realisation that mummies should be treated as vitally important archaeological artefacts to be protected and preserved. This symposium is aimed at discussing the legislative framework surrounding mummy research and introducing the participants to new ideas and suggestions aimed at optimising the importance of mummies and their associated artefacts as a unique and valuable historical resource.

Examples will be given to demonstrate the potential of the many minimally invasive techniques, and even simple external inspections, which are sufficient for the identification of both historical and anthropological information, as well as the latest conservation techniques aimed at preserving the integrity of such objects. This symposium is a plea to scholars to become involved in mummy research, so that the best non-invasive modern techniques of mummy studies are as widely disseminated as possible in order to avoid further permanent damage to these important cultural artefacts.

217 *The Anatomical Collection of Giovan Battista Rini (1795-1856): A Paleoradiological Investigation*, **DARIO PIOMBINO-MASCALI***, **ALBERT ZINK¹**, **ALBERTO CARLI²**, and **STEPHANIE PANZER³** (¹EURAC – Institute for Mummies and the Iceman, Viale Druso 1, 39100, Bolzano, Italy; ²Department of Humanities and Historical and Social Sciences, University of Molise, Campobasso, Italy; ³Department of Radiology, Trauma Center Murnau, Murnau, Germany; dario.piombino@eurac.edu).

Eight specimens selected from the anatomical collection of Giovan Battista Rini (1795–1856), at the Desenzano Hospital Pathology Division (Brescia, Italy), were examined by computed tomography (CT). The aim of this study was to obtain detailed information on the preservation state and preparation techniques used. Relying upon the existing literature, the examined pieces could be divided into three types of anatomical specimens, namely: ‘dry preparations,’ ‘corrosion preparations,’ and ‘organ preparations’. Specifically, CT examination enabled the assessment of the exact features of the specimens, the preparation techniques applied, the presence of foreign bodies and the use of substances to fill the blood vessels. All of the cases demonstrated an extremely good state of preservation. In conclusion, the Rini collection represents an important sample of preparations created for different purposes of anatomical demonstration. Results of the CT investigation were

consistent with the anatomical preservation methods described in 18th to 20th century literature, especially those from Italy.

218 *Development of a New Glass Case System for Mummies Conservation*, **MARCO SAMADELLI^{1*}**, **DARIO PIOMBINO-MASCALI¹**, **F. U. ROLLO²**, **VITO C. FERNICOLA³**, and **ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ²UNICAM, Scuola di Bioscienze e Biotecnologie dell'Università degli Studi di Camerino, Camerino, Italy; ³I.N.R.I.M., Torino, Italy; Marco.Samadelli@eurac.edu; dario.piombino@eurac.edu).

The goal of this project was to construct a new type of glass case combining the requirements of proper conservation and presentation of mummies in museums or in their original find sites. For this, different techniques already in use within museum environments were analyzed and a new concept of an optimized glass case was developed. As a model, a glass case was designed for the mummy of Rosalia Lombardo, who is preserved in the Capuchin Catacombs in Palermo and is often referred to as the sleeping beauty. In a first step, the mummy environmental conditions were analyzed in order to obtain the ideal conservation parameters. The design of the glass case was accompanied by mathematical calculations to ensure that the casing not only contributes to better conservation, but also eases maintenance and allows better visibility. In the newly developed glass case, the humidity can be adjusted to exact specifications by means of a special humidifier. Additionally, the humidifier can also be used for disinfection and sterilization purposes by adding chemical solutions. Finally, a wireless system is included to monitor the atmospheric conditions in the glass case, thereby allowing constant surveillance of the conservation parameters. The new glass case is constructed in such a way that it can be adapted to all kinds of dry mummies conserved under different environmental conditions.

219 *The Royal Mummies of Ancient Egypt: A History Re-written by Science*, **ALBERT ZINK^{1*}**, **YEHIA Z. GAD²**, **SOMAIA ISMAIL²**, **PAUL GOSTNER³**, **ASHRAF SELIM⁴**, **CARSTEN M. PUSCH⁵**, and **ZAHY HAWASS⁶** (¹EURAC - Institute for Mummies and the Iceman, Viale Druso 1, I-39100, Bolzano, Italy; ²National Research Center, El-Buhoth St., Dokki, Cairo, Egypt; ³Department of Radiodiagnosics, Central Hospital Bolzano, Bolzano, Italy; ⁴Cairo Scan Radiology Centre, Soliman Abaza St. 35, Mohandesseen, Giza, Egypt; ⁵Institute of Human Genetics, Division of Molecular Genetics, University of Tübingen, Wilhelmstr. 27, D-72074, Tübingen, Germany; ⁶Supreme Council of Antiquities, 3 El Adel Abou Bakar S., Zamalek, Cairo, Egypt; albert.zink@eurac.edu).

Tutankhamun is probably the best-known pharaoh of ancient Egypt, due to the discovery of his undisturbed tomb by Howard Carter in 1922. Despite the perfect preservation of the tomb and the many precious grave goods, no clear information on Tutankhamun's ancestry could be revealed. In our study we investigated the familial relationships between 11 royal mummies of the late 18th dynasty, dating from circa 1410-1324 BC and presumed to be kindred of Tutankhamun. The royal mummies underwent a detailed anthropological, radiological, and genetic study. The results of the genetic fingerprinting enabled the construction of a 5-generation pedigree of Tutankhamun's immediate lineage and the identification of his parents. In contrast to previous assumptions, the paleopathological analyses revealed no signs of gynecomastia and craniosynostoses

(such as Antley-Bixler syndrome) or Marfan syndrome in the royal mummies. In Tutankhamun, we diagnosed a severe avascular bone necrosis (Köhler disease II) that would have caused walking impairment. Additionally, the detection of ancient *Plasmodium falciparum* DNA revealed the presence of malaria tropica in Tutankhamun. In summary, by using a multidisciplinary scientific approach, we were able to significantly contribute to a better understanding of the ancestry and disease of Pharaoh Tutankhamun.

220 *Marking with Needles and Lancets: The Antiquity of Therapeutic Tattooing*, **LARS KRUTAK** (Repatriation Office, Department of Anthropology, National Museum of Natural History, Smithsonian Institution, 10th and Constitution Avenue NW, MRC 138, P.O. Box 37012, Washington, DC 20013; krutakl@si.edu).

For thousands of years, peoples around the world have marked their bodies with various types of tattoos. This painful form of body art was not just the latest fashion, it was a visual language that exposed an individual's desires and fears as well as ancient cultural values and ancestral ties that were written on the body.

However, many other forms of tattooing also embodied therapeutic values, and the surfaces of the human body became the location where preventive spiritualistic medicine was practiced. Drawing on the paleopathological record of tattooed mummies and ethnographic research, this paper will explore the indelible legacy of curative corporeal marking to reveal the complex system of tools, techniques, and beliefs by which ancient and more recent cultures attempted to control their bodies, lives, and experiences.

221 *Zweeloo Woman: Multidisciplinary Investigation of a Bog Body*, **RAFFAELLA BIANUCCI^{1,2*}**, **DON BROTHWELL³**, **WIJNAND VAN DER SANDEN^{4*}**, **CHRISTINA PAPAGEORGIOPOULOU⁵**, **PAUL GOSTNER⁶**, **PATRIZIA PERENTER⁶**, **EDUARD EGARTER VIGL⁷**, **FRANK MAIXNER⁸**, **MAREK JANKO^{9,10}**, **DARIO PIOMBINO-MASCALI⁸**, **GRAZIA MATUTINO⁴**, **FRANK J. RÜHLI¹¹**, and **ALBERT ZINK⁸** (¹Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ²Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseilles, Boulevard Pierre Dramard, 13344 Marseilles, France; ³BioArch, Department of Archaeology, University of York, The King's Manor, York Y01 7EP, UK; ⁴Drents Plateau, Stationsstraat 11, 9401 KV Assen, The Netherlands; ⁵Institut für Anthropologie, Johannes Gutenberg - Universität, SB-II Colonel Kleinmann-Weg 2, D-55128 Mainz, Germany; ⁶Department of Nuclear Medicine, General Regional Hospital, Via L. Böhler 5, 39100 Bolzano, Italy; ⁷Department of Pathology, General Regional Hospital, Via L. Böhler 5, 39100 Bolzano, Italy; ⁸EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ⁹Department of Earth and Environmental Sciences, Ludwig - Maximilians - Universität München, Schellingstraße 4, 80799 Munich, Germany; ¹⁰Center for NanoSciences, Ludwig - Maximilians - Universität München, Schellingstraße 4, 80799 Munich, Germany; ¹¹Zentrum für Evolutionäre Medizin, Zürich Irchel - Universität, Winterthurerstr. 190, 8057 Zürich, Switzerland; raffaella.bianucci@unito.it; raffaella.bianucci@gmail.com).

The bog corpse of an adult female individual from the Roman period (78- 233 AD) was unearthed, in 1951, in the "Damsel's Bog" near the village of Zweeloo (The Netherlands).

"Zweeloo woman's" skeleton shows signs of pathology

affecting both forearms and lower legs. Long bone measurements, stature assessment and CT scan were carried out to assess the degree of micromelia and possibly dwarfism.

Atomic force microscopy imaging and histology were used to assess the degree of preservation. The radiological findings were consistent with Léri-Weill dyschondrosteosis (DSC), a dominantly inherited dysplasia marked by short stature with mesomelic shortening of middle segments of the forearms and lower legs. Only three cases of probably or indicative DSC have been described so far in pre-modern societies. This is the first case of DSC syndrome recognized in a 2nd century bog body from The Netherlands.

Atomic force microscopy imaging (AFM) of the skin showed evidence of a moderate decomposition of type I collagen fibrils. A good state of preservation of bones and abdominal organs was shown histologically.

The eggs of the lancet liver fluke *Dicrocoelium dendriticum* were found embedded in the liver parenchyma. Dicrocoeliasis is contracted by the oral uptake of infected ants attached to vegetables. This infection is quite rare in humans and has never been described in a bog body.

Whether Zweeloo woman was intentionally killed or died a natural death remains unclear.

222 Mummies in Private Collections: Aspects of Law, Ethics, and Heritage, HEATHER GILL-FRERKING^{1*} and CHRISTOPHER FRERKING² (¹German Mummy Project, Reiss-Engelhorn Museums, Mannheim, Germany; ²Attorney-at-Law and Independent Scholar, Mannheim, Germany; heather.gill-robinson@mannheim.de).

Most mummy research is conducted with mummies from archaeological sites or museum and institutional collections. In some cases, however, mummies may be held in private collections and “owned” by individuals. Many of these collections are clandestine, while others are known publicly. Numerous questions arise about mummies held in private collections. Aside from the obvious questions related to the authentic provenience of the specimen and the manner in which the specimen was acquired, researchers who have the opportunity to work with mummies from private collections must consider other issues. For example, what is the specific right of access to the mummy, and who owns any data collected during the course of research projects? Are limitations placed on the types of investigations that can be conducted, or on which results can be published or otherwise publicly released? Is it acceptable for researchers to work with mummies held in private collections, and what are the challenges, both ethical and legal? These are just a few issues that face mummy researchers who work with mummies from private collections.

This paper will explore some of the aspects of law and ethics related to human mummies held in private collections and consider the impact of such collections on national and international heritage, archaeology, and mummy studies as a discipline.

A Multidisciplinary Collaboration for Tissue Analyses: The Case of Kwäday Dän Ts’ınchi Thursday, starting at 3:30 p.m. in KIPJ Theatre

223 The Value of Morphological Observations of Soft Tissues of Frozen Ancient Corpses, MARÍA VICTORIA MONSALVE¹,

ELAINE HUMPHREY², and DAVID WALKER^{1*} (¹Department of Pathology and Laboratory Medicine, University of British Columbia, 2350 Health Sciences Mall, Vancouver, BC V6T 1Z3; ²Department of Mechanical Engineering, University of Victoria, PO Box 3055, STN CSC, Victoria, BC, Canada, V8W 3P6; dwalker@hli.ubc.ca).

We will consider three sets of observations we made from the frozen corpse of *Kwäday Dän Ts’ınchi*. The body was found in a Northwest British Columbian glacier in 1999 and was dated to be approximately 500 years old. First we will show the extent to which hard and soft tissues were preserved in the frozen corpse. Second we will consider the apparent types of microorganisms seen in various tissues and comment on possible health consequences. Finally we will show how the presence of pulmonary anthracosis assisted in differentiating between lung parenchyma and non-parenchymatous tissues from his frozen, compressed lungs.

As expected the integrity of hard tissues like bone were well preserved. We found unexpectedly well preserved subcellular detail in soft tissues in organs of the corpse that had apparently remained frozen since death. Ultrastructurally, we could identify bacteria and possibly fungi in soft tissues such as heart, lung and skeletal muscle. In the compressed lung of *Kwäday Dän Ts’ınchi* we saw that anthracosis that usually occurs around conducting airways was present in tissues we believed to not be compressed parenchyma and absent from what we believed to be parenchyma.

In summary we suggest that in ancient frozen corpses one may find and identify important tissue types and pathogens in regions of soft tissues that apparently have not been exposed since the time of death but remained in ice or within body cavities. All of this suggests that one can do more in terms of assessing the possible state of well being of such an individual than previously imagined.

224 FTIR Spectromicroscopy Investigations of Preserved Tissue from Kwäday Dän Ts’ınchi, LUCA QUARONI^{1*}, COLLEEN CHRISTENSEN², and MARÍA VICTORIA MONSALVE³ (¹Swiss Light Source, WSLA/118 Paul Scherrer Institut; CH 5232 VILLIGEN-PSI, Switzerland; ²Department of Agriculture and Bioresources, University of Saskatchewan, 51 Campus Drive, Saskatoon, SK, Canada, S7N 5A8; ³Department of Pathology and Laboratory Medicine, University of British Columbia, 2350 Health Sciences Mall, Vancouver, BC, V5K 2Z7; luca.quaroni@psi.ch).

Fourier Transform Infrared (FTIR) spectroscopy is a useful technique for the compositional analysis of tissues. Absorption of radiation in the mid-infrared spectral region provides rich information on the molecular properties of the sample, in particular regarding composition.

To gain insight into postmortem degradation in glacier-preserved corpses, we analyzed tissue from the *Kwäday Dän Ts’ınchi* remains using synchrotron based FTIR spectromicroscopy. Previously, we analysed biceps muscle tissue. We are now following up on past work by analysing trapezius muscle tissue of *Kwäday Dän Ts’ınchi* and an unbalanced cadaver. In many portions of the biopsies subject to analysis, *Kwäday Dän Ts’ınchi* remains display mid infrared absorption spectra that are similar to those of modern day tissue, with only limited evidence of degradation. In particular, retention of alpha-helical secondary structures appears common throughout the sample, suggesting several muscle proteins have been preserved, partially or entirely. In contrast, the ester carbonyl group of phospholipids appears to be hydrolyzed throughout large portions of the sample. This is in agreement with previous work

detecting formation of adipocere in the remains. Furthermore, we were able to identify areas with high concentrations of polysaccharides, possibly derived from the partial degradation of glycogen, and a high content of as yet unidentified carboxylate-containing molecules, perhaps also derived from processes of ester hydrolysis. Overall, the use of FTIR spectromicroscopy provided us with an overview of major compositional changes, or lack of them, within the sample, allowing us to assess the state of preservation of the *Kwāday Dān Ts'ınchi* tissues.

225 *The identification of a Latent Tuberculosis Infection in the Ancient Kwāday Dān Ts'ınchi Individual*, **TREENA SWANSTON***¹, **HARRY DENEER**², and **ERNIE WALKER**¹ (¹Department of Archaeology and Anthropology, University of Saskatchewan, 55 Campus Drive, Saskatoon, SK, Canada, S7N 5B1; ²Department of Pathology and Laboratory Medicine, University of Saskatchewan, 103 Hospital Drive, Saskatoon, SK, Canada, S7N 0W8; treena.swanston@usask.ca).

Mycobacterium tuberculosis (MTB) is the pathogen responsible for the disease tuberculosis in humans. According to the World Health Organization, one in three individuals worldwide has a latent MTB infection, and 5 to 10% of infected individuals will develop the disease. The analysis of ancient microbial DNA associated with past human infections is useful in defining the spatial and temporal associations between humans and their pathogens. In 1999, an ancient individual was recovered from a glacier in northern British Columbia, Canada. Radiocarbon dates of the *Kwāday Dān Ts'ınchi* site indicated a timeframe of AD 1670 to 1850, which is either pre-contact or early European contact for that area. Based on current *M. tuberculosis* infection rates and the potential for determining if the site was precontact based on identifying *M. tuberculosis* polymorphisms associated with specific populations, the ancient individual's tissues were tested for the presence of *M. tuberculosis* DNA. Even though a pathological and histological examination was negative, *M. tuberculosis* complex DNA was identified in the lung tissue with primers specific for the IS6100 insertion sequence. Additional evidence of MTB DNA was determined through the amplification of regions within the *Rv3479*, *gyrB* and *katG* genes.

Hair in Archaeology

Thursday, 4:30 p.m. in KIPJ Theatre

226 *Assessment of the State of Preservation of Archaeological Keratin Fibers – A Study of Different Analytical Approaches*, **GABRIELE WORTMANN***, **ALAA JABUR**, and **FRANZ-JOSEF WORTMANN** (Textile and Paper, School of Materials, University of Manchester, Manchester, UK; gabi.wortmann@manchester.ac.uk).

Keratinous materials, such as human and animal hair or woolen textiles, are very stable and resistant to environmental influences. Consequently it is often found together with historical and archaeological human or animal remains. Environmental conditions during preservation induce specific chemical and physical changes to the keratin material. Humidity, temperature, pH and specific chemical influences during the preservation process change fibre proteins in different ways.

The degree of structural stability of the fibres gives an indication about storage conditions and can be used as a guideline in view for the conservation of the keratin fibres.

The state of preservation of the intermediate filaments (IF) as well as the degree of cystine modification in the intermediate filament associated proteins (IFAPs) gives evidence of the mechanical properties and stability of the keratin fibres.

Non-destructive and destructive analytical techniques can be used for damage assessment of keratin material and both approaches elucidate specific facets of the changes of the molecular and morphological structure of the fibres. The comparison of several analytical tools gives an example for the information value of these different analytical approaches.

227 *The Richest Ornament: Hair Analyses of Women from the Kellis 2 Cemetery, Dakhleh Oasis, Egypt*, **LANA J. WILLIAMS***, **TOSHA L. DUPRAS**, and **SANDRA M. WHEELER** (Department of Anthropology, University of Central Florida, Orlando, FL 32816; ljwillia@mail.ucf.edu).

From an archaeological perspective, hair serves not only as an ornament of appearance but also provides insight into social and economic standing, health status, and seasonal cycles of customs and practices. To date, the remains of 76 women between the ages of 16 and 70 years of age at death, all retaining well-preserved hair, have been recovered from the Kellis 2 Cemetery, Dakhleh Oasis, Egypt. These women are thought to be associated with the nearby Roman administrative center of Kellis (c. 50–450 AD). Macroscopic study on this portion of the cemetery population has yielded results concerning hairstyles and hair preparation prior burial. Microscopic study has provided insight into practices of hair care and general living conditions within the community. Isotopic analyses have provided an even greater wealth of information concerning health status, pregnancy, seasonal diet, and the aging process among these women.

228 *Life in an Extreme Environment: An Isotopic Investigation into Seasonal Resource Use in the Lower Ica Valley, Peru*, **LAUREN CADWALLADER** (Department of Archaeology, University of Cambridge, Downing Street, Cambridge, CB2 3DZ, UK; lc340@cam.ac.uk).

The lower Ica Valley, though today largely an unpopulated and arid desert, is rich in archaeological remains of settlement and irrigated field systems spanning approximately 2000 years from the Early Horizon (500 B.C.) to the Spanish Conquest. This research aims to understand how subsistence strategies, influenced by both biological and social factors, evolved during this period using isotopic analysis of human tissues. Previous archaeobotanical work suggests that a gradual transformation took place as natural and anthropogenic changes took their toll on the environment. Additionally, repeated cultural transitions provided social impetus for economic based changes.

Isotopic dietary information obtained from mummified human remains has been used to investigate three main transitions: a) the Late Ocucaje to Early Nasca cultural transition (c. 200 B.C. - 200 A.D.); b) the Late Nasca to Wari transition (c. 800 - 1000 A.D.) during which there was a gradual collapse of the desert ecosystem; and c) the transition from the Wari to the regionally developed Ica-Chincha period (1000 - 1400 A.D.).

Results from the isotopic analysis of bone collagen show the diet of each period to be subtly different, with a range of resources potentially being exploited. Several explanations can be put forward indicating that the subsistence strategies cannot be simply defined as 'hunter-gatherer' or 'agriculturalist'. Isotopic analysis of

hair samples is used here to explore seasonal resource use in each of these cultures in an attempt to tease out information about the mixed economies employed by these populations.

229 Hydrogen and Oxygen Isotope Analysis of Hair from Inca-Period Mummies: Exploring Mobility and Resource Use in Central Peru, JOCELYN S. WILLIAMS^{1*}, ANDREW S. WILSON², EMMA BROWN³, ANDREW GLEDHILL³, and M. ANNE KATZENBERG⁴ (¹Assistant Professor, Department of Anthropology, Trent University, 2140 East Bank Drive, Peterborough, ON, K9J 7B8, Canada; ²Lecturer in Forensic and Archaeological Sciences, School of Life Sciences, University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK; ³Division of Archaeological, Geographical and Environmental Sciences, School of Life Sciences, University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK; ⁴Professor, Department of Archaeology, University of Calgary, 2500 University Drive, NW, Calgary AB, T2N 1N4, Canada; jocelynwilliams@trentu.ca; a.s.wilson2@bradford.ac.uk).

Peru is composed of numerous biomes that lie within a small area; in certain parts of Peru one can move through all three biomes within 200 kilometers. As such, both prehistoric and modern Andean societies often utilize a variety of ecological zones at different altitudes (i.e., vertical control/verticality). In contrast, Rostworowski de Diez Canseco (1977; 1978), argues that coastal populations, due to the abundance of agricultural land and marine resources in their immediate area, would be involved in a horizontal economy, controlling large river valleys and beach access. Because hydrogen and oxygen isotope values in precipitation differ with altitude and temperature it is possible to explore whether coastal populations practiced a vertical or horizontal economy using incremental samples of preserved hair. For this research project we sampled hair from 13 individuals (10 adults, 3 subadults) and analyzed the hydrogen and oxygen isotopic composition of sequential one cm increments (where 1cm = 1 month). The isotope data, for most individuals, show minimal variability from month to month. This indicates that most of the individuals were not regularly travelling between the coast and highlands (i.e., they were not practicing verticality). However, some individuals exhibited above average variability in their hydrogen or oxygen isotopic composition from month to month. When compared to isotopes that reflect diet (S, C and N), the variability in $\delta^2\text{H}$ and $\delta^{18}\text{O}$ is likely due to the seasonal fluctuations in resource availability. These data support earlier research suggesting coastal populations do not utilize verticality but rather rely on a horizontal economy.

230 Insight into the Final Months of the Capacocha from El Plomo Using Stable Light Isotope Data, ANDREW S. WILSON^{1*} and MARIO M. CASTRO² (¹School of Life Sciences, University of Bradford, Bradford, West Yorkshire, BD7 1DP, UK; ²Department of Anthropology, University of Chile, Santiago, Chile; Anatomy unit, Department of Morphology, Faculty of Medicine, University of Chile, Santiago, Chile; a.s.wilson2@bradford.ac.uk).

La Momia del Cerro El Plomo, the well preserved remains of an Incan child found on Cerro El Plomo in 1954 in the Andes, was the first discovery of a *capacocha* at a high-altitude site in South America. The mummy recovered from his mountain-top tomb at 17,700 ft is now curated by the National Museum of Natural History in Santiago, Chile.

When discovered, the frozen remains of the El Plomo boy were accompanied by a dizzying array of ornate textiles, and other

artefacts suggestive of an Imperial rite, including small bags containing human tissue (deciduous teeth and nail clippings) and distinctive human and animal figurines as offerings.

This paper will describe the results of a recent re-evaluation of these remains, exploiting unique data represented by the incremental growth of hair. Sequential isotopic measurements along the hair shaft illustrate dietary and physiological changes concerned with the final months of El Plomo's life and contribute new insight into the preparations that preceded his death.

231 Investigating the Use of Coca and Other Psychoactive Plants in Andean Archaeological Populations, EMMA BROWN*, ANDREW S. WILSON, BEN STERN, ROB JANAWAY, and TIMOTHY TAYLOR (Archaeological Sciences, University of Bradford, Richmond Road, Bradford, West Yorkshire, BD7 1DP, UK; elbrown@bradford.ac.uk).

Psychoactive plants have played a significant role in Andean cultures for millennia. This is evident in the archaeological record; for example the depiction of San Pedro cactus (*Echinopsis pachanoi*) on Cupisnique vessels (c 1000-200 BC), snuff trays and tubes from San Pedro de Atacama (c 200-900 AD) and *in situ* coca leaves in the cheeks of Chiribaya mummies (c1150-1300 AD). A number of practices, such as coca chewing and folk healing using ayahuasca and San Pedro cactus are still practiced in parts of Peru and Ecuador.

Despite the evidence for the use of a number of psychoactive plants in Andean cultures, the use of these plants is not fully understood. This is particularly true for plants imbibed as decoctions that do not require a specific vessel or equipment for ingestion.

A novel method for investigating the use of psychoactive plants in antiquity is the analysis of hair for drug compounds. The approach taken for this research project involves the use of liquid chromatography electrospray ionisation tandem mass spectrometry (LC-ESI-MS/MS) to detect a select number of compounds, including mescaline, atropine, cocaine, and *N,N*-dimethyltryptamine in hair samples from Cabuza (1100-1400 AD) populations in the Azapa Valley.

232 Biologic Rhythms in Ancient Hair, ANTONIO LANZIROTTI¹, MIKE SPILDE², CLIFFORD QUALLS³, RAFAELLA BIANUCCI^{4,5,6}, MARIO GIUSIANI⁴, VALENTINA GIUFFRA⁴, GINO FORNACIARI⁴ ABDUL-MEHDI ALI³, LARRY AGENBROAD⁷, and OTTO APPENZELLER^{8*} (¹National Synchrotron Light Source, Brookhaven National Laboratory, Upton, NY 11973; ²Department of Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131; ³Department of Mathematics and Statistics, University of New Mexico, Albuquerque, NM 87131; ⁴Division of Paleopathology, History of Medicine and Bioethics, Department of Oncology, Transplants and Advanced Technologies in Medicine, University of Pisa, Italy; ⁵Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Italy; ⁶Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, University of Marseilles, France; ⁷The Mammoth Site Hot Springs, South Dakota, USA; ⁸NMHEMC Research Foundation, Albuquerque, NM 87122; ottoarun12@aol.com).

The pulsing of life is synchronous with the rotation of the earth around the sun. These pulses occur every 24 hours, at "circadian" intervals, but there are longer rhythms recurring at weekly, monthly, yearly or decadal intervals. The rhythms are found in unicellular and gigantic multicellular animals and each tissue has its

own rhythmicity, synchronized, in those with a nervous system, in the hypothalamus, the “master time keeper” of the brain.

The pulsing is affected by geography and modified by water and food intake and biological poisons. Hair is a repository of biologic rhythms which give insight into physiology and disease.

Here we used variations in hydrogen isotope ratios along the length of hairs and microfocused synchrotron X-ray fluorescence analyses of mammoths’ hairs from widely separated locations in Siberia and hair from ancient Italian nobility, poisoned with mercury, to show that such hairs are a readily available archive of life style and of disease.

We propose that similar analyses of archaeological specimens could give insight into the biology and pathology of ancient people and animals.

CONTRIBUTED ORAL PRESENTATIONS

World Congress on Mummy Studies

CONTRIBUTED PAPERS: SESSION I

Sunday, starting at 1:30 p.m. in KIPJ Theatre

233 Microscopic and Molecular de novo Analysis of the Iceman’s Stomach Content, **FRANK MAIXNER^{1*}**, **EDUARD EGARTER VIGL²**, **ANDREAS KELLER³**, **ANDRE FRANKE⁴**, **KLAUS OEGGL⁶**, **GIOVANNA CIPOLLINI¹**, **ANGELA GRAEFEN¹**, **PAUL GOSTNER⁵**, **DARIO PIOMBINO-MASCALI¹**, **MARCO SAMADELLI¹**, and **ALBERT ZINK¹** (¹EURAC - Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ²Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; ³Department of Human Genetics, Saarland University, Homburg, Saar, Germany; ⁴Institute of Clinical Molecular Biology, Schittenhelmstr. 12, Christian-Albrechts University Kiel, 24105 Kiel, Germany; ⁵Department of Radiodiagnosics, Central Hospital Bolzano, Bolzano, Italy; ⁶Institute of Botany, University of Innsbruck, Sternwartestr. 15, Innsbruck 6020, Austria; frank.maixner@eurac.edu).

Until recently, the Iceman’s stomach had not been found radiologically and was therefore assumed to be empty. During a recent re-examination however, the Iceman’s stomach was not only identified radiologically, but also shown to be completely filled. This circumstance not only sheds new light on the final hours leading up to the Iceman’s untimely death, but also on to general life and nutritional habits in the Neolithic era. A sample of the stomach content has been taken in November 2010 and first subjected to macroscopic and microscopic investigations. In addition we started a series of molecular analyses of the stomach material aiming to identify the nature of the

234 Terahertz Imaging of Ancient Mummies, **LENA OEHRSTROEM¹**, **ANDREAS BITZER²**, **MARKUS WALTHER³**, **THOMAS BÖNI⁴**, **GIOVANNI COLACICCO⁵**, and **FRANK J. RÜHLI^{1*}** (¹Swiss Mummy Project, Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Department of Molecular and Optical Physics, Albert-Ludwigs-University, Freiburg im Breisgau, Germany, ³Institute of Applied Physics, University of Bern,

Sidlerstr. 5, CH-3012 Bern, Switzerland; ⁴Orthopedic University Clinic Balgrist, University of Zürich, Switzerland; ⁵Division of Neuroanatomy and Behaviour, Institute of Anatomy, University of Zürich, Winterthurerstr. 190, 8057, Zürich, Switzerland; lena@ohrstrom.ch).

Ancient Egyptian mummified objects are investigated using non-ionizing Terahertz time-domain imaging and the results are compared with corresponding images obtained by conventional computed tomography.

Computed tomography is currently the gold-standard in non-invasive diagnostic imaging of mummies. The radiation used in CT is high energetic and possibly damages the already fragmented DNA. Terahertz though is a very low energetic radiation and completely harmless to human cells. The aim of the present study was to show the feasibility of Terahertz imaging in ancient mummies. THz time domain imaging was used for the very first time in historic specimens. An artificially embalmed ancient Egyptian human mummy hand (ex-collection Musée d’Orbe Switzerland, ca. 1300 BC) and a macerated human lumbar vertebra (Galler collection, Pathology Department, University Hospital, Zürich, Switzerland, ca. 1950 AD) were examined by a standard THz time-domain spectroscopy system. Correlative multislice conventional X-ray and CT images were performed. Our results demonstrate that THz imaging allows mummy tissue and bone discrimination; however, imaging by conventional X-ray in particular reveals higher spatial resolution.

THz time-domain imaging also provides spectroscopic information within a wide frequency range, which makes it possible to identify different tissue types or characteristic absorbing chemical substances whereas X-rays rather provide density information. The composition of embalming resin possibly could be detected using Terahertz radiation.

Terahertz radiation provides a completely non-invasive diagnostic imaging modality for historic dry material.

235 Comparative CT and MR Imaging of Ancient Mummified Tissues, **LENA OEHRSTROEM¹**, **HENDRIK von WALDBURG¹**, **PETER SPEIER²**, **MICHAEL BOCK³**, and **FRANK J. RÜHLI^{1*}** (¹Swiss Mummy Project, Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Siemens Medical Solutions, Erlangen, Germany; ³German Cancer Research Centre, Heidelberg, Germany; lena@ohrstrom.ch).

As ancient Egyptian and Peruvian mummies are extremely valuable historic relics, their completeness should be guaranteed. Thus, non-invasive investigation methods are most desirable. Computed tomography (CT) is currently the gold-standard in radiological mummy research. The radiation though is high energy and damages the already fragmented DNA. Magnetic resonance imaging (MRI) - while operating with electromagnetic field - does not affect this sensitive DNA. In recent decades MRI couldn’t be applied in mummified tissue, because of its high water content. Recently, this method has been demonstrated for the first time in mummies using the special ultra-short-echo-time (UTE) technique. The aim of the present study was to evaluate the value of MR images in comparison to CT images of ancient mummies. We acquired and analysed data from two ancient Egyptian mummified hands and an ancient mummified head (circa 1500-1100 BCE), as well as from an ancient Peruvian mummy (circa 1100 CE). Signal intensity and signal variance were evaluated using a qualitative scale and

compared. Additionally contrast-to-noise and signal-to-noise ratios have resolution. Magnetic resonance imaging is still in its infancy and further research is required. However, this study demonstrates that additional information can be gained by using MRI. There is great potential in the use of MRI in historic specimens, so the quality can hopefully be improved in the future to increase the use of this non-invasive modality.

236 *A Medieval Infant Burial from Quimper (Bretagne–France): An Example of Brain Preservation in Wetland*, **VERONIQUE GALLIEN^{1,2*}**, **CHRISTINA PAPAGEORGOPOULOU³**, **RAFFAELLA BIANUCCI^{4,5,6}**, **ANNE DIETRICH^{1,7}**, **FRANCOIS GUILLON⁸**, **KATHARINA RENTSCH⁹**, **MAANASA RAGHAVAN¹⁰**, **MARIA-INES HOFMANN¹¹**, **GIOVANNI COLACICCO¹¹**, and **FRANK J. RÜHLI¹¹** (¹INRAP, French National Institute for Preventive Archaeological Research, 20 rue Hippolyte Foucault F-72220 Le Mans, France; ²Biological Anthropology, UMR 6130 CNRS-CEPAM, University of Nice Sophia Antipolis, Campus Saint-Jean-d'Angély, 24 avenue des Diables Bleus, F-06357 Nice cedex 4, France; ³Zentrum für Evolutionäre Medizin, Zürich Irchel - Universität, Winterthurerstraße 190, 8057 Zürich, Switzerland; ⁴Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ⁵Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseilles, Boulevard Pierre Dramard, F-13344 Marseille, France; ⁶Division of Paleopathology, History of Medicine and Bioethics, Department of Oncology, Transplants and Advanced Technologies in Medicine, University of Pisa, Italy ; ⁷Environmental Archaeology, UMR 7041, CNRS-ArScAn, University of Nanterre, Maison René Ginouvès, 21 allée de l'Université, F-92023 Nanterre, France; ⁸Medecine and Health, Avicenne Hospital, 125 Rue de Stalingrad, F-93009 Bobigny Cedex, France; ⁹Institute for Clinical Chemistry, University Hospital Zürich, Switzerland; ¹⁰Center for GeoGenetics, Natural History Museum of Denmark, University of Copenhagen, Copenhagen, Denmark; ¹¹Zentrum für Evolutionäre Medizin, Zürich Irchel - Universität, Winterthurerstraße 190, 8057 Zürich, Switzerland; veronique.gallien@inrap.fr).

During an excavation carried out in 1998 in the forecourt of Quimper's Cathedral (Bretagne--France), a wooden infant coffin from the 13th century AD was unearthed. The corpse of an infant, aged 18-24 month-old, was recovered. The skull showed evidence of a circular fracture involving the cranial vault without signs of healing. Inside the skull, an astonishingly well-preserved cerebral material was found.

Macroscopic examination of the brain showed an excellent preservation of its main structures (sulci and gyri), and histology showed remarkable morphological details. Differentiation between grey and white matter was clear. Grey and white matter could be readily recognised. Blood vessels, glia, and Nissl bodies as well as neurons and dendrites could be identified.

Hemosiderin deposits were present on the outer surface of the cortex but no signals of a cerebral hemorrhage were identified by CT scan and MRI. The deposits of hemosiderin may indicate that the child had subdural bleeding due to the skull fracture but we have no evidence to suggest that this was the cause of death. The presence of hemosiderin suggests that the bleeding occurred, at least, several days before the death of the infant.

Here we provide evidence of a unique paleo-case of

well-preserved cerebral material. Furthermore, we provide new information on the funerary practices and techniques used in coffin construction in Medieval France.

237 *Dental Pathologies of the Iceman*, **ROGER SEILER^{1*}**, **ALBERT ZINK²**, **PAUL GOSTNER³**, **EDUARD EGARTER VIGL⁴**, and **FRANK J. RÜHLI¹** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²EURAC - Institute for Mummies and the Iceman, Bolzano, Italy; ³Department of Radiodiagnostics, Central Hospital Bolzano, Bolzano, Italy; ⁴Department of Pathological Anatomy and Histology, General Hospital Bolzano, Italy; rogerseiler@bluewin.ch).

Exactly twenty years ago, the Iceman was discovered in the Italian Alps and he has been recognized as an important historic find. Since then, he has been examined thoroughly both anthropologically and medically. However, oral pathologies were not found. Now, using the available CT-scans, we analyzed the viscerocranium region in more detail and were able to demonstrate several different pathological changes. In addition to the known pathological changes such as abrasions and the central upper diastema, we found evidence of damage to the dentition. Especially the molars of the upper jaw showed loss of alveolar bone as a sign of periodontitis. Evidence of mechanical trauma was found on two teeth. A surprising find was the high frequency of caries. This finding may indicate a diet change in the Neolithic transition phase; however, this should be interpreted with caution.

238 *Evidence Based Paleopathology: Meta-analysis of PubMed-listed Scientific Studies on Pre-Columbian, South American Mummies*, **KATI DAGEFOERDE** and **FRANK J. RÜHLI*** (Centre for Evolutionary Medicine, University of Zürich, Switzerland; kati@dagefoerd.com).

The aim of our study was to review all PubMed®-listed scientific studies performed on Pre-Columbian South American Mummies. A total of 69 studies have been found (1975-2005). Reviewed criteria include e.g. method of examination, mummification (spontaneous or by intention), paleopathological diagnoses and individual age of mummies as well as historical age, which ranges from 9000 – 500 years BP, mostly (if reported) from the Chiribaya culture. The average age of 33 individually reported mummies was ca. 20 years. Only seven studies included computed tomography, thirteen studies used classical X-ray as the examination method. Nine studies analysed parasitological related diseases, especially *Trypanosoma cruzi*. Among all reported infectious diseases (N=11), there are five studies presenting cases of Tuberculosis. We also compared our results inter-culturally: In 69 studies (21 case reports and 48 epidemiological studies) about 6537 mummified individuals were analysed. In contrast, meta-analytic data for Ancient Egyptian mummies (Zweifel et al. 2006) showed about 3000 analysed individuals in 131 studies (85 case reports and 46 epidemiological). Ancient Egyptian mummies were shown to be intentionally mummified overall, whereas the given Pre-Columbian mummies show a great variety in terms of spontaneous mummification. However, ritualistic mummification methods were practiced also (N=2). All this shall help to improve evidence-based research in paleopathology in general.

239 *The Value of Ancient Mummified Tissue for Clinical Research: A Perspective*, **FRANK J. RÜHLI** (Centre for Evolutionary Medicine, University of Zürich, Switzerland; frank.ruhli@anatom.uzh.ch).

The value of historic remains for the study of the evolution of human morphology and disease patterns has become increasingly recognized. Samples of mummified soft tissue - natural mummies such as the Neolithic Iceman “Ötzi” or artificial mummies such as Ancient Egyptian mummies are crucial to the advances of clinically oriented evolutionary medical research. Ancient mummies are a rich source of information about past human biological conditions as they originated world-wide and from different cultures and time periods (Cockburn and Cockburn 1980; Aufderheide 2003). Mummies preserve soft tissues and are likely to yield more ancient DNA than skeletal remains. Contributions made by mummy studies to our medical knowledge are increasing, particularly in the study of infectious diseases (Aufderheide 2003; Lynnerup 2007). Naturally and artificially mummified human remains have been the source for genomic analyses of the adaptive evolution of Mycobacterium strains (Zink, Sola et al. 2003) or with more recent mummified samples for the analyses of the Spanish flu (Taubenberger, Reid et al. 1997; Reid, Fanning et al. 2000). The aim of this presentation is to review the contributions ancient mummies can do towards progress in modern clinical research. Aufderheide, A.C. (2003), *The Scientific Study of Mummies*, Cambridge University Press, Cambridge, UK and New York; Cockburn, A. and E. (1980), *Mummies, Disease and Ancient Cultures*. Cambridge University Press, Cambridge, UK; Lynnerup, N. (2007), “Mummies.” *Yearbook, American Journal of Physical Anthropology* 45: 162-190; Reid, A. H.; T. G. Fanning, et al. (2000), “Characterization of the 1918 “Spanish” Influenza Virus Neuraminidase Gene,” *Proc Natl Acad Sci USA* 97(12): 6785-6790; Taubenberger, J. K., A. H. Reid, et al. (1997), “Initial Genetic Characterization of the 1918 “Spanish” Influenza Virus.” *Science* 275(5307):1793-1796; Zink, A. R., C. Sola, et al. (2003), “Characterization of Mycobacterium Tuberculosis Complex DNAs from Egyptian Mummies by Spoligo-typing.” *J Clin Microbiol* 41(1): 359-367

240 *The Chehr Abad Salt Men (1,500-2,500 BP) – A Multidisciplinary International Mummy Research Project*, **FRANK J. RÜHLI***, **AYDIN ABAR²**, **ABULFAZI AALI³**, **N. BOENKE⁴**, **DON BROTHWELL⁵**, **MARK POLLARD⁶**, **SAHAND SAEDI⁷**, and **THOMAS STÖLLNER⁸** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²German Mining Museum Bochum, Institute of Archeological Studies, Ruhr University, Bochum, Germany; ³Head of the Archaeology Museum, Zanjan, Iran; ⁴Institut für Archäologische Wissenschaften, Ruhr-Universität, Bochum; ⁵University of York, UK ⁶Department of Archeology, University of York, UK, ⁷Abhar University, Iran; ⁸German Mining Museum and Ruhr University, Bochum; frank.ruhli@anatom.uzh.ch).

The first mummified salt miner was incidentally unearthed at the salt mine near Hamzehlu, Iran during commercial mining activities in 1993. Systematically conducted excavations by Abulfazi Aali (*miras farhangi* Zanjan, Iran) led to the salvage of spectacularly well preserved salt mummies, clothing and underground everyday commodities in 2004/05. The project was relaunched in 2010 by *miras farhangi* Zanjan, and the Ruhr-University of Bochum and the German Mining Museum Bochum in cooperation with an international team. Target-oriented work led to a detailed understanding of stratigraphic relations between layers, finds, and formerly excavated mummies. As assumed before, the miners had

been killed during at least two mine disasters, which happened between ca. 2500 and 1500 years ago. The date is supported by a number of ¹⁴C dates taken from freshly excavated layers. Mummy expert PD Dr. Ruehli was able to take samples of bones and soft tissues from all ancient victims, which were sent to several European laboratories for further analyses.

Work will be continued in 2011 bringing together specialists from Iran, the European Union, and Switzerland in a comprehensive campaign. Besides excavations for a better understanding of working methods of ancient mining, it is planned to take the mummies to Tehran, where they will be scanned in a modern 3D-scanner.

241 *Archaeogenetic and Histological Analysis of Natural Mummification under High Salt Conditions: Investigation of the Chehr Abad Salt Men (1,500-2,500 BP)*, **CHRISTINA WARINNER**, **NATALIA SHVED**, **KARL LINK**, and **FRANK J. RÜHLI*** (Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Switzerland; frank.ruhli@anatom.uzh.ch).

High-salt burial environments can lead to exceptional organic preservation in climates and geographical regions that otherwise rarely produce mummified remains. In this study, we investigate tissue preservation in four naturally mummified miners from the Douzlakh Salt Mine in (Cherābād, Zanjan Province). Radiocarbon dating of the bodies indicates at least two separate episodes of mining hall collapse (1,500 BP and 2,500 BP), which trapped and killed the miners. Gross tissue preservation of the miners was variable, ranging from complete soft tissue mummification to near skeletonization. Samples of hair, skin, muscle, organ, and bone from four miners (mummies 2, 3, 5, and 6) were further analyzed for cellular and genetic preservation. Soft tissue histological sections were stained with standard and special histological staining methods, including H and E, Goldner Trichrome, Sudan Red, Berlin Blue, and Gram, and bone and hair samples were investigated for mitochondrial and nuclear genetic markers using PCR. Preliminary results indicate both the preservation of microscopic tissue structures such as hair follicles, adipose tissue, and muscle fibers, as well as sub-cellular structures, including intact cell nuclei. Plant material was recovered from digestive organs, and compact plant fibers from a textile were also identified. Genetic analysis confirms the presence of preserved high quality ancient DNA, and mitochondrial ancestry informative markers (AIMs) are consistent with a local maternal origin for the miners. We conclude that natural salt mummification yields exceptional preservation of human tissues at the macroscopic, microscopic, and molecular level.

242 *Lyuba (41,910 BP), A Baby Woolly Mammoth (Mammuthus primigenius Blumenbach, 1799): Histological Findings*, **KARL LINK**, **CHRISTINA PAPAGEORGOPOULOU**, and **FRANK J. RÜHLI*** (Centre for Evolutionary Medicine, Institute of Anatomy, University of Zürich, Switzerland; karl.link@anatom.uzh.ch).

Lyuba was found frozen in the permafrost of the Siberian tundra on the Yuribey River in 2007. She is the best-preserved mammoth discovered to date. As part of the examination of Lyuba, tissue samples of hair, muscle, and internal organs were taken by endoscopy. The sectioned biopsies were stained with standard and special histological stains. In general, the microscopic preservation of the tissue was not as good as the overall macroscopic preservation, and no clearly identifiable cell nuclei were found in the sections. The best-preserved structures were collagen fibers, which gave some structural semblance to the organs. In the hairs, evidence of pigmentation, a scaly surface, diagonal intra-hair structures, and a medulla

were seen. Fat droplets could be identified in the subcutaneous fat sample and several organs. Bacteria were seen on the lumen side of the small intestine and cecum, and in the liver and lung tissue. In addition, fungi and pollen were found in the lung sample. In the wall of the cecum and small intestine it was possible to demonstrate blood vessels and nerves. Iron was identified in the vivianite sample. The histological finds support the theory that Lyuba drowned in muddy water. The microscopic tissue preservation indicates that Lyuba's body underwent at least one freeze-thaw cycle.

243 *CT-based Assessment of Relative Soft Tissue Alteration in Different Types of Ancient Mummy.* **CHRISTINA SYDLER¹, THOMAS BÖN², ULRICH WOITEK³, and FRANK J. RÜHLI^{1*}** (¹Swiss Mummy Project, Centre for Evolutionary Medicine, University of Zürich, Switzerland, ²Orthopedic University Hospital Balgrist, University of Zürich, Switzerland, ³Institute of Empiric Research in Economics, University of Zürich, Switzerland.)

Mummification of any type leads by definition to alteration of soft-tissue morphology. Hitherto, no research addressed mummification-type (e.g. artificial versus natural mummies) specific alteration of soft-tissue shrinkage as assessed by computed tomography (CT). Our aim was to test whether soft-tissue alteration is specific for type of mummification. A total of 17 human mummies have been investigated by CT. As references, four recently deceased bodies were used. Type of mummification included ancient Egyptian style, natural Peruvian mummies, Ice mummies (including the Iceman, South Tyrol Museum of Archeology, Bolzano, Italy, ca. 3,300 BC), bog bodies, and a possible Asian mummy. As diagnostic gold-standard the CT cross-sectional data set of the visible human project ® was used. Soft-tissue shrinkage (area in number of voxels) was defined relative to area of bone. Measurements were taken at various anatomically defined locations (e.g. at mid-metacarpus 5 and at cervical vertebra 4). Ice mummies - independent of historic age - show the highest degree of preservation most likely due to water being frozen within tissues. Relative to the reference sample of Ice mummies (35 measures), all other types of mummies show significantly (at $p < 0.05$) smaller relative area of preserved soft-tissue. Variation between different anatomical structures (e.g., upper lip versus mid-femur) is significant, unlike variation within one compartment (e.g. proximal versus distal humerus). Type of mummification determines significantly the degree of soft-tissue alteration, surprisingly mostly independent of overall historical age. These results highlight the unique morphological impact of taphonomy on soft-tissue preservation and is of particular interest also in tissue research and forensics.

This study is supported by Research Grant, University of Zürich, Switzerland and the Swiss National Science Foundation.

244 *Funeral Traditions, Premature Burial and Mummification: Advances in the "Mummies of Tamaulipas Bioarchaeological Project,"* **GUSTAVO A. RAMÍREZ CASTILLA** (Instituto Nacional de Antropología e Historia (INAH), Centro Tamaulipas, Calz. Gral. Luis Caballero 1552, col. Tamatan, C.P. 87069, Ciudad Victoria, Tamaulipas, México; ramx36@hotmail.com).

The Mummies of Tamaulipas Bioarchaeological Project was begun in 2008 in order to study a group of mummies recovered in the State of Tamaulipas, México in 1954. The study includes a more recently funded and recovered burial, through the use of non-invasive techniques. Locating the related artifacts and archives was another goal of the project, which permitted the reconstruction of the archaeological context, as well as of their ways of life and death.

It has also been possible to discover a sequence of the funeral traditions practiced in the region since 2,400 B.C to 1,200 A.C. Also of interest, was the forced position of hands, feet, head and the mummy's body which perhaps shows evidence of "premature burial".

245 *A 'Defective Mummy' at the Museo de La Plata in Buenos Aires,* **M. BELÉN DAIZO^{2*}, HÉCTOR M. PUCCIARELLI¹, DIEGO M. SANTOS², FERNANDO ABRAMZON³, and SONIA LESYK³** (¹Anthropology Division, Museo de La Plata, Paseo del Bosque s/n°, La Plata, Buenos Aires, B1900FWA; ²CEEMO - Centro de Estudios del Egipto y del Mediterráneo Oriental, Lambaré 1120, Ciudad Autónoma de Buenos Aires, C1185ABH; ³Radiology Department, Hospital Municipal de Trauma y Emergencias Dr. F. Abete, Ruta 197 y Miraflores, Malvinas Argentinas, Provincia de Buenos Aires, 1613; hmpucci@museo.fcnym.unlp.edu.ar; mbelendaizo@yahoo.com.ar).

The Museo de La Plata preserves a late Ptolemaic 'defective mummy' acquired in Cairo in the late 19th century. Because of its small size, the mummy was believed to belong to a toddler, but after the first radiological study in the 1980s, it was revealed as an adult male skull without a lower jaw. The skull does not show evidence of mummification but was carefully wrapped, the body entirely reconstituted with linen and prepared with a cartonnage and gilded mask. This mummy presents an interesting discussion on the defective mummies and their place in Egyptian funerary practices.

This paper discusses recent new radiological findings after full volumetric scan and 3D reconstructions, using a state-of-the-art 64-slice CT scanner and past scholarship on defective mummies.

**World Congress on Mummy Studies
CONTRIBUTED PAPERS: SESSION II
Monday, starting at 8:00 a.m. in KIPJ Theatre**

246 *A New Use for an Old Tool: Intestinal Content 'Histology' in Paleopathology and Beyond,* **GUIDO P. LOMBARDI^{*}, FRANCISCO A. TEJADA, and URIEL GARCIA-CACERES** (Laboratorio de Paleopatología, Cátedra Pedro Weiss, Universidad Peruana Cayetano Heredia, Av. Javier Prado Este 449, Lima 27, Perú; guido_lombardi@hotmail.com).

The application of a day-to-day 'histological' technique to coprolites – which technically cannot be referred as tissues – opens a new way to explore ancient diets, pathologies, and therapeutics. This paper illustrates our use of this method on 67 coprolites from Caral archaeological site (5.000 – 4.000 B.P.), and on intestinal contents from two mummies from the central coast of Perú, (A.D. 1.850 – 1.880). Besides presenting the findings of parasites and different dietary remains, the authors discuss the challenges of this approach and the possibility of extending this direct microscopic examination of thin sections of intestinal content to forensic and even living cases.

247 *Sha-Amun-em-su: The Singer of Amun,* **SHEILA MENDONÇA DE SOUZA¹, ANTONIO BRANCALFON², and CLAUDIA RODRIGUES-CARVALHO²** (¹Departamento de Endemias da Escola Nacional de Saúde Pública/FIOCRUZ, Rua Leopoldo Bulhões, 1480/sala 606, 21041-210 Rio de Janeiro, RJ Brazil; ²Departamento de Antropologia, Museu Nacional, UFRJ, Quinta da Boa Vista, Rio de Janeiro, RJ 20940-040 Brazil; sferaz@ensp.fiocruz.br).

The Brazilian collection of Ancient Egyptian objects comes from Thebes, being one of the most remarkable pieces the sealed coffin of Sha-Amun-em-su, a middle aged woman described as a former singer of Amun's temple at Thebes. The coffin was given to the Brazilian Emperor Pedro II by the Khedive of Egypt in the 19th century. Details about the mummy inside the coffin are in the hieroglyphic coffin decoration. A CT scanning provided detailed information about the coffin's preservation, the mummy, the objects inside it and also the mummification techniques. The special preparation of the body included putting a package in the neck's anterior portion, a specific hairdressing style, a package of amulets and a heart scarab, among others. Comparing this mummy with Meresamun, another singer of Amun found in Thebes, today in exhibition at the Oriental Institute in Chicago, show they shared some similarities on the methods of mummification, indicating a style of mummification used in Thebes during the Third Intermediate Period, about 747 BC. The gender could be proved based on skull and pelvic features and the age on partial closure of the skull sutures, dental decay and backbone arthrosis. A large nose, dolicocephaly, prognathism and narrow face fit well with her African ancestry. Dental decay and other characteristics became evident from the CT frames and 3D reconstructions, being consistent with the person described in the coffin. The fact that the coffin had never been opened, even after more than 120 years in exhibition, helps to confirm the mummy's identity, providing additional information to the curators in charge of Egyptian exhibit improvements.

248 *The Lost Mummies of Lower Nubia*, **JENEFER A. COCKITT***, **RYAN J. METCALFE**, and **A.R. DAVID** (KNH Centre for Biomedical Egyptology, 3.507A Stopford Building, University of Manchester, Oxford Rd, Manchester, UK, M13 9PL; jenefer.cockitt@manchester.ac.uk).

In 1907, Sir Grafton Elliot Smith began the study and autopsy of a large collection of artificially mummified bodies found in the course of the first Archaeological Survey of Nubia. These mummies, perhaps the largest series ever found in Nubia, demonstrated clear evidence of Egyptian style mummification, together with some more novel adaptations that appear specific to the area. Despite the importance of this collection for examining both the evolution of burial ritual in the region and the transmission of ideas between Nubia and Egypt, the mummies are now all but forgotten. There are now few known surviving examples of these bodies due to problems with recording during the early 1900s and the loss of several of the most outstanding examples in the bombing of the Royal College of Surgeons, London, during the 1940s. Those that do survive remain in relative obscurity.

Here, the evidence provided by the surviving mummies and the available archival material will be used to review the practise of artificial mummification in Lower Nubia. Dated by George Reisner to the Ptolemaic-Roman period, these mummies offer a unique opportunity to study an almost entirely unknown area of mummification, developing at a time when mummification in Egypt itself was on the decline.

249 *Feathered Cape, Camelid Fiber, and Cordage – Peruvian Mummies in Oslo*, **GWYN MADDEN¹**, **JORDAN KARSTEN^{2*}**, and **ROSE DREW³** (¹Grand Valley State University, Department of Anthropology, 1 Campus Drive, Allendale, MI 49401; ²State University of New York, Albany, Department of Anthropology, 1400 Washington Ave, Albany, NY, 12222; ³University of York,

Heslington, York, YO10 5DD UK; maddeng@gvsu.edu).

No records are available describing the acquisition of the remains or their culture history. Visual observation, radiography, and CT scans were used to examine the remains. The three males and one female present varying quantities of material remains, including remnants of a feathered cape, headdresses, camelid wrappings, and thick cordage. Material remains, the mummies, and radiocarbon dates suggest affinity with the Nazca/Paracas of Peru.

250 *The Meaning of Mummification among the Anga of the Aseki Region of Papua New Guinea: A Tradition in Transition*, **ANDREW J. NELSON¹** and **RONALD G. BECKETT^{2*}** (¹The University of Western Ontario; ²Bioanthropology Research Institute, Quinnipiac University, Hamden, Connecticut; c/o 16010 South 11th Place #31, Phoenix, Arizona 85048; ronald.beckett@quinnipiac.edu).

The Anga are the only existing society in which Smoke Body mummification was routinely practiced within living memory. As such it provides an important opportunity to explore this practice using ethnographic methods. Several studies have previously been conducted on this group, and a stereotypic understanding of Anga mummification has emerged. However, our recent fieldwork demonstrates that there is considerable variability within this culture, both across the entire Anga region and within local areas. Furthermore, the Anga's perception of the practice is changing demonstrating the continued impact of missionary efforts as well as the effects of globalization as it continues to encroach on the Anga and their cultural traditions. These results have important implications for other studies of mummification practices which seek to make generalizations across space and time.

251 *Scientific Exploration of the Smoked Body Mummification Practice of the Anga of Koke Village, Papua New Guinea*, **RONALD G. BECKETT^{1*}** and **ANDREW J. NELSON²** (¹Bioanthropology Research Institute, Quinnipiac University, Hamden, Connecticut; ²The University of Western Ontario; ronald.beckett@quinnipiac.edu).

Smoked body mummification has been practiced by various cultural groups in Papua New Guinea for many years and was reported in the earliest ethnographic information of the region. This study reports on the continued scientific study of the Anga mummification practice in Koke village in the Aseki region of the fringe of the Eastern Highlands, Morobe Province, Papua New Guinea. This research adds to the knowledge gained in a 2008 expedition where much of the smoked body process was studied. In the current 2010 study, we examined the nature of the mummification process through examination and characterization of the microclimate created within the smoking hut, the smoke and related materials used in the process. Additionally, we gained knowledge of procedural steps of the Smoked Body process not observed in the 2008 study.

252 *The Warrior Ways of the Anga, Trauma and Artifact Analysis*, **ANDREW J. NELSON¹** and **RONALD G. BECKETT^{2*}** (¹Department of Anthropology, The University of Western Ontario, London, ON, Canada, N6A 5C2; ²Bioanthropology Research Institute, Quinnipiac University, Hamden, Connecticut, c/o 16010 South 11th Place #31, Phoenix, Arizona 85048; ronald.beckett@quinnipiac.edu).

Early ethnographic reports describe the Anga as a cultural group wrought with intertribal wars often brought on by territorial disputes. The decrease in warring practices among the Anga can be

attributed to the increase in the regional missionary efforts in the early 1950's. This study reports on the examination of 32 mummified and skeletal remains or partial remains from in and around the Aseki region of Papua New Guinea. We report on 23 remains from Koke village, three from Oiwa, five from the Imauka cave, and one from Yeakunga. The examination resulted in a graphic validation of the manner of combat and retaliation present in the pre-missionary Aseki region. 11 crania had enough of the vault preserved and bone exposed to allow an assessment of whether or not the individual had suffered a depressed cranial fracture. Of those 11, five had depressed or penetrating cranial fractures. In addition, two of the individuals from Oiwa demonstrated perimortem slashing wounds to the skin. Therefore, there is abundant evidence for a very high prevalence for violent trauma among these individuals validating the early ethnographic reports. In addition, the most common artifacts associated with the remains were weapons such as bows, arrows, spears, and clubs. In one case, a weapon said to belong to one of the Koke mummies, fits perfectly into one of the penetrating skull fractures observed.

253 *Assessment of the Restoration of the Smoked Body of Moimango, Former Clan Leader, Warrior, and Shaman of the Anga of Koke Village, Papua New Guinea*, **RONALD G. BECKETT**^{1*} and **ANDREW J. NELSON**² (¹Bioanthropology Research Institute, Quinnipiac University; ²Department of Anthropology, The University of Western Ontario; ronald.beckett@quinnipiac.edu).

The Anga of the Aseki region of Papua New Guinea mummify their honored dead through a smoking process. The mummies are then placed on display on a ledge or cliff niche where they continue to be active members of village rituals. While the mummification process produces well preserved individuals, the cliff display and the subsequent exposure to the elements causes severe deterioration over time. The clan leader of Koke Village, Gemtasu, wants to rekindle the practice of Smoked Body mummification and be mummified in the traditional manner when he dies. The restoration of Moimango, his father's smoked body, is key in his quest. Gemtasu, by tradition, desires to 'see the face' of his father and by extension, derive a continued spiritual connection. In 2008, the smoked body of Moimango was assessed and restored using only native materials with the results reported at the 1st Bolzano Mummy Congress in 2009. In 2010 the authors returned to Koke village and assessed the efficacy of the restoration procedures developed in 2008. We report on the efficacy of these restoration efforts. Many of the methods were found to have held up for the last two years. A re-assessment was conducted and new restoration needs, not present in 2008 were required and are reported here.

254 *The Mummy Tissue Database at Manchester's KNH Centre for Biomedical Egyptology (Part I)*, **MICHAEL R. ZIMMERMAN**^{1*} and **BARBARA H. ZIMMERMAN**² (¹Villanova University, Biology Department, 800 E. Lancaster Avenue, Villanova, PA; ²Villanova University, Department of Computing Sciences, 800 E. Lancaster Avenue, Villanova, PA 19085; michael.r.zimmerman@villanova.edu).

As a Visiting Professor at the University of Manchester's KNH Centre for Biomedical Anthropology in the Spring 2009 semester, I taught a course in paleopathology, participated in the Wellcome Trust funded project: *Sir Grafton Elliot Smith and the Archaeological Survey of Nubia: Their Significance to the Palaeopathological Tradition*, and donated my 40 year collection of mummy specimens

to the KNH Centre's International Mummy Tissue Bank. A database was developed for the 672 specimens. Information from the database was incorporated into the recent invited paper written by Dr. Rosalie David, Director of the KNH Centre, and Michael R. Zimmerman on the history of cancer (*Cancer: A New Disease, an Old Disease, or Something in Between?* 2010. R.A. David and M.R. Zimmerman. Nature Reviews Cancer, 10:728-733 (advance online publication, 3 Sept. 2010).

255 *The Mummy Tissue Database at Manchester's KNH Centre for Biomedical Egyptology, (Part II: Mummies Meet the Digital Age)*, **BARBARA H. ZIMMERMAN**^{1*} and **MICHAEL R. ZIMMERMAN**² (¹Villanova University, Department of Computing Sciences, 800 E. Lancaster Avenue, Villanova, PA 19085; ²Villanova University, Biology Department, 800 E. Lancaster Avenue, Villanova, PA 19085; barbara.zimmerman@villanova.edu).

The 672 specimens donated by Michael R. Zimmerman were entered into a computer database developed by Angela Thomas of the KNH Centre and Barbara Zimmerman. The specimens consist primarily of microscopic slides and a number of tissue specimens. The database includes a KNH ID number, an original institution slide or specimen number, specimen description, diagnosis, original source, natural or artificial mummification, provenance, history and published references. The database, formatted in an Excel spreadsheet, is currently being used by post-graduate students in the KNH Centre program in Biomedical and Forensic Studies in Egyptology. Researchers may apply to the KNH Centre for access to this international source (<http://www.knhcentre.manchester.ac.uk>). The database is being converted to a full database management system with a web based front end accessible world-wide.

256 *The Ancient Egyptian Animal Bio Bank at the KNH Centre for Biomedical Egyptology, University of Manchester*, **LIDIJA MCKNIGHT**^{*}, **A.R. DAVID**, **STEPHANIE ATHERTON**, and **CONSTANCE LORD** (KNH Centre for Biomedical Egyptology, University of Manchester, 3.507A Stopford Building, Oxford Road, Manchester, M13 9PT, UK; lidija.mcknight@manchester.ac.uk).

The ancient Egyptians were the only civilisation to artificially mummify their animal dead. The role played by animals was underpinned by a complex and often contradictory belief system which, although not easy to understand, tells researchers a great deal about the civilisation and the surrounding environment. Despite this, research into animals in Egypt has always been something of a 'poor cousin' to the study of the civilisation's human population through the analysis of their physical remains. It is hoped that this project will redress the balance in this regard.

The Ancient Egyptian Animal Bio Bank project, which commenced in Summer 2010, has established a unique, centralised database providing up-to-date written and photographic records of mummified animal and pseudo-animal remains from ancient Egypt held in international museum collections. The Bio Bank contains complete records on the acquisition of the specimens, the geographic provenance and date, measurements and descriptions, photographs, radiographic images (X-ray and CT scans where possible), and history of previous studies undertaken with the results obtained. It combines evidence from a variety of sources – written, artistic and archaeological – to form a comprehensive repository of knowledge. The ultimate aim is to provide a safe location for the storage of information, images and minute samples removed from such specimens, providing an unparalleled bank of information and

a resource for use by future generations of researchers.

The procedures and protocol implemented to date in the formulation of the Bio Bank will be discussed.

257 *The Ancient Egyptian Animal Bio Bank – Preliminary Results of the Northern England Pilot Study*, **LIDIJA McKNIGHT***, **A.R. DAVID**, **STEPHANIE ATHERTON**, **CONSTANCE LORD**, and **KATHERINE CURRIE** (KNH Centre for Biomedical Egyptology, University of Manchester, 3.507A Stopford Building, Oxford Road, Manchester, M13 9PT, United Kingdom; lidija.mcknight@manchester.ac.uk).

The first stage mailing of the Ancient Egyptian Animal Bio Bank identified a large number of animal mummies located in museum collections in Northern England. In order to test the principles of the Bio Bank and to assess the viability of the resource, a range of non-invasive and minimally invasive scientific techniques have been employed to discover their potential value on material of this nature.

Radiography (X-ray and CT scanning) have been employed where possible in order to obtain a non-invasive insight into the contents of the bundles and the methods of mummification employed. Samples obtained from the mummies were analysed using combinations of Microscopy, Environmental Scanning Electron Microscopy (ESEM), Histology and Gas Chromatography – Mass Spectrometry (GC-MS) dependent on the specific research questions being asked.

This paper will present the preliminary results from the pilot study and a discussion of what the results mean to the future direction of the Bio Bank as a conservation measure and as a resource for researchers.

258 *Pathology in Sacred Bird Remains: Evidence of Sub-standard Husbandry in Ancient Egypt?* **STEPHANIE ATHERTON** (KNH Centre for Biomedical Egyptology, University of Manchester, UK; Stephanie.Atherton@postgrad.manchester.ac.uk).

Little research has concerned the possibility that sub-standard rearing conditions may have contributed to the health and disease of sacred birds at ancient Egyptian temple complexes. Biological research has shown that specific components of a captive habitat for wild animals are crucial factors for successful breeding and rearing programmes. The first part of the research comprises a study of the ancient Egyptian temple complexes to identify and assess captive habitats as a result of archaeological and literary evidence. Examples of this include sector 7, block 3 at Saqqara, which is described as an “artificial incubation area” for rearing Ibis and Falcon species; Tuna el-Gebel, which has been described as a “natural biotope” and the first *Ibiotropheia*; and the temple of Edfu, which describes the Festival of the Coronation of the Sacred Falcon, an annual celebration when a sacred bird is chosen from many kept within the temple in which the god Re is manifest. Accompanying this research is the examination of a number of bird mummies, with wrapped specimens being radiologically analysed as a preservation measure. The results include interesting pathological conditions including Harris Lines and healed fractures, which may point to sub-standard husbandry in captive habitats at ancient Egyptian temple complexes.

259 *IMPACT – A PACS Based Collaborative Mummy Database Project*, **ANDREW J. NELSON^{1*}**, **ANDREW D. WADE¹**, and **GREG GARVIN²** (¹The University of Western Ontario; ²St. Josephs’ Health Care, London X-ray Associates; anelson@uwo.ca).

Many advanced imaging applications involve the detailed analysis of one or a few images or objects. This is due to two main reasons: the time intensive nature of advanced image analysis and the difficulty of storing and accessing advanced image datasets. The storage and access issue is particularly true for the DICOM data sets derived from CT and microCT scanners. These datasets can be extremely large and they cannot be handled by regular database software. This paper reports on a project that is currently under development that is designed to create a large scale collaborative database of mummy studies using a radiological Picture Archive and Communication System. Mummy studies is a field that is characterized by case studies, or by studies of small series of mummies. This is largely due to the fact that few mummies have been x-rayed or CT scanned and the studies that do exist are very difficult to access. This project aims to establish a database of radiological studies of mummies by inviting individual scholars or institutions to contribute their individual studies and to collaboratively construct a much larger study sample than could be possible in any other way. In this paper we will explore the issues that need to be solved for this project to work. These issues fall into several categories – issues of a technical nature, issues of intellectual property and issues of control and access. The resolution of these issues will have important implications for the area of advanced image analysis in bioarchaeology.

260 *Re-thinking Anthracosis: A Critical Re-examination of a Diagnostic Trend (Case Study from a 19th Century West Virginian Mummy)*, **JULIA WOODWARD^{1*}**, **CATHERINE GAITHER¹**, **RAMONE GONZALEZ²**, **RONALD G. BECKETT²**, **GERALD J. CONLOGUE²**, **CARLYNE COOL^{3,4}**, and **STEVE GROSHONG⁴** (¹Metropolitan State College of Denver; ²Quinnipiac University; ³University of Colorado, Denver; ⁴National Jewish Health; jhwoodw@yahoo.co.uk).

The specific aims of the study was to first biopsy a lesion noted on plane radiographs and computed tomography scan taken in 2001 and then to rehydrate and examine the tissue for pathology.

The biopsy was performed on a female mummy from West Virginia, who had died in 1888. The procedure was done at the Barbour County Historical Society Museum in Philippi, West Virginia. Approximately half the lesion was removed for processing. Samples were processed at National Jewish Health laboratories using a modified version of the Sandison technique to rehydrate. They were then placed in a tissue processor, embedded in paraplast x-tra, mounted on slides, and routinely stained with hematoxylin and eosin.

Outcomes: Severe emphysema and moderate to marked anthracosis were found. Research into anthracosis revealed generalized use of the term to describe black carbon pigmentation in the lungs, despite the fact that medical literature defines anthracosis as a form of pneumoconiosis marked specifically by the presence of coal dust in the lungs. Because the mineral source determines particle distribution and subsequent lesion development, differential diagnosis between the different forms of pneumoconiosis, such as silicosis, should be employed. Determining the source of the pigmentation may be a vital regional or economic determinate.

261 *Elmer McCurdy, Mummified “Outlaw” from Oklahoma’s Wild West*, **JUDY MYERS SUCHHEY** (Forensic Anthropologist, Department of the Coroner, 1104 North Mission Road, Los Angeles, CA 90033; jmsuchey@aol.com).

A “wax dummy” at an amusement park in Long Beach, California, turned out to be an adult male. This discovery occurred on December 7, 1976, and Thomas T. Noguchi, the Chief Medical Examiner, drew nationwide attention to the case with his press release. Representatives from Oklahoma (the legendary Clyde Snow, Fred Olds of the Oklahoma Historical Society, and Ralph McCalmont from Guthrie) came to the Los Angeles Coroner thinking this mummy might be their missing outlaw who died in 1911 during a shoot-out with a sheriff’s posse in the Osage Hills. This paper outlines the investigation, as I assisted Dr. Clyde Snow in his anthropological work on the case, leading to the identification of Elmer McCurdy. In this presentation we follow Elmer from the Fun House to the Grave.

262 *A Contextual Analysis of a Mummy from the Sierra Gorda, Querétaro Region of México, Dated 900 to 1200 BC*, **ELIZABETH MEJÍA^{1*}, MARTHA BENAVENTE², ALEJANDRO TERRAZAS², and ALBERTO HERRERA¹** (¹INAH Querétaro, Andres Balvanera #2 Centro, Querétaro, Querétaro CP 76000, México; ²Instituto de Investigaciones Antropológicas, Universidad Nacional Autónoma de México; toluquilla2000@yahoo.com.mx).

In May 2010 a shepherd discovered the burial of a partially mummified body in the Sierra Gorda region of México. The remains were wrapped in a woven mat called a *petate*. The Instituto Nacional de Antropología y Historia, Querétaro, was notified, and anthropologists were sent to the site to examine the burial and determine the archaeological context and the physical characteristics of the remains. This paper presents the joint results of an archaeological and physical anthropological approach that reveals a male individual whose life was one of considerable physical stress. The cultural materials associated with the burial reveal he had sufficient social recognition to afford him a special burial place with rich offerings to accompany it.

263 *Thinking Makes It So’: Reflections on the Ethics of Displaying Egyptian Mummies*, **JASMINE DAY** (Discipline of Anthropology and Sociology, The University of Western Australia, 22 Coolidge Street, Perth, Australia; mummywoman@hotmail.com).

Controversy about museums’ possession and exhibition of human remains has usually affected those identified as ancestral remains by indigenous peoples. Egyptian mummies, with their long tradition of exhibition, seemed exempt from such considerations until the covering of unwrapped remains in the Egyptian gallery at The Manchester Museum in 2008. The museum’s representatives argued that this covering responded to visitors’ objections, but subsequent widespread protest against the measure suggested that it had been carried out with inadequate public consultation. With reference to the Manchester case, I will present two arguments to expand the scope of current debates about human remains display. The first argument favours the consideration of museum visitors from cultures other than those represented by exhibited remains as legitimate stakeholders in the remains’ management, including consideration of their personal reasons and historical precedents for favouring display. The second argument, which reveals the spurious bases of many objections to Egyptian mummies’ display and demonstrates their derivation from misconceptions promulgated by the media, shows that the grounds for public objections to human remains display should be more critically examined. If perpetuated rather than halted, the display of mummies could be used to actively combat disparaging media stereotypes. Human remains exhibition

is not inherently offensive, but can be regarded as such by visitors whose cultural backgrounds fail to prepare them for encounters with the dead. Removing the dead from display avoids engagement with ethics debates rather than facing the challenge of finding ways to respect the dead by facilitating encounters with them.

264 *Cultural and Logistical Challenges in Preparing a Large Travelling Mummy Exhibition for American Museums and Science Centers*, **HEATHER GILL-FRERKING^{1*}, WILFRIED ROSENDAHL¹, and JAMES DELAY²** (¹German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim, Germany; ²American Exhibitions, Inc., 1515 South Federal Highway, Suite 211, Boca Raton, Florida, 33432; Heather.Gill-Robinson@mannheim.de).

In 2007, the exhibition “Mummies: The Dream of Everlasting Life” was created at the Reiss-Engelhorn Museums in Mannheim, Germany. The exhibition included more than 50 human and animal mummies from around the world, loaned from numerous museums throughout Europe. The purpose of the exhibition was to show the various forms of natural and artificial mummification, using the mummies as examples of preservation in different environments and cultures. This exhibition was first presented in Mannheim, and over a period of three years travelled to museums in Germany and Italy. In 2010, a related exhibition travelled to the United States to begin a 3-year tour of museums and science centers.

This paper presents a discussion of the challenges associated with the preparation of a large travelling display of mummies. In particular, the paper highlights the differences between a European-curated and American-presented exhibition; discusses planning the physical logistics associated with the exhibition; presents challenges associated with international academic and commercial collaborations, and shares some interpretations of visitor perceptions of the exhibition at its initial American venue, the California Science Center in Los Angeles.

265 *Supernumerary Vertebrae and Other Spinal Pathology in Three 17th Century Crypt Mummies from Germany*, **HEATHER GILL-FRERKING^{1*}, JAMES SCHANANDORE², and WILFRIED ROSENDAHL¹** (¹German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim, Germany; ²Department of Biological Sciences, North Dakota State University, Fargo, North Dakota; Heather.Gill-Robinson@mannheim.de).

A small group of mummies rest in the von Crailsheim family crypt, at Sommersdorf Castle, in southern Germany. All of the mummies date to the 17th century, and all are naturally preserved, due to the air flow in the crypt area. To date, the German Mummy Project has examined three of the mummies in the crypt: the Baron von Holz, Sophie von Kniestätt and the Baroness Schenck von Geyern. There is limited historical documentation related to these individuals and very little was known about the three adults.

Using a Siemens Definition Dual Energy Source CT scanner and medical imaging software (OsiriX and Mimics), all three individuals were assessed for age-at-death, evidence of trauma or pathology and identification of potential cause of death. Analysis of the CT data indicated that all three adults had evidence of spinal pathology. All three had non-sacralized supernumerary L6 vertebrae and one of three also had an apparent C8 vertebra. Both women had sacral spina bifida occulta and extreme spinal curvatures, the severity of which was made clear through the 2D visualization and 3D reconstruction during the medical imaging. One of the women may

have had tuberculosis; DNA testing for this is pending. DNA analysis to determine the genetic relationship between all three individuals has been inconclusive so far.

266 *Relic, Ritual or Residue: the ‘Saint Achilles’ Remains at Torre de Palma, Portugal*, **MARY LUCAS POWELL¹** and **DELLA COLLINS COOK^{2*}** (¹130 Hamilton Park, Lexington, KY; ²Department of Anthropology, Indiana University, 701 East Kirkwood Avenue, Bloomington, IN 47405; paleomary@insightbb.com; cook@indiana.edu).

The Torre de Palma site in eastern Portugal includes one of the earliest double-apsed basilicas in western Europe, dating from 5th century CE. A total of 255 individuals represent more than 13 centuries of mortuary activity. A prominent tomb contained eight hand and foot elements from a male of advanced age. Both calcanei are included. We consider three hypotheses: that these elements constituted a special relic, perhaps with soft tissue preserved; that the remainder of the skeleton was translated ritually to a different location with these elements left intentionally to maintain the deceased presence in the church; and that these elements were left behind unintentionally when the tomb was cleaned to prepare it for a new occupant.

267 *Tattoos and a Scar: Visible Marks and Invisible Pathology of a South American Woman from the 14th Century*, **HEATHER GILL-FRERKING***, **ANNA-MARIA BEGEROCK**, and **WILFRIED ROSENDAHL** (German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim, Germany; Heather.Gill-Robinson@mannheim.de).

Three small tattoos, one on the face and one on each breast, and a scar on the left breast, are visible on an adult woman attributed to the Chiu-Chiu culture of South America. As part of the evidence-based examination of the mummy, the tattoos and scar were recorded and interpretation attempted, within the bioarchaeological and cultural context of the mummy. The specific meanings of the simple tattoos on this particular woman have not yet been determined and multiple interpretations must be considered. Tattoos on various mummies have previously been interpreted as aesthetic adornment, indicators of social status, ceremonial or religious symbols and possible indicators of therapeutic treatment. The scar on the breast is clearly well-healed, indicating that the woman survived for a long period of time following the event that led to the scar.

This paper will describe the tattoos and scar and offer potential bioarchaeological and cultural interpretations for both the deliberate body modification and the scar, including the results of the medical image analysis of the area of the scar. This paper will also summarize other pathology identified during the medical imaging, in an attempt to understand the health status of this woman.

268 *An Interesting and Indeterminate Disease from the Nubian Pathological Collection*, **MERVYN HARRIS** (KNH Centre for Biomedical Egyptology, The University of Manchester, Room 3.507A, Stopford Building, Oxford Rd., Manchester M13 9PT, UK; mervyn.harris@manchester.ac.uk).

The Nubian Pathological Collection is a collection of specimens excavated by Elliot-Smith and Wood-Jones during their extensive “Archaeological Survey of Nubia” which took place during the early years of the 20th century. The collection consists of specimens included because of their particular pathological interest

and do not provide insight into the prevalence of any particular disease amongst the population of ancient Nubia.

One specimen of particular interest consisted of a pelvis, two femora, two humeri and two ulnae and radii all from the same adult individual. Provenance is uncertain but may date from the Predynastic period. The specimen itself might not be Nubian although it is contained amongst the collection. The pelvis demonstrated a tri-radiate deformity and the developmental abnormality spina bifida occulta. Gross callus formation was noted along both femoral shafts giving the appearance of extensive soft tissue ossification. Both ulnae and radii were bowed and ossification of the intraosseous membrane was noted.

The appearance of the remains suggested a number of possible diseases but was not exactly typical of any one in particular. However, the specimen demonstrated several specific features which suggested a possible diagnosis of type V osteogenesis imperfecta which is particularly interesting as type V has only been identified within the last decade.

269 *The Ankhpakhered Mummy Project*, **SABINA MALGORA^{1*}** and **LUCA BERNARDO²** (¹Egyptologist, Curator, and Co-director of the “Mummy Project,” Castello del Buonconsiglio di Trento, Trento, Italy; ²Head of the Department of Maternal Fetal Science, Co-director of the “Mummy Project,” Fatebenefratelli and Macedonio Melloni Hospital, Milan, Italy; sabinamalgora@libero.it).

The mummy of Ankhpakhered, a priest of Min in the Temple of Akhmin, had been placed inside a painted wooden sarcophagus, dated to the XXII-XXIII dynasties. The mummy and sarcophagus, conserved in the Archaeological and Paleontological Museum of Asti, underwent conservation and radiographic examination. The study revealed the skeletonized body of an adult individual. The essential parts of the body are completely disturbed, with canes supporting the bones. No amulets and jewellery were found.

The 3D reconstructions of the CT scans confirm the radiographic survey. The collected data suggest that this individual had undergone heavy work activities, with the lower part of the body showing marked stresses. These aspects do not seem suitable for the activities of a high priest.

An endoscopy was made to collect samples for analysis to provide more reliable data. The tool used: Video-Bronchoscope STORZ, 61 cm in length, external diameter 5.9 mm, with operating channel of 2.2 mm and Bronchoscope STORZ, 44 cm in length, external diameter 10.5 mm with 3 operating channels. The samples taken were: fragments of bones, canes, bandages, and a tooth. Further research will include: DNA, C14, and toxicology testing. The specialized team consists of a toxicologist, an anthropologist, and a forensic pathologist, with the use of a diagnostic centre. Future tests will allow us to understand this individual: his age at death, cause of death, other pathologies, when he was buried, reason for skeletonization, and where the body was before being buried in this sarcophagus.

270 *Teeth Used as a Tool: Evidence of Task-related Dental Modifications from an Ancient Cemetery at Saqqara, Egypt*, **IWONA KOZIERADZKA-OGUNMAKIN** (KNH Centre for Biomedical Egyptology, University of Manchester, Faculty of Life Sciences, 3.507 Stopford Building, Oxford Road, Manchester, England, M13 9PT; iwona.kozieradzka-ogunmakin@postgrad.manchester.ac.uk).

Human dentition is a valuable source of information regarding age, diet and health. A detailed examination of teeth could also

reveal evidence of past activity patterns that required a use of ‘a third hand’. The use of teeth as a tool could produce distinctive patterns and result in accidental modifications of dentition; these changes could be related to specific tasks. The paramasticatory function of teeth could offer a unique insight into cultural behaviour of the past population. A collection of 111 individuals from an Old Kingdom and Late to Ptolemaic cemetery in Saqqara, Egypt, was subjected to a detailed osteological examination that yielded several examples of unusual dental abrasion. These dental modifications were studied in relation to habitual activities as well as dietary practices that could possibly be associated with dental attrition.

271 *Hearts and Minds: Excerebration and Evisceration in the Egyptian Mummification Tradition*, **ANDREW D. WADE*** and **ANDREW J. NELSON** (Department of Anthropology, University of Western Ontario; awade4@uwo.ca).

The popular and academic literature abounds with normative descriptions of the treatment of the cranial and abdominal-thoracic cavities, and their contents, in the ancient Egyptian mummification tradition. These norms are largely derived from the classical accounts of the embalmer’s art by Herodotus, Diodorus, Siculus, Porphyry, and Plutarch.

In spite of the high degree of variability apparent in the literature as an aggregate, researchers continue to focus on classical and modern stereotypes rather than on the rich variability in the Egyptian mummification tradition as it evolved across Egypt over the course of more than three millennia.

Recent studies by the authors have demonstrated substantial variability in the excerebration and evisceration traditions of ancient Egyptian embalmers. These studies have called into question the long-held classical stereotypes, particularly dogmatic class associations, through comparison with empirical data from the literature and from first-hand observation of computed tomography scans.

This paper will discuss integrated results of the ongoing synthetic evaluations of evisceration and excerebration features in ancient Egyptian mummies, drawing from adequate descriptions in the literature and from a sample of seven mummies examined directly using computed tomography.

This study compares empirical data on suites of excerebration and evisceration features with classical descriptions of evisceration, excerebration, and organ and cavity treatments. Brain and body cavity treatments, and the removal and treatment of organs vary between time periods, sexes, and statuses, and are discussed in relation to their coincidence as suites of features, their treatment in the literature, and their radiological appearance.

272 *Crime and Punishment: A Reconstruction of Mortuary Practices in Nomadic Mongolia Based on the Study of Human Burials from 3,000 BP (Bronze Age) to AD 1700 (Ming Dynasty)*, **BRUNO FROHLICH¹**, **TSEND AMGALANTUGS²**, **DAVID HUNT^{1*}**, and **KRISTEN PEARLSTEIN¹** (¹Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Washington DC, USA.; ²Institute of Archaeology, Mongolian Academy of Sciences, Ulaanbaatar, Mongolia; FROHLICH@si.edu).

Human mummified remains have been found in caves in several Mongolian *aimags* (provinces). To present, we have studied 18 individuals from the Bronze Age (3,000 BP) to the Ming Dynasty (ca. AD 1650). Cause of death for the majority of these burials is from traumatic events; including hanging, strangulation, broken

necks, and high force impacts. These burials are generally single individuals, but two instances were multiple burials with both sexes and a range of ages. Variation in mortuary practice is attributed to historical periods, however, the number of cave burials is too small and age periods extensive to represent a well-defined population.

Previous theories suggested that cave burials were shamanistic, relating to spiritual and/or ritual expression. However, our theory is more simple or practical. Nomadic groups roam well-defined geographical areas for suitable grazing areas. Distances travelled are dependent on the recovery speed of the landscape from the destruction of grazing. Nomads of the Gobi Desert travel long distances, while the people of the fertile northern Hovsgol *aimag*, travel less than 15 km over a year. Ill-behaving individuals that are detrimental to the group (dangerous or a liability) need to be neutralized for the good of the group. This would be accomplished by execution of the individual, and in instances, include execution of the nuclear family due to lack of resources to sustain them. This interpretation is supported by Mongolian ethnographic record in the way criminals are punished, in order to eliminate the danger of these individuals for the survivorship of the group/society.

AAASPD

EDUCATION SECTION

Monday, starting at 8:40 a.m. in KIPJ 220

273 *Marine Invasive Species Assessment in San Diego Bay*, **KATHLEEN F. ESTRELLA***, **GABRIEL L. TUKEMAN***, and **JAY S. VAVRA** (High Tech High, 2861 Womble Rd., San Diego, CA, 92106; kestrella@hightechhigh.org, gtukeman@hightechhigh.org).

The onslaught of invasive species pose a serious threat to biodiversity worldwide. Urban environments tend to have an abundance of invasives leading to billions of dollars of damage across the U.S. Unlike other well studied urban marine environments (eg. San Francisco Bay) relatively little is known about the invasive species of San Diego Bay.

In 2009, High Tech High established a cooperative agreement with the U.S. Navy to follow the National Invasive Species Council and management plans which help prevent the spread of invasive species. Students of the HTH Biotechnology class conducted a pilot study for a future large scale ecological survey of the Bay.

Initially students learned about conservation forensics and invertebrate zoology, and then were assigned different taxonomic groups to study benthic species in the Bay. Subtidal invertebrates were sampled from fouling organisms growing on weighted ropes placed along Grape Street Pier in San Diego Bay since 2005. The first approach to identify specimens involved comparative morphology and taxonomic keys. Later, students applied DNA barcoding using Cytochrome Oxidase C Subunit I to identify species.

A variety of native and invasive species were identified through this study. This included invasives such as numerous tunicates and bivalves, which were identified and barcoded. Several native species were also identified, which comprised of several species of bryozoans and molluscs.

Through these surveys and collaboration with taxonomic experts, this study details an approach for the early detection and routine monitoring of biodiversity to help prevent and slow the spread of invasive species.

274 *A Model for Empowering Young People from Urban and Diverse Backgrounds to become Tomorrow's Scientific Leaders*, **SHARA FISLER and LINDSAY GOODWIN*** (Ocean Discovery Institute, 2211 Pacific Beach Drive, San Diego, CA 92109; lgoodwin@OceanDI.org).

There is a critical need for programs that build students' scientific understanding, and prepare them to fill the roles of future decision-makers and the scientific workforce. In particular, efforts are needed to reach the underserved communities, which represent the greatest untapped talent pool in the sciences. Ocean Discovery Institute's model uses authentic scientific discovery to generate the spark that makes young people, from the most urban and diverse backgrounds, eager to learn. As they use science to discover the world around them, they discover themselves and their future as scientific leaders. The model incorporates education, scientific research, and environmental stewardship with the primary guiding principles of 1) focusing on one geographic area, allowing us repeated exposure to students and families as they grow from K-12; 2) integrating our efforts into the broader community, helping parents and teachers to attain a shared vision for these students; 3) employing a hands-on, action oriented approach that draws upon students' assets and talents; 4) engaging students in authentic research side-by-side with practicing scientists; 5) eliminating the unique barriers faced by urban, diverse young people as they study science and pursue higher education. The success of this model includes increasing students' science performance, attendance in college, and major selection in the sciences. This work uses science to empower young people to transform their lives, their community, and ultimately our world.

We will share lessons learned from over ten years of science program experience, describe the best practices tested, successful approaches, and the challenges still underway.

275 *Initial Results from Piloting a Science Literacy Concept Inventory*, **EDWARD B. NUHFER^{1*}, CARL KLOOCK,³ CHRISTOPHER B. COGAN,² and GREGORY WOOD⁴** (¹Director of Faculty Development and Professor of Geology, ²Environmental Science and Resource Management Program, and ⁴Applied Physics Program, California State University (CSU) Channel Islands, 1 University Drive, Camarillo, CA 93012-8599; ³Department of Biology, CSU Bakersfield, 9001 Stockdale Hwy., Bakersfield, CA 93311-1022; ed.nuhfer@csuci.edu, Carl_Kloock@firstclass1.csu-bak.edu, Christopher.Cogan@csuci.edu).

Nine science professors from five science disciplines representing four campuses, supported by funding from the California State University's Office of the Chancellor's Institute for Teaching and Learning, began a project in 2008 to promote science literacy in general education science courses. We deduced twelve measurable learning outcomes that correspond to important concepts of understanding science, in contrast to the usual and often erroneous presentations of "the scientific method" commonly found in textbooks. Since 2010, CSU and University of California guidelines incorporated our work to assess transferability of science courses as general education courses.

The team, using established principles of concept inventory construction, next developed a Science Literacy Concept Inventory (SLCI) to assess the twelve outcomes to measure conceptual understanding of science as a way of knowing and reasoning. We pilot-tested two 40-item versions at universities across the nation. Reliability is good ($R = 0.83$), and some results are surprising. As

a nation, we don't teach science's valuable conceptual ways of knowing in general education courses, even though institutional catalogues frequently convey that science literacy is the justification for requiring such courses. Professors are science literate and score above 90 on the SLCI, but they don't pass this understanding on to their undergraduates, who score about 59. General education courses teach the knowledge and applications of science, but they produce no significant difference in conceptual understanding of the evidence-based reasoning of science. The concepts are teachable, but poor conceptual understanding persists all the way through graduation.

276 *Investigating Novice-to-Expert Transitions in Undergraduate Biology Education*, **KIMBERLY D. TANNER^{1*}, JULIA I. SMITH^{1,2}, and ELIJAH COMBS¹** (¹SEPAL: The Science Education Partnership and Assessment Laboratory, Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; ²Department of Biological Sciences, Holy Names University, 3500 Mountain Blvd., Oakland, CA 94619; kdtanner@sfsu.edu).

University biology education aims to produce students who possess biology expertise. However, little is known about the extent to which biology majors develop biological expertise during their undergraduate years. Expertise has been described in cognitive psychology as not only knowledge within a discipline, but also the structure of that knowledge. To investigate expertise in physics education, Chi and colleagues developed a task in which participants were asked to sort physics problems into groups (Chi, 1981). Through this card-sorting task, researchers demonstrated that novices sorted problems based on "surface" features (e.g. pendulum problems), while physics experts sorted problems based on "deep" features (e.g. Newton's first law problems), suggesting differences in how these populations structured their knowledge of physics. We have developed a similar card-sorting task to investigate differences in novice and expert thinking in biology education. Sixteen biology problems were adapted from undergraduate biology textbooks, such that each card represented both one hypothesized "surface" feature in biology and one hypothesized "deep" feature. Guiding research questions include: To what extent do Biology Faculty (BF) sort based on hypothesized deep features? To what extent do Non-Biology Majors (NBM) sort based on hypothesized surface features? How do Entering Biology Majors (EBM) and Advanced Biology Majors (ABM) perform these sorts, and to what extent do their sorts more closely resemble NBM or BF? Analyses of results from this novel card-sorting task collected at a small, private college and a large, public university will be presented at the conference.

277 *Development and Implementation of a Workshop on Inclusive Teaching for Undergraduate and Graduate Teaching Assistants by Postdoctoral Scholars at UCSD*, **SANDRA L. CLEMENT*, SAURABH JOSHI, SUZANNE R. LEE, EVAN C. MERKHOFFER, STEFANIE OTTO, MARTA VICENTE-CRESPO, and GABRIELE WIENHAUSEN** (Division of Biological Sciences, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0322; slclement@ucsd.edu).

The loss of talented students from Science, Technology, Engineering and Math (STEM) majors is a major challenge for U.S. technological advancement and global competitiveness in the 21st century. Although inclusive teaching strategies can help student retention, formal instruction in pedagogy has not traditionally been

a part of STEM graduate education and is often completely absent from postdoctoral training. Thus, increased access to training in pedagogy for student teaching assistants (TAs) and postdoctoral scholars has the potential to improve the quality of instruction in the STEM classroom. In order to provide TAs with the advice and tools they need to create a safe learning environment that respects student diversity and encourages learning, a group of postdoctoral scholars in the Division of Biological Sciences at UCSD have developed a TA training workshop on inclusive teaching. We began our development of this workshop by reviewing a series of relevant readings and discussing the roles that identity, diversity, and unconscious bias play in the classroom. Currently, our workshop uses a combination of self-reflective and group activities to personalize diversity issues and model best practices for inclusive teaching. Based on participant pre- and post-surveys, this workshop has been successful in promoting awareness of unconscious bias and providing strategies that participants can use in their classrooms to facilitate and encourage student learning. We will discuss the format for our workshop as well as the process for preparing postdoctoral facilitators and efforts to ensure sustainability and replicability.

278 *On Mathematical Education: Mathematics Neither Necessary Nor Sufficient for Science*, **G. ARTHUR MIHRAM^{1*} and DANIELLE MIHRAM²** (¹P. O. Box No. 1188, Princeton, NJ 08542-1188; ²Department of French and Italian, University of Southern California, 650 W 35th St., Los Angeles, CA 90089; dmihram@usc.edu).

We expand on the ancient (Greek) mathematicians' appreciation—that familiarity with mathematics is important not so much for remembering mentally its content but more for its ability, in a learner, to discipline his/her mind for adult decision-making.

In particular, with respect to Science [being that human activity devoted to the search for the very explanation for (i.e. for the truth about) any particular naturally occurring phenomenon], mathematics is neither necessary nor sufficient for its successful conduct:

On sufficiency: Mathematics, being a language and, therefore, historically a subject of arts, and not science, faculties, need not be concerned with explaining any naturally occurring phenomenon directly: Euclidean geometry.

On necessity: Since any scientist needs—as his explanation of the naturally occurring phenomenon observed in Nature—a model, he/she can choose from any art form which would convey it, preferably with specificity: the cave wall, a painting, or any of three linguistic forms: (I) natural language: à la Darwin (first-person); (II) mathematics: à la Newton (third-person: $F=mXa$); or, today, (III) algorithmic, computer-programming languages (second-person), ideal for capturing with scientific credibility the dynamics of any living/social system since the decision, providing irregular change(s) in such systems, is readily expressed as an algorithm, which, though impeccably logical, is not mathematics: to wit, 'IF IX a, b, c'.

For educators, the pertinence of mathematics in the curriculum of tertiary education is requisite; Science neither necessarily follows from its use nor requires that it be employed in any particular scientific explanation (model).

**AAASPD
ANTHROPOLOGY and ARCHAEOLOGY SECTION
Monday, starting at 11:00 a.m. in KIPJ 220**

279 *The Seri, the Sun and the Slug: Cultural and Natural History of Berthellina ilisima (Mollusca: Opisthobranchia) from the Central Sea of Cortez*, **HANS BERTSCH^{1*} and CATHY MOSER MARLETT²** (¹Universidad Autónoma de Baja California, 192 Imperial Beach Blvd. #A, Imperial Beach, CA 91932; ²SIL International, 63955 E. Conalia Pl., Tucson, AZ 85739; hansmarvida@sbglobal.net, cathy_marlett@sil.org).

The Seri people of western Sonora have a rich and profound relationship with molluscs. In addition to multiple sustainable uses (for food, utensils, tools, etc.), molluscs form an important component of their folklore, history and linguistics. They gave indigenous names to over 150 species of molluscs. Two species of opisthobranch molluscs are known by common names in their language: *Bulla gouldiana* Pilsbry, 1893, and *Berthellina ilisima* (Marcus and Marcus, 1967).

The Seris used the shelled cephalaspidean *Bulla gouldiana* for pendant jewelry, and called the animal *cacaapxom* ('what fattens [something]').

Living *Berthellina ilisima* are bright yellow to orange-red, reaching 60 mm in total length. The Seris named this species *xepenozaah* ('sun in the sea'). However, this species is not eaten nor used by the Seri. Its brilliant color and commonness called their attention to this slug.

Berthellina ilisima ranges throughout the Sea of Cortez and south along the Mexican and Central American coastline to Panamá. It also occurs in the Galápagos Islands, and northerly in southern California during warm water El Niño events. At Bahía de los Ángeles, Baja California (an area known to and probably visited by the Seri people for centuries), it was the fourth most common opisthobranch observed during an 18-year long term ecological study. This species showed a distinct annual August–June life cycle. Over 90% of egg masses were seen from May–July; copulating pairs were seen in May and June. Examination of fecal material suggests it eats haploscleridan sponge.

280 *Complete Fourth Metatarsal and Arches in the Foot of Australopithecus afarensis*, **JEFF MELDRUM^{1*}, ESTEBAN SARMIENTO², and PAUL MITCHELL³** (¹Department of Biological Sciences, Idaho State University, 921 S. 8th Ave, Pocatello, ID 83209; ²Human Evolution Foundation; ³Department of Anthropology, University of Pennsylvania, 3451 Walnut Street, Philadelphia, PA 19104; meldd@isu.edu).

In a recent *Science* report on a complete *Australopithecus afarensis* fourth metatarsal (AL 333-160). Ward et al. argue that this bone shows the foot of this hominin had fixed transverse and longitudinal arches and conclude that this taxon was an habitual biped, unlikely to have been under any selection for arboreal behaviors. These same measurements on larger samples, including all African ape species, humans, and baboons, do not support their conclusions. The authors dismiss other skeletal evidence for the presence or absence of pedal arches in *A. afarensis* as ambiguous, incorrectly asserting that key bones from the midfoot have been lacking. Yet they ignore all of the literature on the other *A. afarensis* foot bones from the same AL 333 locality offering more extensive studies strongly suggesting the AL 333 foot possessed considerable tarsal mobility and no fixed transverse or longitudinal arches. While the

makers of the Laetoli tracks are as yet indeterminate, they do not evidence the presence of a modern human-like arch, contrary to Ward et al., as established in the diagnosis of the ichnotaxon *Praehominipes laetoliensis* MELDRUM et al. 2011. The practice of inferring overall behavior and/or morphology of an organism based on a single element should be viewed critically. The indications of mosaicism in the transformation of the bipedal foot, evidenced in the foot of *A. afarensis* as well as other early hominin feet, render broad generalizations based on a single element suspect, even if the interpretations of that element are accurate.

281 *Review of the Patterson-Gimlin Film as Evidence of an Unrecognized North American Ape*, **JEFF MELDRUM¹* and **BILL MUNNS²** (¹Department of Biological Sciences, Idaho State University, 921 S. 8th Ave, Pocatello, ID 83209; ²Bill Munns Creature Gallery, www.billmunnscreaturegallery.com; meldd@isu.edu).**

The Patterson-Gimlin film footage remains the most intriguing, albeit controversial photographic evidence for the existence of sasquatch. It was captured on 16mm film in northern California, along Bluff Creek, a tributary of the Klamath River, on October 20, 1967, by Roger Patterson and Bob Gimlin, of Yakima Washington. A number of highly popularized claims have alleged the film is merely a hoax. We address the assertion that the film depicts “just a man in a fur suit” by three means: 1) Using photogrammetry to establish a reliable digital site model that unifies the filmsite landscapes and establishes the scale of the subject, with height reconstructed at 2.25 m; 2) Assessing the potential and limitations of costume fabrication in light of the means and materials available in 1967; and 3) Using enhanced digital imagery in evaluating the subject’s anatomy and movements as compared with humans and great apes. The associated footprint evidence has already formed the basis for a new ichnotaxon, *Anthropoidipes ameriborealis*, MELDRUM 2007, which provides footprint morphology correlated with the distinctions of gait evidenced in the film subject. These combined lines of assessment offer strong evidence for the film subject being a distinct biological entity and not a human in a costume.

**AAASPD
ECOLOGICAL, ORGANISMAL BIOLOGY, and
ENVIRONMENTAL SCIENCES SECTION
Monday, 8:40 a.m. in KIPJ 218**

282 *Fungal Endophyte Growth in a Nitrogen-free Solution: Nitrogen Fixation Symbiosis May Extend Beyond Bacteria*, **RACHEL SEWELL NESTERUK^{1,2*}**, and **RUSTY RODRIGUEZ²** (¹Department of Biology, University of Washington, 24 Kincaid Hall, Box 351800, Seattle, WA 98195-1800; ²United States Geological Survey Western Fisheries Research Center, 6505 NE 65th St, Seattle WA 98105; rlsn@u.washington.edu).

Members of the plant family Fabaceae are well known for their ability to form symbioses with nitrogen fixing bacteria such as *Rhizobia*. These symbioses allow legumes to invade poorly developed habitats and provide a competitive advantage over their neighbors without beneficial nitrogen-fixing symbioses. However, there may be other symbiotic microorganisms besides bacteria that are capable of fixing nitrogen in legumes. We screened several isolates of vertically-transmitted fungal endophytes cultured from *Lupinus latifolius* collected from volcanically disturbed habitats at Mount St. Helens for the ability to grow in a nitrogen-free solution. The

ability of endophytes to use media without nitrogen is compared between habitats defined by disturbance severity. Additional evidence of possible nitrogen fixation is presented utilizing PCR reactions of DNA extracted from fungal endophytes amplified using Nif primers. The evidence combines to suggest that, in addition to *Rhizobia* partners, plants in the Fabaceae may also retain fungal endophyte partners capable of providing nitrogen.

283 *A New Honey Bee Threat – the Phorid Fly Apocephalus borealis*, **ANDREW CORE^{1*}**, **CHARLES RUNCKEL²**, **JONATHAN IVERS¹**, **CHRISTOPHER QUOCK¹**, **TRAVIS SIAPNO¹**, **SERAPHINA DENAULT¹**, **BRIAN BROWN³**, **JOSEPH DERISI²**, **CHRISTOPHER D. SMITH¹**, and **JOHN HAFERNIK¹** (¹Department of Biology, San Francisco State University, San Francisco, California 94132, USA; ²Department of Biochemistry and Biophysics, University of California, San Francisco, San Francisco, California 94143, USA; ³Entomology Section, Natural History Museum of Los Angeles County Los Angeles, California 90007, USA; acore13@yahoo.com).

Colony Collapse Disorder (CCD), a syndrome characterized by loss of hives and the behavior of hive abandonment, threatens honey bees (*Apis mellifera*) in the United States and Europe. So far, the main causal suspects have been fungal parasites, viral diseases and interactions amongst them. While viral and microsporidian infections have been linked to increased mortality and declining health in CCD colonies, studies have not directly addressed behavioral changes involved in abandonment of hives. Here we report that *Apocephalus borealis*, a phorid fly native to North America, previously known to attack bumble bees and paper wasps, has begun to attack the non-native honey bee. Notably, this fly has a profound effect on parasitized bees, leading them to abandon their hives at night. Through DNA barcoding, we confirm that phorids that attack honey bees in the San Francisco Bay Area are the same as those attacking bumble bees. We sample honey bee hives throughout the Bay Area, and demonstrate that the majority of hives yield honey bees parasitized by phorids. We investigate diseases co-occurring with *A. borealis* using a comprehensive honey bee disease microarray chip. Bees parasitized by *A. borealis* carry other diseases, some linked to CCD. Adult flies and larvae also test positive for pathogens that have been implicated in colony collapse. Understanding causes of the hive abandonment behavior we document could explain symptoms associated with CCD. Further, knowledge of this parasite could help prevent its spread into regions of the world where naïve hosts may be easily susceptible to attack.

284 *Cutthroat Trout Phylogenetic Relationships: Geologic Processes Preserved in DNA*, **DENNIS K SHIOZAWA¹**, **PETER UNMACK¹**, **DEREK HOUSTON¹**, **JASON MATHIS¹**, and **R. PAUL EVANS^{2*}** (¹Department of Biology, ²Department of Microbiology and Molecular Biology, Brigham Young University, Provo, Utah, 84602; evansp@byu.edu).

The phylogeography of aquatic organisms in western North America has been strongly influenced by the complex geological history of the region. Native western fishes, because they require sufficient water to avoid seasonal and long-term temperature extremes and desiccation, carry genetic signals that are constrained over geological history.

Approximately 14 subspecies of cutthroat trout, *Oncorhynchus clarkii*, are recognized from western North America. Most populations are seriously threatened or endangered mostly due to

introgression, predation, and competition from introduced trouts as well as general habitat. Here we present data from multiple protein coding mitochondrial genes in a combined analysis to investigate broader phylogenetic patterns across the range of this species. Three moderate to strongly resolved main lineages are identified - a basal cluster consisting of Coastal, Lahontan, and Westslope cutthroat trout, a Yellowstone cutthroat trout and Bonneville cutthroat trout of the Bear River Basin of Utah and Idaho clade and a Colorado River, Greenback, Rio Grande, and Bonneville (main Bonneville Basin) cutthroat trout clade. The subspecies are strongly resolved, but separation of subspecies within lineages is not strongly supported by bootstrap values. Two groups, the Yellowstone and Bear River Bonneville cutthroat, and the greenback cutthroat trout have proven to be problematic relative to their taxonomic status as well as original distribution. These are further examined to resolve their biogeographical history.

285 Emergence Times of the Giant Clam (Genus *Tridacna*) in Response to Varying Degrees of Disturbance in Areas of High and Low Human Impact, REBECCA F. SCHWARTZ^{1*} and IAN TIBBETTS² (¹Department of Marine Science and Environmental Studies, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110, rebeccas@san Diego.edu; ²Center for Marine Studies, University of Queensland Australia, 320 Gehrmann, Brisbane, QLD 4072, i.tibbetts@uq.edu.au).

Response to human disturbance mimics response to predation risk in many prey species, as responses to both represent similar trade offs for an individual in terms of missed opportunities, for example to feed or mate. To balance the cost of such risk-averse behavior, many species have evolved plastic behavioral responses to threats. To address whether such behavioral response variability exists in two species of the giant clam, genus *Tridacna*, this study quantified post-disturbance emergence times in clams from an area of high and low human impact on Heron Island, Great Barrier Reef, Australia.

Results indicate that individuals from an area of high impact have longer emergence times than their counterparts in a low impact area, and that emergence time increases with intensity of stimulus. This suggests that highly impacted individuals have become sensitized to disturbance and that habituation does not occur as disturbance increases. This process has consequences for the health of giant clam species on the Great Barrier Reef. As functional autotrophs whose endosymbiotic zooxanthellae depend on light for photosynthesis, *T. maxima* and *T. crocea* may be negatively affected by longer emergence times and the resultant missed opportunities to acquire energy. Maintaining the health of these two giant clam species has serious implications for the overall health of the Great Barrier Reef, as Tridacnid clams are major contributors to bioerosion, and have been linked with higher abundance and diversity in local reef fish populations.

286 Ecological Engineering and Restoration of Six Mile Cypress Slough, JOHN M. MURRAY (Integrated Engineering Department, Southern Utah University, 351 West University Boulevard, Cedar City, Utah, 84720; murrayjm@suu.edu).

A study of the hydrology and ecology of Six Mile Cypress Slough, a subset of the Tidal Caloosahatchee River Basin, Fort Myers, Florida, was initiated and funded by Lee County, Florida, the South Florida Water Management District (SFWMD), and Florida Gulf Coast University in 2004. Six Mile Cypress Slough,

the heart of the Six Mile Cypress Watershed, a subset of the Western Everglades, is a 9-mile long, 0.5-mile wide cypress swamp encircled by development. The purpose of the study was to answer the question, “Has Six Mile Cypress Slough been ecologically impacted by regional hydrological changes?” Understanding the ecology and hydrology of the slough required that field investigations and 3D hydrological simulations of the slough be conducted. An integrated, regional simulation model based on field investigations was developed and calibrated for predicting hydrological behavior of the system. DHI Water and Environment’s MIKE SHE/MIKE 11 3-D hydrological simulation software was employed. Impact assessment was performed by connecting observed and simulated hydropatterns to plant communities along four constructed transects. Pine flatwood, wet prairie, cypress, and pond communities were considered since they interact in the slough in complex ways related to hydrologic conditions, fire regimes, and soils. The study indicated that Six Mile Cypress Slough Preserve was ecologically impacted. The average wet season water depth will not sustain cypress communities (*Taxodium* spp.) in the slough. As a result of this study, ecosystem restoration of Six Mile Cypress Slough was initiated by Lee County, and monitoring of the ongoing restoration effort is currently underway.

**AAASPD
EARTH SCIENCES SECTION
Monday, 10:40 a.m. in KIPJ 218**

287 Evidence for Large Scale Catastrophic Flooding in Eurasia, GEORGE R. DE NEEF (2106 Walnut Lane, Vista, CA 92084; Marcontech@cox.net).

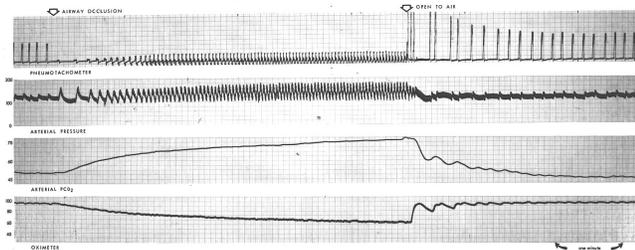
This paper presents pictorial evidence gleaned from Google Earth showing shorelines, topographical flow patterning, drumlins, tunnel valleys, flood scours, remnant dry falls and transverse bars covering millions of square kilometers in Central Asia, the Mediterranean region and Central Europe and presents a discussion of the flood. Corroborating evidence from scientific publications is presented, erosional landforms are used to show how this flood temporarily raised the level of the Mediterranean approximately 300 meters above its present level and evidence is presented linking this event to the onset of the Younger Dryas cooling period.

**AAASPD
HEALTH SCIENCES SECTION
Monday, starting at 10:00 a.m. in KIPJ 219**

288 Cheyne-Stokes Respiration Is Caused Primarily by Cycling of Hypoxic Drive, Not CO₂ Cycling, WARREN G. GUNTHEROTH (Department of Pediatrics, (356320), Division of Cardiology, University of Washington School of Medicine, Seattle, WA 98195; wgg@uw.edu).

Cheyne-Stokes respiration (C-SR) or periodic breathing was reported in 1909 by Douglas and Haldane after voluntary hyperventilation in normal volunteers. They concluded that this cycling reflected hypoxic drive. Fifty years later, Guyton, Milhorn and others used animal experiments to produce C-SR with long transit times, and computer modeling with “increased gain” of the respiratory controller based on CO₂. In 1975, we published on hypoxic apnea and gasping using continuous, intra-arterial recordings of

CO₂ and O₂ saturation in 21 anesthetized dogs, using fiberoptics for oxygen saturation and a flexible pCO₂ electrode. We found evidence for two separate domains of respiratory control, hypoxic and CO₂ drives. We also observed that C-SR occurred during recovery from hypoxic apnea. A reviewer asked that we remove the discussion of domains and C-SR. Recently, I reviewed C-SR in PubMed for mechanisms and found nearly all still invoked Guyton's factors. I then reviewed our 1975 records that confirmed that airway occlusion produced moderate hypoxia and marked hypercarbia. When the airway was reestablished (slide), a couple of strong inspirations sharply increased arterial O₂ that suppressed the hypoxic drive, causing apnea despite continued high CO₂. With the apnea, the CO₂ rose and the O₂ level fell; the latter re-initiated hypoxic drive, and three more C-SR cycles followed, ending when both O₂ and CO₂ reached normal levels. In conclusion, C-SR is a phenomenon of hypoxia with oscillating O₂ levels with intermittent suppression of hypoxic drive rather than CO₂ oscillations.



Inspiration was recorded with a solid-state transducer in the esophagus. Arterial pressure was via a catheter into the abdominal aorta. The pCO₂ and oxygen saturation were recorded from separate catheters advanced from the femoral arteries into the aorta. The occlusion time of the airway was 5.3 minutes. The oxygen saturation recovered sharply after only 10 seconds, the sharp rise in O₂ saturation suppressed the hypoxic drive and apnea occurred for 15 seconds, despite the CO₂ of 60. After only four apneas the O₂ saturation recovered to nearly normal but the CO₂ did not return to normal for 130 seconds reflecting a much larger pool requiring wash-out than the pulmonary blood volume. (The late CO₂ was lower than the pre-asphyxiation level presumably reflecting metabolic acidosis causing hyperventilation.

289 Eggsplottation in the Human Fertility Trade, KALA PERKINS (Bioethics Institute, 1 LMU Drive, Los Angeles, CA 90045; dperkin4@lion.lmu.edu).

Over and over again, young women are coming forward who share this ...pain. Desperate for money to pay the bills, they sacrifice their own health—physically, psychologically and spiritually—to supply eggs to the fertility industry. (Center for Bioethics and Culture)

We are at present engaged in a rapidly expanding fertility trade. Opening the advertisement section of the campus newspaper on most major universities, one may likely find five to ten solicitations for healthy, attractive, intelligent young women to undergo a series of drug treatments required for inducing an excess of egg generation from their ovaries, for harvesting by laboratories specializing in supplying human eggs to couples who are otherwise unable to reproduce, and for research. There has to-date been little research into long term health consequences of these drugs on female donors, nor is there mandatory national registry as yet for follow-up. Certain major hospitals are attempting to set standards, but private clinics do not necessarily adhere. Economic motivation runs from \$5000 up to \$30,000+, for the optimum subject. The UK is at the forefront of legislative guidelines, having originated the

IVF procedure. According to the literature, the US has not found comprehensive legislation required. Yet more and more cases are arising of ovarian loss, stroke, cancer, associated heart attacks and at worst, death of the subjects involved. What is called for is the use science that is grounded in moral responsibility.

**AAASPD
ENGINEERING, TECHNOLOGY
and APPLIED SCIENCES**

Monday, starting at 10:40 a.m. in KIPJ 219

290 Feedback Effects of Extracellular Matrix Composition on AMPK Signaling Pathway: Pathway to Novel Drug Therapeutics Targeting Atherosclerosis, PRASHANTHI VANDRANGI^{1*}, VICTOR G.J. RODGERS¹, and JOHN YJ SHYY² (Departments of ¹Bioengineering and ²Biomedical Sciences, University of California Riverside, A220 Bourns Hall, 900 University Avenue, Riverside, CA 92521; pvand002@ucr.edu).

Atheroma is initiated and progressed in the unhealthy and arteroprone region of the blood vessel. During the process, the collagenous subendothelium (in the command of signaling pathways) is converted to a fibrillar subendothelium. This process involves the deposition of fibronectin and fibrinogen which alters the release of NO and the compliance of the vessel wall.^[1] Appropriate ECM composition establishes the functioning of the endothelial signaling pathways in the vascular intima.^[2] In this work, we use immunocytochemical methods that employ the distinct variations in extracellular matrix to study the characteristic behavior of endothelial cells in atheroprotective and atherogenic stages. We hypothesize that owing to different ECM configuration, AMP modified protein kinase (AMPK) phosphorylation will vary with flow.

For each experiment, the sterilized flow circuit is maintained at 37°C, ventilated with 95% humidified air - 5% CO₂, and connected to the peristaltic pump. A parallel-plate flow channel is used to impose laminar flow at 12 dyne/cm² for stipulated time intervals on a confluent monolayer of endothelial cells (ECs). The contribution of extracellular matrix for atheroprone, atherogenic, and atherosclerotic stages of the vasculature and their effects on AMPK signaling pathway is explored through these in-vitro experiments.

Exploring the stress-related AMPK signaling pathway provides striking insights into the onset and progression of atherosclerosis. We identify a possible feedback response between NO production and ECM.

[1] Hahn C, Orr AW, Sanders JM, Jhaveri KA, and Schwartz MA. The Sub-endothelial Extracellular Matrix Modulates JNK Activation by Flow. *Circulation Research* 2009;104:995-U180.

[2] Shyy JYJ. Extracellular Matrix Differentiating Good Flow versus Bad Flow. *Circulation Research* 2009;104:931-932.

**AAASPD
COMPUTER and INFORMATION SCIENCES SECTION**
Monday, starting at 11:00 a.m. in KIPJ 219

291 Mapping User Search Queries to Product Categories, CAROLYN T. HAFERNIK (College of Information Science and Technology, The Pennsylvania State University, University Park, PA 16802; cth132@ist.psu.edu).

Gathering detailed information about user product interests is

becoming increasingly important for online advertisers. However, when gathering this information maintaining the privacy of online users is a concern. This research is part of a larger project aiming to provide privacy preserving advertising. Specifically this research aims to provide a method for mapping user search queries to actual product categories while limiting how much information on a user leaves a user's computer. Product information gathered from two large shopping websites and real user search queries from a log file are used to match user search queries with the most relevant categories. Several different algorithms for choosing the most relevant product category while storing all information on the user's computer are evaluated and compared to a baseline where search queries must be sent off of the user's computer. Our findings indicate that the most successful algorithms on the user's computer, which preserve privacy, can match the results of those where information is sent off the computer. Having specific fine-grained product categories would help advertisers, search engines and marketers by providing them with more information about the users. Better information on user product interests would help provide more relevant ads for users. If this information can be provided while still preserving the privacy of the users than users may be more willing to use services that provide personalized ads.

292 How Fast Does a Continued Fraction Converge? C.E. FALBO (Professor Emeritus, Sonoma State University, Rohnert Park, CA; current: P. O. Box 606, Joseph, OR 97846; clemfalbo@yahoo.com).

Let b be any positive number and let $u(b)$ be the positive root of the quadratic equation $x^2 - bx - 1 = 0$. We show how to compute the rate at which a periodic continued fraction converges to $u(b)$. It turns out that this rate depends only upon b and not upon whether the limit is rational or irrational. What makes this result useful is that every irrational number is either $u(b)$ or $-1/u(b)$ for some b . We will also discuss why we need the concept of the nearest rational approximation to support the claim that $b=1$ produces one of the slowest converging continued fractions.

AAASPD CHEMISTRY and BIOCHEMISTRY SECTION Tuesday, 8:30 a.m. in KIPJ Room I

293 Predictive Potential Unraveled with DockoMatic, REED B. JACOB* and OWEN M. McDOUGAL (Department of Chemistry and Biochemistry, 1910 University Dr, Boise State University, Boise, ID 83725; rbjacob@u.boisestate.edu).

DockoMatic is a graphical user interface (GUI) that was developed to allow the experimental scientist access to computational prediction. The user friendly DockoMatic interface provides a suite of capabilities originating from the subordinate software programs AutoDock, TreePack, Modeller, and X-Score. The focus of this work was the use of DockoMatic to create novel analogs of conotoxin peptides for binding prediction to homology models of the $\alpha 3\beta 2$ nicotinic acetylcholine receptor (nAChR). This was followed by output analysis and determination of ligands with the highest likelihood of binding affinity for the receptor. An overview of the capabilities of DockoMatic, the use of the program to create, bind, and evaluate ligand to receptor interactions, and the future directions for this project will be presented.

294 Collagen XI $\alpha 1$ Chain Amino Propeptide Structural Model and Glycosaminoglycan Interactions in Silico, CHRIS MALLORY (Department of Chemistry and Biochemistry, 1910 University Drive, Mail Stop 1520, Boise State University, Boise, ID 83725; chrismallory@u.boisestate.edu).

A crystal structure for the amino propeptide of type XI collagen $\alpha 1$ has yet to be determined. The computer program MODELLER was used to construct a homology model for this important protein based on the crystal structure template of the NC4 domain of type IX collagen (PDB: 2UUR). In addition, a structural model for a dimer of the Npp $\alpha 1$ was constructed in MODELLER using a thrombospondin dimer (PDB: 1Z78) and submission of two monomer subunits to ClusPro. Interactions between each model and heparan sulfate (disaccharide and decasaccharide) were examined using AutoDock4. Results support the increase in affinity of heparan sulfate for the dimer over the monomer, with estimated K_i s in the femtomolar range. Alanine replacement of basic amino acids in the heparin binding site provided insight into the importance of each basic residue in the binding of heparan sulfate. A decrease in affinity was observed with each subsequent Ala substitution; a finding that complemented experimental data.

295 Bridging the Experimental to Computational Divide, OWEN M. McDOUGAL (Department of Chemistry and Biochemistry, 1910 University Drive, Mail Stop 1520, Boise State University, Boise, ID 83725; owenmcdougald@boisestate.edu).

The increasing variety of freeware software, decreasing computer costs, and the availability to cluster, cloud, and parallel computing have provided scientific experimentalists the opportunity to harness the power of computational chemistry. This presentation will address the evolving use of computer software to enable undergraduate student researchers to obtain results that just ten years ago would have been limited to doctoral candidates. Specifically, an experimental investigation of pK_a determination in conotoxin amino acid side chains as determined by nuclear magnetic resonance spectroscopy, binding studies of these peptides to nicotinic acetylcholine receptors, and the computational prediction that complements the experiments will be addressed.

296 Biochemical Components Effecting Myocyte Membrane ATPase, DAVID BLACKMAN (retired, UC Berkeley, current address: 307 2nd St., Phoenix, OR, 97535; Gribear@Mac.com).

Of three components theory myocyte function will be presented to parts of this triad were presented in previous talks. The pieces converge on the sodium potassium ATPase system. The kinetic equation for the rate limiting step is quadratic way dependent upon the serum potassium. It is also linearly dependent upon ATP. ATP concentrations, mitochondrial cytoplasmic and the vicinity of the sodium potassium ATPase will be explored. Factor affecting the mitochondrial ATP synthesis is cross matrix pH gradient which is the source of the energy driving the production of ATP. Because sodium, potassium ATPase is linearly dependent upon ATP, and quadratically dependent upon extracellular potassium, ATP is a minor player in potassium gradient creation.

AAASPD**CELL and MOLECULAR BIOLOGY SECTION****Tuesday, starting at 9:20 a.m. in KIPJ Room I**

297 Biochemical and Biophysical Study of Functional Characteristics of Hemoglobin Components from Caspian Sea Sturgeons (*Acipenser persicus* and *Acipenser stellatus*) Blood, SHOHREH ARIAEENEJAD^{1*}, SHAHLA JAMILI^{1,2}, MEHRAN HABIBI-REZAEI³, MOHAMMAD REZA FATEMI¹, NAJMEH POUR-SASAN⁴, and ALIA MOOSAVI-MOVAHEDI⁴ (¹Marine Biology Department, Science and Research Branch, Iua, Pobox: 14515-775, Tehran, Iran; ²Iranian Fisheries Research Organization of Iran; ³School of Biology, College of Science, University Of Tehran, Tehran, Iran; ⁴Institute of Biochemistry and Biophysics, University Of Tehran, Tehran, Iran; Ariaee.sh@srbiau.ac.ir).

Hemoglobin (Hb) multiplicity enables fishes to adapt themselves with different ecological and environmental conditions. In the current study, the Hbs of two Iranian Sturgeon species have been investigated. After extraction of Hb from blood, the isoelectric focusing study has shown that both species have multiple Hbs with different isoelectric points and the dominant Hb can be identified from other Hb components. The dominant Hbs of these species has been purified using Ion-exchange chromatography on CM-cellulose column. Fluorescence spectrophotometry studies showed that the Hbs of these fishes have similar structural properties with each other and clear differences with human Hb. Comparing the heat capacity versus temperature of different Hbs profiles using differential scanning calorimetry (DSC) showed varying thermal unfolding characteristics. The percentage of alpha-helix and beta-sheet substructures has been obtained based on circular dichroism analysis (CD) investigation. UV-vis spectrophotometer was used to measure oxygen affinity using sodium dithionite. Oxygen affinity and structural properties of these Hbs were compared using Hb oxygen dissociation curves.

298 Loss of Bacterial MTN Activity Causes Polyamine Deficiency, KEN CORNELL (Department of Chemistry and Biochemistry, Boise State University, Boise, ID 83725-1520; kencornell@boisestate.edu).

5' Methylthioadenosine/S-adenosylhomocysteine nucleosidase (MTN) is a microbe specific enzyme important in purine and methionine salvage from byproducts of S-adenosylmethionine dependent reactions such as polyamine synthesis, biological methylation, autoinducer and vitamin synthesis. Interruption of MTN activity in *E. coli* leads to marked decreases in intracellular polyamine content and decreased growth rates that are largely reversible by polyamine supplementation. The altered polyamine synthesis is most likely the result of product inhibition of polyamine synthase reactions caused by the accumulation of 5' Methylthioadenosine (MTA). Proteomic analysis also reveals that decreased levels of polyamine synthases accompany MTN gene knock-out. Additional effects on a wide-range of metabolic pathways are found with MTN deficiency, underscoring a complex set of mechanisms of action that will be exerted by anti-MTN specific drugs, and suggesting routes of drug potentiation that could lead to potent combination therapies.

299 Exposure to TCDD (Dioxin) Increases Hepatic Stellate Cell Activation, WENDY A. HARVEY*, COLEY J. DOOLITTLE, JALISA J. ROBINSON, and KRISTEN A. MITCHELL (Department of Biological Sciences, Boise State University, Boise,

ID 83278-1515; wendyharvey@u.boisestate.edu).

2,3,7,8-Tetrachlorodibenzo-*p*-dioxin (TCDD) is an environmental pollutant in the family of halogenated aromatic hydrocarbons. Exposure to TCDD elicits a spectrum of toxic effects, many of which are rooted in aberrant cell proliferation, activation and differentiation. We have previously shown that exposure to TCDD suppresses hepatocyte proliferation in a mouse model of liver regeneration induced by 70% partial hepatectomy (PH). In the present study, we tested the hypothesis that TCDD alters the activation of hepatic stellate cells (HSCs), which regulate regeneration through the production of soluble mediators. Mice were treated with TCDD (20 µg/kg) or peanut oil 24 hr prior to PH, and plasma and liver tissue were collected after surgery. Exposure to TCDD increased expression of the HSC activation marker alpha-smooth muscle actin and increased levels of monocyte chemoattractant protein (MCP)-1, a chemokine abundantly produced by HSCs. Likewise, in vitro studies using a human hepatic stellate cell line revealed that TCDD treatment increased proliferation and MCP-1 production and impaired the ability of these cells to store retinoids. Hence, inappropriate HSC activation may contribute to impaired liver regeneration in TCDD-treated mice through excessive production of soluble mediators, leading to enhanced inflammation or suppressed hepatocyte proliferation.

300 Expression of Multipotency Markers in Adult Adipocyte-Derived Stem Cells as a Function of Time, LAURINE J. SHAHMIRIAN^{1*} and KRISTINA I. BOSTROM² (¹Chaminade College Preparatory High School, 7500 Chaminade Ave, West Hills, CA 91304; ²David Geffen School of Medicine, University of California, Los Angeles 10945 Le Conte Avenue, Suite 3132 Los Angeles, CA 90095; laurine.shahmirian@yahoo.com).

White mature adipocytes have been shown to lose their fat in culture and de-differentiate into de-differentiated (DFAT) cells. Immediately after the loss of lipids, DFAT cells express several stem cell markers as a sign of multipotency. However, it is not known for how many cell passages the cells express stem cell markers, information that is essential in defining how long the cells can be used as a source of multipotent cells. To test the longevity of DFAT cell expression of stem markers, mouse DFAT cells were cultured for up to 10 passages. Cellular RNA was extracted after each passage, and cells were fixed and prepared for immunostaining or fluorescence-activated cell sorting (FACS). Expression was determined by real-time PCR.

Real-time PCR showed that expression of Oct3/4, Nanog and SOX2, pluripotency markers, gradually decreased to near undetectable levels over 10 passages. After ~2 passages, <25% of the original level of expression was observed. Immunofluorescence confirmed expression of Oct3/4 and Nanog in early passages, and also showed cells positive for SSEA-3, another pluripotency marker, and c-kit, a mesenchymal stem cell marker. FACS revealed that SSEA-3 expression gradually decreased to undetectable levels after ~5 passages, whereas Sca1 only decreased to ~65% of the original level. Thus, it can be concluded that mouse DFAT cells maintain expression of stem cell markers at a level >25% of baseline (passage 0) for at least 2 additional passages. Optimally, DFAT cells should be used for regenerative purposes no later than two passages after the isolation of adipocytes.

301 Oncostatin M: Potential Target for Inhibiting Breast Cancer Metastasis to Bone, CELESTE BOLIN, KEN TAWARA, and

CHERYL L. JORCYK* (Department of Biological Sciences, Boise State University, 1910 University Drive, Boise, ID 83725; cjorcyk@boisestate.edu).

Oncostatin M (OSM) is an interleukin-6 (IL-6)-family cytokine that has been implicated in a number of biological processes including the induction of inflammation and modulation of the extracellular matrix. OSM was initially shown to inhibit the proliferation of breast cancer cell lines *in vitro* and has been evaluated as a potential cancer therapy. However, evidence in the literature and our data suggest that OSM may actually promote tumor invasion and metastasis. Using the orthotopic 4T1.2 mouse mammary model of metastasis, we have investigated the ability of OSM to enhance the formation of metastases in organs such as lung and bone *in vivo*. OSM expression was knocked down using shRNA in 4T1.2 cells, which endogenously express both OSM and its receptor. These 4T1.2-OSM cells were orthotopically injected into Balb/c mice and resulted in a decrease in metastasis to bone and lung compared to that of 4T1.2-Lac Z control cells. Metastases were quantified using qPCR to detect the vector neomycin resistance gene in post-mortem organ samples. We are currently investigating the specific cellular mechanisms that might be important for tumor cell-derived OSM promotion of metastasis to bone, such as hypoxia-inducible factor 1 alpha (HIF1 α) and vascular endothelial growth factor (VEGF). Our results suggest that OSM might be an important therapeutic target in the prevention of metastatic breast cancer invasion of bone. Funded by ACS RSG-09-276-01-CSM, Susan G Komen for the Cure KG100513, and NIH/NCRR P20RR016454.

302 *MicroRNA Signatures in Small Molecule Induced Cardiac and Neural Lineage-Specification Direct from Pluripotent Human Embryonic Stem Cells*, **XUEJUN H. PARSONS** (San Diego Regenerative Medicine Institute, San Diego, CA 92121 and Xcelthera, San Diego, CA 92121; parsons@SDRMI.org).

Human embryonic stem cells (hESCs) are genetically stable with unlimited expansion ability and unrestricted plasticity, proffering a pluripotent reservoir for *in vitro* derivation of a large supply of disease-targeted human somatic cells that are restricted to the lineage in need of repair. One of the major challenges for both developmental studies and clinical translation has been how to channel the broad differentiation potential of pluripotent cells to a desired phenotype efficiently and predictably. Conventional approaches rely on multi-lineage inclination of pluripotent cells through spontaneous germ layer differentiation, resulting in inefficient and uncontrollable lineage-commitment that is often followed by phenotypic heterogeneity and instability, hence, a high risk of tumorigenicity. To overcome these obstacles, we resolved the elements of a defined culture system necessary and sufficient for sustaining the epiblast pluripotence of hESCs, serving as a platform for *de novo* derivation of therapeutically-suitable hESCs and effectively directing such hESCs uniformly towards clinically-relevant lineages. Employing the defined platform, we found that nicotinamide (NAM) and retinoic acid (RA) induced respective cardiac- and neural-lineage commitment direct from pluripotent hESCs that further progressed to beating cardiomyocytes and ventral neurons with drastic increases in efficiency. To uncover key regulators, genome-scale microRNA (miRNA) profiling was used to identify novel sets of development-initiating miRNAs. A unique set of pluripotence-associated miRNAs was down-regulated, while novel sets of distinct cardiac- and neural-driving miRNAs were up-regulated upon lineage induction. Our study opens new dimensions of direct control and modulation

of hESC fate when deriving clinically-relevant lineages from pluripotent cells for regenerative therapies.

**AAASPD
HISTORY and PHILOSOPHY OF SCIENCE SECTION
Tuesday, starting at 8:20 a.m. in KIPJ Room G**

303 *The First Pacific Conchologist: Eusebio Kino SJ, Abalones and California's Insularity*, **HANS BERTSCH** (Universidad Autónoma de Baja California Sur, 192 Imperial Beach Blvd. #A, Imperial Beach, CA 91932; hansmarvida@sbcglobal.net).

Studies on molluscan biogeography are dependent upon good mapping and correct identification of localities. Prior to the works of Linnaeus, Martyn and Eschscholtz, Father Eusebio Francisco Kino made the first collection of American west coast shells. Interestingly, this missionary's proper documentation of a mollusc's distribution changed the maps.

Kino recognized that blue shells given him by the indigenous peoples of modern Arizona and northwest Sonora were the same as he had seen 14 years earlier on the Pacific coast of Lower California, but were not present in the Gulf of California. In the 1600s the commonly held (and mapped) European belief was that California was an island. Could their presence by trade on mainland Mexico indicate that California was really a peninsula? If so, he could supply the California missions by an overland route.

He convened the First International Conference on the Zoogeography of Northeast Pacific Abalones at San Xavier del Bac ($\approx 32^{\circ} 06' 20''$ N; $111^{\circ} 00' 30''$ W) on 30 April–1 May 1700, discussing with members of various nations the origin of the blue shells obtained in trade from the Colorado River peoples. All asserted the shells came from the opposite coast of California, a ten or twelve days' walk. After further expeditions, and crossing the Colorado River on a raft, he was convinced of the peninsularity of Lower California.

In late 1701, he redrew his earlier "insular" map. After it was printed in 1705, it was never again in doubt that Lower California was a peninsula.

304 *Tracing the Birth of New Science in the Literature of the 17th and 18th Centuries*, **FAYE MANKOWSKE** (Department of English, University of San Diego, Founders Hall 173, 5998 Alcalá Park, San Diego, CA 92110; fayem@sandiego.edu).

The seventeenth century saw the birth of the Royal Society of London, the activities of which were to prompt a fundamental shift in the study of Natural Philosophy, towards a paradigm initially known as "New Science." Paradigm shifts are generally accompanied by uncertainty, experimentation, failures and intellectual controversy, and the movement towards New Science was rife with these elements. The epistemological shift occurring during the Renaissance contributed added controversy to the movement towards modern science.

This paper is concerned with investigations of the evolution of Natural Philosophy into the New Science in the context of the seventeenth century, and specifically in tracing manifestations of this evolutionary shift in the literature of the seventeenth and eighteenth centuries. The ability of literature to provide a view into both the historical realities and intellectual controversies surrounding the development of New Science allows a richer knowledge of this fundamental movement, and of the philosophical, ethical and pragmatic questions that accompanied its evolution.

305 Darwinian Evolution and Jack London: Dualistic Representations of Evolution and Social Darwinism in the Character of Buck, **BERNADETTE E. SMITH** (University of San Diego, 5998 Alcalá Park Unit # 8335, San Diego, CA 92110; besmith@sandiego.edu).

Jack London's two greatest influences were Charles Darwin and Herbert Spencer, and their theories appear in varied forms throughout London's writings. *The Call of the Wild* in particular follows the character Buck, and through Buck London ruminates upon the applications of evolution and social Darwinism in the natural world. London wrote *The Call* during a time when science and literature were being recognized as divergent fields, yet London himself preserved the connected nature of the two fields through his liberal education and his writings. *The Call of the Wild* is a timeless narrative that reflects the interconnectedness of man to the natural world. As the novel's hero, Buck is a character that can be appreciated by people from all walks of life, because he embodies scientific and emotional truths that are inherent to life in the natural world. The presentation will explore the ways in which Buck, and his fellow canines navigate social hierarchy in the Yukon territory's "law of club and fang," as well as the inherent tension between self-preservation and the necessary cooperation to maintain survival in a harsh environment. By the end of London's novel, Buck hears "the call" and allows his natural instincts to reign supreme in a land of vast wilderness. Examining London's two greatest literary influences allows for a more thorough and multi-faceted appreciation of turn-of-the-century literature and science.

306 Public Mathematics and Discrete Policy: Federal Administrations and Mathematics Education Reform in the 20th Century United States, **EMILY T.H. REDMAN** (Department of History, University of California at Berkeley, 3229 Dwinelle Hall, Berkeley, CA 94720-2550; ethredman@berkeley.edu).

Mathematics education reform continues to be a hot-button issue in the United States, yet historical analysis on this subject is fragmented. The literature traditionally conflates it with efforts in science education, yet upon closer investigation it is clear that mathematics education reform capitalized on the post-Sputnik explosion of interest and available funds in *parallel* to those in science, and therefore must be understood as a wholly separate policy issue. During the 20th century, a multitude of actions shaped education reform efforts, complicated by changing federal administrations, competing agency, and unsettled questions of democratic ideals of a nation. This paper aims to outline the role of the federal government in mathematics education reform efforts throughout the second half of the 20th century as a function of changing administrative policy.

Policy decisions in the U.S. that were made in the wake of a "victory of math and science" in WWII directly entered the classroom in the mid- to late-twentieth century, at the same time dramatically shifting the role of the federal government in guiding and effecting this reform. This shift was not a result of a contiguous series of implemented changes, however, but must be understood in terms of discrete eras of administrative control. By breaking down federal involvement in mathematics education into policy decisions made under particular administrations, I question the traditional narrative of education reform in American history and replace it with a more appropriately complex picture with which we can better address modern-day issues in mathematics education reform.

307 A Measurably Sanitary Landscape: Malaria and Flooded Rice Agriculture in California's Great Central Valley, **BARBARA**

YABLON MAIDA (Department of Geography, 1255 Bunche Hall, University of California, Los Angeles, CA 90095; bymaida@ucla.edu).

To understand malaria in California's Great Central Valley requires a complex vector/host/agent relationship model, the so-called "malaria knot." The historical ecology of malaria in the Great Central Valley addresses seasonal flooded landscapes on the one hand, and purposeful irrigation on the other; however, a vector ecology perspective throws light on the complexity of Central Valley malaria, and its interconnection with flooded rice agriculture. With von Humboldt as exemplar, Thomas Logan, first California State Board of Health secretary, emphasized environment as a way of understanding disease patterns, and hypothesized a specific malarial environment that did not rely on miasma as an explanation. In spite of this, tangible, recoverable data for California's malaria deaths proved elusive to professional malariologists. Even after 1897, when the anopheline mosquito was isolated as vector, the premise tended toward how to treat the insalubrious environment rather than the individual. Was a malaria diagnosis, for whatever reason, merely a casualty of its own complexity? Would the precision of improved techniques determine the cause of death, or were there simply too many or too few possible diagnoses during a given time period? Medical topography remains a valid approach to these questions. If the malaria theory did anything for disease etiology, it was to grant a better understanding of ultimate and proximate cause. These causes became both more clear and more elusive in the twentieth century, when the Sacramento Valley gambled on a crop found unexpectedly suited to soil and climate, one having the potential to exacerbate malaria's host-vector-agent paradigm.

308 Millennial Biology: The National Science Foundation and the Life Sciences, 1975-2005, **DONALD J. MCGRAW** ("Dr. Donald J. McGraw, Independent Scholar/Contractor," P.O. Box 515, Ephraim, UT 84627; donaldmcgraw@mac.com).

At recent meetings of the AAAS/Pacific Division, Dr. McGraw has presented several talks in a series of interim reports on the status of his book being written under contract to the National Science Foundation. In his earlier reports, the author described the contract and the research period efforts, three trips of six weeks each, to the NSF headquarters in Alexandria, VA, to the National Archives, etc., and discussion of completed draft Chapters 1-3. For the present interim report, Dr. McGraw will describe work accomplished on the sections of the book (Chapters 4-9), which bring the book to 1991-2005 for the modern period. The chapters from those purely introductory (1-3) include: 4 and 5, social sciences and behavioral sciences, respectively; 6 and 7, the micro and the macro ends of biology from 1975-1990, respectively; Chapter 8, the Great Reorganization of 1990-1991 in which BIO splits from the social/behavioral sciences; and, finally, Chapter 9, the first modern BIO chapter of a set of four (final four in the book) that deals with the Division of Biological Infrastructure and Resources (DBI). Work on the remainder of the book will be purely in the history of biological sciences at NSF from 1991-2005 and will examine the three content divisions of BIO: MCB, IBN, and DEB and will occupy the remainder of 2011, with completion of the book by 2012 when the contract concludes.

309 On Science: Natural Philosophy Its Basis, Analogy Its Advance, **DANIELLE MIHRAM¹* and G. ARTHUR MIHRAM²** (¹Department of French and Italian, University of Southern California, 650 W. 35th St., Los Angeles, CA 90089; ²P.O. Box No.

1188, Princeton, NJ 08542-1188; dmihram@usc.edu).

How has any scientist advanced human knowledge historically? This paper, compiled as an annotated bibliography, concludes: By analogy. (A) Via science as natural philosophy: see the 1971 paper [INT'L J GEN SYSTEMS 1: 41-60 and 281] on human knowledge: role of models, metaphors, and analogy, revealing indeed: (B) analogy's fundamental role, a finding confirmed in natural philosopher Konrad Lorenz's Nobel Acceptance Address, 1973.

First: Science is that human activity devoted to the search for the very explanation for (i.e., for the truth about) any particular naturally occurring phenomenon. In *The Origins of Modern Science*, H. Butterfield concludes that modern science was—and is to be—natural philosophy founded on observation—and advanced by—mental reflexion thereon (his p. 90, First Collier Edition, 1962): See Roger Cotes's preface in Newton's *Mathematical Principles of Natural Philosophy* (2nd ed), ca. 1713.

Second: Any advancement of (or innovation into) accumulating human knowledge is the result of an analogy-based reflexion. On analogy indeed: See also Lorenz's confirmatory acknowledgement in the Preface to *An Epistle to Dr. Benjamin Franklin*, Exposition-University Press, NY, 1975(1974).

We note two contemporary shortcomings: 1. Statisticians' regression theory selects the/a mathematical model before any scientific observation, much less mental reflexion, has been made; 2. The Scientific Method [JGS, *ibid*] is not a mimicry of the mathematician's theorem-proving process (à la Euclid, e.g.), since a mathematician's innovation (though it surely be founded on an analogy with previous mathematical knowledge) need not be at all the result from any observation(s) of a naturally occurring phenomenon.

**AAASPD
GENERAL and INTERDISCIPLINARY STUDIES SECTION
Tuesday, starting at 11:00 a.m. in KIPJ Room G**

310 Pleistocene Ecology and the Rise of Civilization, JEFFREY GRITZNER (Department of Geography, The University of Montana, 32 Campus Drive, Missoula, MT 59812-5040; jeffrey.gritzner@umontana.edu).

Several lines of enquiry converge to suggest the existence of relatively complex societies during the Late Pleistocene. It would appear that glacial advance and topographic barriers constricted and channeled migration in Eurasia, and that the intensification of interaction led to the so-called Broad Spectrum Revolution (BSR) of the Palaeolithic. The BSR, significant environmental change, and social response resulted in widespread plant and animal domestication at the Pleistocene-Holocene transition, and evidently precipitated other areas of social innovation as well. Recent research, including the reported discovery of a city at a depth of thirty-six meters in India's Gulf of Khambhat, encourages a re-evaluation of settlement history. It has been proposed that the city, dated at 9500 B.P., is the Dwarka of the Mahabharata that was consumed by the Arabian Sea. Similar reports, particularly in areas affected by glacial eustatism, encourage further investigation. The possible existence of relatively complex Late Pleistocene societies, coupled with the effective transmission of information through guild-like structures in antiquity, further suggests that certain classes of specialized knowledge, such as those associated with systems of religion, medicine, and architecture emerged in the more distant past.

311 Across the Divide: An Expedition into the American West, JOHN M. MURRAY^{1*}, WENDY V. MURRAY², and JOSEPH KAKAREKA³ (¹Integrated Engineering Department, Southern Utah University, 351 West University Boulevard, Cedar City, UT 84720; ²Biology Department, Southern Utah University, 351 West University Boulevard, Cedar City, UT 84720; ³College of Arts and Sciences, Florida Gulf Coast University, 10501 FGCU Blvd. South, Fort Myers, FL 33965; murrayjm@suu.edu).

The Lakota proverb, "A people without history is like the wind on the buffalo grass...The wind blows and the grass bends," suggests that the events of "Across the Divide: An Expedition into the American West" be recorded. Inspired by having lived and travelled in the American West, a group of Florida Gulf Coast University faculty decided FGCU students could benefit from experiencing that magnificent region and assembling what they learned into an integrated whole. In Hamlet's words, "There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy." We hypothesized that exploration in the tradition of Polo, von Humboldt, Lewis and Clark, Darwin, Mead, and Armstrong was possible in the 21st century. Science, history, culture, politics, economics, art, media, and literature set the stage upon which this 6-week, 6000-mile adventure would unfold. Experiencing wildness, solitude, and diverse perspectives would expand the student's circle of understanding and action. Envisioning fundamental limits, future possibilities, dichotomies, divides, shades of gray, and long-term vs. short-term thinking would exercise their intellectual, emotional, and spiritual faculties. Over the course of the expedition, we hoped students would develop a sense of place, camaraderie, and self-knowledge; exhibit courage, fortitude, generosity, and wisdom; and most importantly, survive. A systems or holistic view of the West became the focus of the expedition, a vision that could provide a framework for future leadership. This paper chronicles ten of forty field experiences during this transdisciplinary Western odyssey, summarizes what was learned, and suggests strategies for future explorations.

312 Science and Law: A Meeting of the Minds, DEBORAH M. HUSSEY FREELAND (University of San Francisco School of Law, 2130 Fulton Street, San Francisco, CA 94117; dhusseyfreeland@usfca.edu).

Terminological overlaps between science and law can be confounding. These disciplines share many terms, but pivotal terms point in different directions in their respective disciplines. Crucial terms that relate to truth and professional judgment in both law and science, such as "fact," "uncertainty," and "proof," are superficially identical but actually homonymous. Their latent ambiguity poses a high risk that they erroneously will be regarded as identical. When scientists and lawyers are unaware of the epistemological need for interdisciplinary translation, their cooperation is unnecessarily troubled.

For instance, in a legal context the phrase "scientific fact" may sound as though it indicates a conclusively determined bit of reality, while if "fact" is used in science it functions more as a placeholder indicating our best knowledge at the moment. To bring information from science—in which it is subject to revision as our understanding deepens—into law, is to turn it into something more definite and persistent: to transform shades of grey into either black or white. If unmarked, this redefinition can be profoundly misleading, as a context-sensitive scientific account is silently rendered into a fixed basis for legal judgment.

Lawyers' duties include avoiding misrepresentation before the court. A lawyer who draws from science without building a translational bridge over the law-science epistemic gap risks misrepresenting facts and uncertainties. It follows that lawyers are duty-bound to work with scientists to translate facts and uncertainties from science to law, to create a legal account that preserves their significance so that courts may fairly rely on them.

**AAASPD
PSYCHOLOGY SECTION**

Tuesday, starting at 1:40 p.m. in KIPJ Room 214

313 *Heterogeneity and Transgroupness of Individual Cognitive Types*, **MAGOROH MARUYAMA** (Interactive Heterogenetics, 3833 Nobel Drive, Suite 3333, San Diego, CA 92122; kuniko_maruyama@sbcglobal.net).

This paper discusses two interrelated topics: (A) heterogeneity of individual cognitive types and (B) transgroupness of individual types. (A) Beneath the surface of culturally ritualized and socially conditioned behavior, there is heterogeneity of individual perceptual/cognitive/cogitative/design types (Maruyama 1980, 1081, 2003), abbreviated as “mindscape types.” Though there can be as many mindscape types as there are individuals, the following four types and their combinations correspond to approximately two-thirds of individuals in most cultures: Type H: homogenist, hierarchical, classifying, sequential, one truth, zero-sum; Type I: heterogenist, unifying, randomizing, surprises, temporary, laissez-faire, negative-sum; Type S: heterogenist, interactive, inbreeding, simultaneous, stability, positive-sum; Type G: heterogenist, interactive, outbreeding, simultaneous evolution, cogenerative, poly-ocular¹, positive-sum. (B) Individual cognitive types cut across boundaries between cultural, social, geographic, gender and other commonly used stereotyping categories.

¹Binocular vision works, not because the two images are additive, but because the differences between the two images enable the brain to compute invisible dimensions (for example, depth).

**AAASPD
SOCIAL, ECONOMIC and POLITICAL SCIENCES**

Tuesday, 2:00 p.m. in KIPJ 214

314 *Cartooning the Issues: Popular Understanding of Economic Policies, 1865-1919*, **MARK ALDRICH** (Department of Economics, Smith College, Northampton MA 01063 MAldrich@Smith.edu).

Popular understanding of economic events is central to the proper workings of a democracy. Editorial cartoonists both reflected and shaped public understanding of economic issues from the Civil War to World War I. Employing images from a range of newspapers and magazines, this paper shows how contemporaries understood the tariff, the railroads, the rise of big business, monetary and other economic issues. Cartoons also chronicle the deep divisions over these subjects, some of which remain with us to this day. Collectively these images help explain how popular understanding and misunderstanding of events shaped political and economic policies in the 19th and early 20th centuries.

315 *Ethiopia's Planned Gibe III Hydrodam: Dismantling Pastoral Survival Systems, Armed Conflict and Political Destabilization in the Kenya-Ethiopia-Sudan Border Region*, **CLAUDIA J. CARR** (Associate Professor, Department of Environmental Science, Policy and Management, University of California Berkeley, Berkeley, CA 94720; claudiacarr@berkeley.edu).

Efforts by indigenous pastoral societies in the Sudan-Ethiopia-Kenya transborder region to adapt to large territorial expropriation by powerful external political and socioeconomic forces during the past half century have focused on diversification of their economic systems. Faced with intensifying geographic confinement and unavoidable overgrazing of lands they have inhabited for centuries, these pastoral groups have increasingly turned to alternative survival strategies - namely, recession (flood) cultivation in small areas along the Omo River and in the extensive Omo River delta of Ethiopia and Kenya, along with fishing in the Omo River and throughout Kenya's Lake Turkana -the highly saline Rift Valley lake that forms the terminus of the Omo River. Already partially constructed but not yet fully funded, The Gibe III hydrodam, planned by international development agencies and the Ethiopian government as the world's second tallest dam and largely for export of power to surrounding nations, would radically reduce the Omo River's flow and the waters of Lake Turkana, thus destroying all recession cultivation, fishing, “last resort” grazing and other subsistence activities within the region. The result would be the full-scale collapse of indigenous economies throughout the transborder area. This economic collapse would cause massive scale starvation among the region's 500,000 traditional indigenous peoples, escalation of sporadic and localized conflicts to full-scale regional armed conflict, government repression (particularly in Ethiopia) and transborder political destabilization, particularly in the face of intensifying arms trafficking and conflict within southern Sudan.

316 *Neoclassical Theory of the Fully Temporal System Yielding Completed Input/Output Substitution*, **THOMAS E. CHAMBERLAIN** (Independent Researcher, 2107 Moray Avenue, Los Angeles, CA 90732; tomchamb@ix.netcom.com).

In his pivotal contributions during the Marginal Revolution, Walras along with W.S. Jevons assigned subjective utility directly to market goods as, in effect, a simplifying assumption—an assumption destined to become the *keystone* of neoclassical economics. But this “keystone” assumption caused a disregard of *variable duration-for-consumption* because of the possibility of consumption-utility double-counting. In the present contribution, we provide a complete formulation of the essential durations (production, consumption, and leisure) within the intratemporal (e.g., single-day) interval, and then extend this single-day formulation to the intertemporal interval for assumed periodic equilibrium accounting for labor-capital function and utility discounting. A basic concept in this regard is a new constraint on the commodity-based utility function—a constraint which relates the consumed amount of a market-good to its corresponding (variable) duration-for-consumption. As an application, a (neoclassical) intertemporal relationship between labor-capital marginal productivities and investment risk is derived. Two additional applications conclude the paper: (1) Walras's input/output substitution relations are completed using the present neoclassical intratemporal system; and (2) Forward substitution relations are formulated using the newly-derived intertemporal system. As part of (2), the natural interest rate is shown equal to the individual's discount rate for the economic system in equilibrium.

Because the fully temporal system provided herein unites the Gossenian (1854) and neoclassical mathematical systems, the Austrian tradition (after Menger) and neoclassical tradition (after Jevons and Walras), which have been on separate paths since the Marginal Revolution of the 1870s, are closer to conciliation.

317 *The Science of Laws: Data Base of Cause and Effect Reports*, **DAVID G. SCHRUNK^{1*}** and **GARY B. SANER²** (¹Quality of Laws Institute, 14341 Horizon Court, Poway, CA 92064; ²Primero Systems, 14123 Rasmussen Way, San Diego, CA 92129; docs-cilaw@aol.com).

Each field of science is characterized by its own accumulated body of specialized knowledge. The exception to this rule is the science of laws (i.e., laws of government). Scientific investigations of the cause and effect mechanisms of individual laws have been reported in peer-reviewed sociologic, economic, and medical, etc., scientific journals for more than a century. However, these studies of laws have not been organized into a single comprehensive repository of knowledge. This paper presents the methods, materials, and results of the effort to create a data base of the scientific reports of the cause and effect mechanisms of laws. The advantages of having a separate body of knowledge of the science of laws and the need to upgrade and expand the scope of the data base are also discussed.

318 *Multidisciplinary Engineering Approach to the Design of Laws*, **DAVID G. SCHRUNK** (Quality of Laws Institute, 14341 Horizon Court, Poway, CA 92064, docs-cilaw@aol.com).

The traditional method of lawmaking is based upon testimony, debate, and compromise. This process is incapable of evaluating the interconnectedness of more than two or three variables in the design of a law of government and is thus unable to create laws that consistently and effectively solve societal problems. To improve the lawmaking process, a multidisciplinary engineering approach to the creation of laws is proposed.

Advances in modeling, simulation, and computer technologies now enable design teams to create and evaluate models of systems that have thousands of variables. For the solution of a complex societal problem, it is proposed that a multi-disciplinary team (consisting of participants from the fields of engineering, law, economics, sociology, political science, psychology, and statistics, etc.) create a model of a law to solve the problem. With the use of high speed computer facilities, the model would then be simulated and parameters adjusted to create a law that optimally solves the problem. This approach to lawmaking takes advantage of recent advances in engineering design technologies and has the potential of making significant improvements in the ability of governments to satisfy their public benefit objectives by means of laws.

**AAASPD
ENGINEERING, TECHNOLOGY and
APPLIED SCIENCES SECTION
Tuesday, starting at 3:40 p.m. in KIPJ 214**

319 *Prospective versus Retrospective View of Engineering Design Testing the Engineering Design Process Through Litigation*, **MICHAEL S. MORSE** (Department of Electrical Engineering, University of San Diego, 215 Loma Hall, 5998 Alcalá Park, San Diego, CA 92110).

As taught and as practiced, engineering design is a multi-step forward looking, iterative process. Engineers are taught to identify the problem to be solved, flesh out perspective solutions, identify the best solution, develop the solution, analyze/test the solution and then to iteratively return to earlier steps to improve the design. Ultimately, if all is done right, the final design should be the best design possible given all practical constraints and realities. Unfortunately, even with the very best engineering design, there will be failures. If the product of engineering design is successful, failure and even injury are both inevitable and foreseeable. As a result, it is predictable that engineering design will be tested in hindsight through the litigation process. Although many perceive litigation as an evil that renders design more costly, it is simply part of the process and part of what drives quality in engineering. Engineers need to consider how to design with the real specter of litigation looming large if they are successful in the design. Engineers need to consider how to incorporate preparations for retrospective deconstruction of their design into the design process. This presentation will consider how product litigation is to a large extent simply one additional step in the engineering design process.

**World Congress on Mummy Studies
CONTRIBUTED PAPERS: SESSION III
Thursday, starting at 11:30 a.m. in KIPJ Rooms A and B**

320 *Development of a Nubian Pathological Ontology*, **RYAN METCALFE** (KNH Centre for Biomedical Egyptology, University of Manchester, 3.614 Stopford Building, Oxford Road, Manchester, M13 9PL; ryan.metcalfe@manchester.ac.uk).

The scientific study of ancient remains has moved increasingly away from isolated case studies towards large scale population analysis. This is especially the case in areas such as the Sudan, where large scale rescue archaeology has been conducted in the past, and is currently underway to excavate sites ahead of dam building. Such work produces great quantities of material for analysis, often by several institutions in several countries.

Many other fields that produce large quantities of information for analysis have adopted specific terminologies (i.e. ontologies) to describe their data. This greatly increases the ease with which samples can be annotated and therefore retrieved for future analysis and comparison. Such tools have significant potential for use in large scale archaeology, as a consistent terminology improves data retrieval by allowing more rapid data mining of published works and catalogues. There is also the advantage of speeding up the description of artefacts once excavated. Using an appropriate ontology can therefore help both excavators and researchers to handle the sudden influx of data presented by rescue archaeology.

The initial outline of our ontology, and the problems raised when designing a terminology for use on samples collected over more than a century, will be presented in the hope of stimulating debate into the use of such tools in archaeological science. Although the focus of the ontology to be described is pathological, the underlying theory may be applied to other areas of interest, such as tomb architecture, pottery or other artefacts.

321 *Rethinking Burial Dates at a Graeco-Roman Cemetery (Fag el Gamous, Fayoum, Egypt)*, **DAVID M. WHITCHURCH^{1*}** and **R. PAUL EVANS²** (¹Department of Ancient Scripture, ²Department of Microbiology and Molecular Biology, Brigham Young University,

Provo, UT 84602; dwhitchurch@byu.edu).

Since 1981, Brigham Young University under the direction of Dr. C. Wilfred Griggs, has been excavating in the Fag el Gamous cemetery located at the western edge of the Fayoum. The authors of this paper have been excavating for the past decade. We express gratitude to the Supreme Council of Antiquities for permission to continue this work.

The Fayoum functioned for centuries as a cultural and religious melting pot where Greek and Roman colonizers integrated with native Egyptian populations. Burial shafts in the Fag el Gamous cemetery are oriented on an east-west axis with slight seasonal variations due to solar alignment. Older burials generally occur at a depth between one to two and a half meters with a head toward the east orientation. Reversal or head-west burials consistently are found above head-east burials. It has been argued that the directional shift of these burials occurred as early as late first to early second century CE, and may be attributable to Christian influences.

While methods in dating pottery are well accepted and can be quite reliable in many archaeological sites, contamination due to soil disturbances from later burials and sandy soil conditions preclude balks with well-defined demarcation of substratum and add significant problems of dating bias. This presentation reports on the historical context of the Fayoum during the Graeco-Roman period. Tissue samples of burials were subjected to AMS radiocarbon dating. The directional shift of burials occurs in the late third to fourth century CE, challenging the previous dating schema for this cemetery.

322 *The Alleged Bog Body or the Identification of a South American Mummy via Multi-element Isotope Analyses*, **SANDRA LOESCH¹, CHRISTINE LEHN², ULRICH STRUCK³, PETER HORN⁴, STEFAN HÖLZL⁴, OLIVER PESCHEL², ANDREAS NERLICH⁵, and BRIGITTE HAAS-GEBHARD⁶** (¹Department of Physical Anthropology, Institute of Forensic Medicine, Bern University, Fabrikstr. 29d, CH-3012 Bern, Switzerland; ²Institute of Legal Medicine, University of Munich, Nussbaumstr. 26, 80336 Munich, Germany; ³Humboldt University of Berlin, Museum für Naturkunde, Invalidenstr. 43, 10115 Berlin, Germany; ⁴Bavarian State Collection of Palaeontology and Geology, Richard-Wagner-Str. 10, 80333 Munich, Germany; ⁵Institute of Pathology, Municipal Clinic Bogenhausen, Engelschalkingerstr. 77, 81925 Munich, Germany; ⁶Bavarian State Archaeological Collection and Museum, Lerchenfeldstr. 2, 80538 Munich, Germany; sandra.loesch@irm.unibe.ch).

For several decades a female corpse was exhibited in the Bavarian State Archaeological Collection in Munich. Due to its external appearance it was assumed to be a bog body from a South German peat area northwest of Munich. Radiocarbon dating indicated an age of approximately 500 years BP. To identify its origin we performed stable isotope analyses of hair and tooth samples. The analysis of stable hydrogen-, carbon-, nitrogen- and sulphur-isotopes of a 10cm long hair strand of the mummy gave evidence that it actually originated from South America, most likely from the South Pacific coastal area. $\delta^{13}C$ and $\delta^{15}N$ data indicate almost exclusive marine nutrition ten to three months ante mortem with extraordinary high $\delta^{15}N$ values. Results of stable oxygen isotopes in dentin and strontium isotopes in enamel and dentine of one tooth maintain our hypothesis that the mummy does not originate from Europe. The shift both in nitrogen and hydrogen isotope patterns of the hair strand over the last three month of the young female's

life indicate a more terrestrial nutrition pattern. We conclude a change in her environment, maybe because of a migration to higher elevations in the inland. Our results entailed historical investigations. They revealed that Princess Therese from Bavaria might have brought back this South American mummy to Southern Germany after an expedition.

323 *Hand-Schueller-Christian's Disease in an Ancient Egyptian Mummy; X-ray, CT and MR Analysis*, **MISLAV CAVKA^{1,2}, GORDANA IVANAC^{1,2}, LEJLA AGANOVIC^{3*}, GERT REITER⁴, SONIA NIELLES-VALLESPIN⁵, PETER SPEIER⁵, IVOR JANKOVIC⁶, IGOR URANIC⁷, and BORIS BRKLJACIC^{1,2}** (¹University Department for Diagnostic and Interventional Radiology in University Hospital "Dubrava", 6 Av. Gojka Suska, Zagreb 10000, Croatia; ²University of Zagreb, Medical School, 3 Salata, Zagreb 10000, Croatia; ³Department of Radiology University of California, San Diego, 3350 La Jolla Village Drive, San Diego, CA 92161; ⁴Siemens AG Healthcare, 2 Allee am Röthelheimpark, Erlangen 91001, Germany; ⁵Siemens AG Healthcare, 315 Strassgangerstrasse, Graz 8036, Austria; ⁶Institute for Anthropological Research, 32 Ljudevita Gaja, Zagreb 10000 Croatia; ⁷Archeological Museum Zagreb, 19 Nikola Subic Zrinski Square, Zagreb 10000, Croatia; mislav.cavka@yahoo.com).

An Ancient Egyptian mummy ("Mistress of the House", named Kareset, Archeological Museum, Zagreb, Croatia) was brought to University Department for Diagnostic and Interventional Radiology in University Hospital "Dubrava", Zagreb, Croatia. The mummy underwent digital radiographs, computed tomography as well as magnetic resonance (MR) imaging employing 3-dimensional ultra-short-echo time (UTE) sequence, a MR technique allowing to image ancient dry tissue. Morphological observations on the skull, the size of the greater sciatic notch and an elongated thin linen wrapped structure in the pelvic region (which probably represents an artificial penis) indicate that the remains are more likely of a male than a female. Stages of epiphyseal plate union combined with a moderate dental wear suggest age at death between 20 and 30 years. Through the thorax and abdomen four long linen wrappings can be clearly identified, which should correspond to visceral packages, a practice done from the 21st dynasty onwards. Multiple osseous lytic lesions are observed throughout the spine and on the frontal bone, parietal bone, occipital bone, orbital wall, and Turkish saddle. Considering the sex, age, and the position of these lesions, we suggest that the likely cause of death was the Hand-Schueller-Christian's disease. Although the mummy was previously dated to 3rd century B.C. based on the properties of the sarcophagi, this is in contrast with the mummification technique used which is more in line with the technique used during the 21st or 22nd dynasty. This was later confirmed by radiometric date (C14) of 900-790 B.C.

CONTRIBUTED POSTERS

World Congress on Mummy Studies Sunday, starting at 5:30 p.m. in KIPJ Rooms C and D

324 *The Bioarchaeology of Activity and Labour Under Inka Occupation: A Regional Analysis of Provincial Burials from Lima, Peru*, **TRISHA M. BIERS¹* and GUILLERMO A. COCK CARRASCO²** (¹Department of Archaeology, University of Cambridge, Cambridge, CB2 3DZ, United Kingdom; ²ConsultPatCu E.I.R.L. (Consultores en Patrimonio Cultural), 777 Monte de Los Olivos, Santiago de Surco, Lima 33, Peru; tmb40@cam.ac.uk).

The objective of this project was to construct a clearer picture of provincial life at the administrative centre of Puruchuco on the central coast of Peru during Inka occupation (A.D. 1400-1532). To accomplish this, the authors created an osteobiography of a sample (N=81) of adult individuals buried at Puruchuco by analysing a suite of markers of occupational stress (MOS) in relation to associated burial objects and mortuary treatment to test ideas about the relationship between activity stress, sexual division of labour, and burial patterns. The MOS examined here included the analysis of musculoskeletal stress markers (MSM), degenerative changes of the synovial joints, trauma and non-specific periostitis to the long bones, vertebral pathologies, and the analysis of robusticity of post-cranial indices.

Burial inclusions point towards a variety of craftsmanship present at Puruchuco such as weaving kits, worked metal ore, and agricultural foodstuffs. A series of “movement models” were developed to examine synergistic muscle processes to reveal an overall workload pattern of labour for the Puruchuco individuals. The underlying assumption of this research was that the MOS would reflect the sexual division of labour within the population with further contributions to identity expressed from the mortuary material. Though caution was used here in confirming any kind of personal identity per individual, commentary on the overall labour patterns, health, activity pressure between the sexes, and burial treatment can contribute holistically to the current understanding of the economic importance the labour of coastal communities played in the overall expansion of the Inka Empire.

325 *Residential Mobility and Stress in Nasca, Peru: New Insights from Cortisol and Isotopic Analyses of Archaeological Hair*, **EMILY WEBB¹*, CHRISTINE WHITE¹, STAN VAN UUM², and FRED LONGSTAFFE³** (¹Department of Anthropology, The University of Western Ontario, 208-740 Proudfoot Lane, London, Ontario, Canada N6H 5H2; ²Department of Medicine, University of Western Ontario, London, Ontario, Canada N6H 5H2; ³Department of Earth Sciences, University of Western Ontario, London, Ontario, Canada N6H 5H2; ewebb7@uwo.ca).

Residential mobility associated with movement among multiple production zones was an integral part of the socioeconomic strategies of many Andean societies. In this paper, we investigate the impact of mobility on individuals from Nasca, Peru (AD1-1000) through reconstruction of diet using isotopic analysis and reconstruction of stress using levels of cortisol, a hormone produced in response to real or perceived stress. Our objective is to assess the relationship between residential mobility (i.e., movement among isotopically-distinct production zones) and experienced

stress by integrating incremental isotopic ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) and cortisol datasets for hair samples from the Nasca region (n=11). We hypothesized that it would be possible to differentiate between seasonally changing diets and the exploitation of multiple production zones via isotopic analyses, and that patterns of experienced stress, accessible through systemic cortisol levels, would also vary in response to movement about the landscape.

Two distinct types of residential mobility have been inferred from the isotopic data for seven of the eleven individuals in this study. Cortisol production was consistently different between those who were actively moving (short-term mobility) and those who relocated more permanently. For individuals engaged in short-term mobility, increases in cortisol levels coincided with periods of rapid change in isotopic composition. In contrast, those who resettled in a new locale experienced a significant reduction in cortisol production, and thus stress, after relocation. This combination of datasets enabled the reconstruction of individual experiences of dietary change, stress and residential mobility, and shed light on the affective experiences of these Nasca individuals.

326 *Labor, Gender, and Identity: Bioarchaeological Activity Patterns in Mummified and Skeletonized Individuals from the Tiwanaku State (AD 500-1000)*, **SARA K. BECKER** (University of North Carolina, Chapel Hill, Department of Anthropology, 301 Alumni Building CB#3115, Chapel Hill, NC 27599; Sara.Becker@unc.edu).

Organized labor is a known key component to the development of state-level societies. However, concepts of labor in pre-historic societies can sometimes be reduced to a one-dimensional idea, overshadowing the actual individuals involved in activity and production within an emerging complex society. Within this paper, I provide a comparative framework of specific skeletal evidence to the archaeological record by using biological markers to infer how habitual activity varies within Tiwanaku state formation both in the Titicaca Basin, Bolivia and the Moquegua Valley, Peru. The excellent preservation at these sites including mummified or partially mummified remains along with these bioarchaeological activity data add specific insight into the routine of individuals and their contributions to the social groups in which they live, revealing divisions of labor such as status or gender differences.

327 *Dress, Death, and Identity in Moquegua Tiwanaku: Textile Evidence from the Rio Muerto Mummies, Moquegua, Peru*, **ELIZABETH M. PLUNGER* and PAUL S. GOLDSTEIN** (Department of Anthropology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0532; psgoldstein@dssmail.ucsd.edu).

Dress is among the most important means of communicating roles and relationships, both in life and death. The mummies and other well-preserved interments from the Tiwanaku cemetery sites at the Rio Muerto archaeological complex (M43 and M70) in Moquegua, Peru, offer a rare opportunity to examine the construction of the identities of Middle Horizon people as they are mourned and interred by family and friends. Information from the examination of the garments from these sites has provided unprecedented information on ideas of status, gender and sex roles, and the roles and importance of children, in this ancient community.

328 *Unwrapping Tiwanaku Diet: Carbon and Nitrogen Isotope Data from the Mummies of Rio Muerto, Moquegua, Peru*, **ANDREW D. SOMERVILLE*, PAUL S. GOLDSTEIN,**

SARAH. I. BAITZEL, MARGARET J. SCHOENINGER, SARAH RAUBENHEIMER, and LINDA YZURDIGA (Department of Anthropology, University of California, San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0532; psgoldstein@dssmail.ucsd.edu).

The superb preservation of human remains at Rio Muerto permits an unusual opportunity for new bioarchaeological research on Tiwanaku society. As markers of individual and group identity, dietary practices convey valuable information on ethnicity, gender, and status-based differences within archaeological populations. Through analysis of bone carbon and nitrogen stable isotope ratios, we reconstruct the paleodiet of the Middle-Horizon Tiwanaku from Rio Muerto in the Moquegua Valley of Southern Peru. Working with mummified remains permits analysis of both traditional bone isotope ratios as well as human hair, allowing comparison between long and short-term dietary intake. Our results are compared to previously generated data from the earlier Huaracane, and succeeding Tumulaca and Chiribaya populations, and to highland Tiwanaku data to assess dietary changes in relation to political and demographic changes across the Tiwanaku core and peripheral regions. Additionally, we investigate gendered food behaviour in the peripheral Tiwanaku colony.

329 Investigating the Use of Coca and Other Psychoactive Plants in Andean Archaeological Populations, EMMA BROWN*, ANDREW S. WILSON, BEN STERN, ROB JANAWAY, and TIMOTHY TAYLOR (Archaeological Sciences, University of Bradford, Richmond Road, Bradford, West Yorkshire, BD7 1DP, United Kingdom; elbrown@bradford.ac.uk).

Psychoactive plants have played a significant role in Andean cultures for millennia. This is evident in the archaeological record; for example the depiction of San Pedro cactus (*Echinopsis pachanoi*) on Cupisnique vessels (c 1000-200 BC), snuff trays and tubes from San Pedro de Atacama (c 200-900 AD) and *in situ* coca leaves in the cheeks of Chiribaya mummies (c1150-1300 AD). A number of practices, such as coca chewing and folk healing using ayahuasca and San Pedro cactus are still practiced in parts of Peru and Ecuador.

Despite the evidence for the use of a number of psychoactive plants in Andean cultures, the use of these plants is not fully understood. This is particularly true for plants imbibed as decoctions that do not require a specific vessel or equipment for ingestion.

A novel method for investigating the use of psychoactive plants in antiquity is the analysis of hair for drug compounds. The approach taken for this research project involves the use of liquid chromatography electrospray ionisation tandem mass spectrometry (LC-ESI-MS/MS) to detect a select number of compounds, including mescaline, atropine, cocaine, and *N,N*-dimethyltryptamine in hair samples from Cabuza (1100-1400 AD) populations in the Azapa Valley.

330 Life in an Extreme Environment: An Isotopic Investigation into Seasonal Resource Use in the Lower Ica Valley, Peru, LAUREN CADWALLADER (Department of Archaeology, University of Cambridge, Downing Street, Cambridge, CB2 3DZ, UK; lc340@cam.ac.uk).

The lower Ica Valley, though today largely an unpopulated and arid desert, is rich in archaeological remains of settlement and irrigated field systems spanning approximately 2000 years from the Early Horizon (500 B.C.) to the Spanish Conquest. This research aims to understand how subsistence strategies, influenced by both

biological and social factors, evolved during this period using isotopic analysis of human tissues. Previous archaeobotanical work suggests that a gradual transformation took place as natural and anthropogenic changes took their toll on the environment. Additionally, repeated cultural transitions provided social impetus for economic based changes.

Isotopic dietary information obtained from mummified human remains has been used to investigate three main transitions: a) the Late Ocucaje to Early Nasca cultural transition (c. 200 B.C. - 200 A.D.); b) the Late Nasca to Wari transition (c. 800 - 1000 A.D.) during which there was a gradual collapse of the desert ecosystem; and c) the transition from the Wari to the regionally developed Ica-Chincha period (1000 - 1400 A.D.).

Results from the isotopic analysis of bone collagen show the diet of each period to be subtly different, with a range of resources potentially being exploited. Several explanations can be put forward indicating that the subsistence strategies cannot be simply defined as ‘hunter-gatherer’ or ‘agriculturalist’. Isotopic analysis of hair samples is used here to explore seasonal resource use in each of these cultures in an attempt to tease out information about the mixed economies employed by these populations.

331 Archaeohelminthology of the Chiribaya Shepherd, Canis familiaris, (AD 700-1476) from Southern Peru, DENNIS J. RICHARDSON¹, SONIA GUILLÉN², RONALD G. BECKETT¹, WESLEY KYLE¹, GERALD J. CONLOGUE^{1*}, and KATHERINE HARPER-BECKETT¹ (¹Bioanthropology Research Institute, Quinnipiac University, 275 Mt. Carmel Ave., Hamden, CT 06518; ²Centro Mallqui, Casilla 63, Ilo, Peru; Dennis.Richardson@quinnipiac.edu; Gerald.Conlogue@quinnipiac.edu).

Although many studies have been conducted concerning human coprolites, there is a paucity of archaeohelminthological data from non-human animals. Eight coprolite samples were examined from dogs associated with the Chiribaya culture, a pre-Columbian agrarian and pastoral society that inhabited the lower and middle regions of the Osmore River in southern Peru between about AD 700 and 1476. Tapeworm eggs (*Diphyllobothrium* sp.) were observed in three coprolites. Eggs of the nematodes *Toxocara canis*, *Trichuris vulpis*, and *Spirocerca lupi* were observed in three coprolites, two coprolites, and one coprolite, respectively. These data constitute the first report of these helminthes from pre-Columbian dogs in the Americas and provide a review of archaeohelminthological data from non-human animals.

332 Preliminary Results of the Histological Study of Ancient Skin Tissue Samples from the Chinchorro Mummies, BRUNO DORE^{1*}, BERNARDO ARIAZA², ROSA BOANO¹, and EMMA RABINO MASSA¹ (¹Department of Animal and Human Biology, University of Turin, via Accademia Albertina 13, I 10123 Torino, Italy; ²Instituto de Alta Investigación, Departamento de Antropología and Centro de Investigaciones del Hombre en el Desierto, Universidad de Tarapaca, Arica, Chile; bruno.dore@unito.it).

The study focused on some mummies referred to the Chinchorro culture, coming from the sites of El Morro I, Maderas Enco and Valparaiso in northern Chile and dating approximately to 5000 BP. The specimens are now housed at the Museo Arqueológico San Miguel de Azapa, Universidad de Tarapaca, Arica, Chile.

We performed histological analyses on small pieces (10 mm) of mummified samples in order to assess the preservation of tissues, cytological characteristics of the tissues and the presence

of infesting agents. The tissues were hydrated and then treated with hematoxylin-eosin, trichromic Masson's, Mallory's and Van Gieson's and PAS staining. The preparations were examined by conventional transmission light microscopy and polarized light microscopy.

Traces of black pigment were always detected, apparently deposited on the surface of the integument. Histological preservation was highly variable among samples, and sometimes in different parts of the same sample. Moreover, in the same histological section, we could observe a well-preserved integument as well as the same structure completely altered by the development of fungal structures (spores). Yet in many instances it was possible to observe histological structures sufficiently preserved to allow safe identification of the integument of a bird, feathers and their follicles. In no circumstance was the identification of mammalian tissues possible.

333 Shrinking Misconceptions: A Neutral Perspective on Shuar Tsantsas, CHEYENNE MCCARTHY* and BENJAMIN KOOBA (Department of Anthropology, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; cmccarthy@sandiego.edu).

The Shuar, an indigenous tribal culture located in the Upper Amazon of Ecuador and Peru, are infamously known for shrinking their dead enemies' heads. This tradition is often interpreted with bias and negativity. But *tsantsa* have deeper meaning: they maintain the delicate balance between physical and spirit worlds, reinforce Shuar religious ideology, and bestow power upon their makers. *Tsantsas* are sacred talismans that Shuar men make to protect themselves from the vengeful spirits trapped within the heads. The shrinking process involves methodical preparation (including shamanic consultation), extensive time and energy, and is followed by feasting and celebration. This project aims to foster awareness and understanding of the Shuar by presenting an objective glimpse into their unique practice of making *tsantsas*. We diverge from the traditional biased perspective, and instead convey the history and significance of *tsantsa* production, in order to dispel misconceptions. Tolerance is a critical anthropological issue. Our poster is a visual medium through which we resolve to illustrate our goal: diminishing cultural prejudice and increasing tolerance. By educating the public about the Shuar as a people, we encourage respect for their traditions, and acceptance of the differences between our culture and theirs.

334 Historical Context of Tsantsa, TOBIAS HOULTON (Centre for Anatomy and Human Identification, MSI/TMW Complex, Dow Street, University of Dundee, Scotland, DD1 5EH; tobias.houlton@hotmail.com).

Tsantsa (shrunk heads) are of historic, religious, and tribal significance. The Shuar tribes of South America are renowned for the ritual of *tsantsa* production, which was also practiced by a number of tribes from North-Western South America and Mesoamerica.

In the late 1800s, native tribesmen, realising an opportunity for trade, exchanged superfluous *tsantsa* for guns and ammunition from interested travellers. In the early 1900s, the Native American custom of head shrinking was adapted for financial gain by Western settlers in Ecuador, Columbia, Panama, and Peru. Initially produced for a macabre, but brisk curio trade among Europeans fascinated in authentic tribal shrunk heads, counterfeit heads were acquired via unethical sources and unscrupulous standards.

This research examines the development and social context of

tsantsa production among Native Indians and Europeans. Motivation and method of practices often perceived as magical, idiosyncratic, and grim are explored.

335 Facial Analysis of a Tsantsa: A Shrunk Head from the Shuar Tribes of South America, TOBIAS HOULTON (College of Anatomy and Human Identification, MSI/TMW Complex, Dow Street, University of Dundee, DD1 5EH, Scotland; tobias.houlton@hotmail.com).

Original MSc research was on a *tsantsa* (shrunk head) from the McManus Museum in Dundee and thought to be from the Shuar Tribes in South America. It challenged recent speculation that the head was simian, and not an authentic example of human head shrinking. The *tsantsa* was assessed for sex and age and the effects of shrinking on facial morphology, studied using pig heads. A 3D facial approximation was attempted using a laser scanner (Fast-SCAN Scorpion) and 3D modelling software (FreeForm Modelling Plus).

To establish the identity of the McManus *tsantsa*, morphologies of extant authenticated human *tsantsa*, a shrunk monkey head, and living simian morphologies were assessed. Microscopic hair analysis confirmed the *tsantsa* as human, of Mongoloid ancestry. Population demographics resulted in the head being estimated as male, age 20-30 years.

The *tsantsa* scan was constructed utilizing craniofacial measurements, obtained from the McManus *tsantsa* and superimposed subject photographs. A scanned template cranium was manipulated in FreeForm to conform to extant Peruvian craniofacial measurements, and a template mandible developed using Sassouni Analysis, providing a hypothetical scaffold for reconstruction. Texturing and tribal decoration was applied with Autodesk Maya 2010. Verification of the reconstruction was not possible due to the absence of ante-mortem photographs.

336 Facial Reconstruction of an Anga Mummy, ANDREW J. NELSON¹, VICTORIA LYWOOD², and RONALD G. BECKETT^{3*} (¹Department of Anthropology, The University of Western Ontario, London, ON, Canada, N6A 5C2; ²John Abbott College, 21 275 Lakeshore Road, Sainte-Anne-de-Bellevue, Québec, H9X 3L9, Canada; ³Bioanthropology Research Institute, Quinnipiac University, Hamden, Connecticut, c/o 16010 South 11th, Place #31, Phoenix, Arizona 85048; ronald.beckett@quinnipiac.edu).

The Anga People of Papua New Guinea are known to have practiced an elaborate mortuary ritual that consisted of smoking the body of their loved ones in a special hut for a period of weeks. The mummified individuals were then placed on cliff faces overlooking their lineage's territory. The practice was halted by missionaries 40 to 50 years ago. The work reported on here arises from a 2010 expedition to study Anga mummies and to undertake an ethnographic study of the modern Anga people. The main rationale the modern people offer for the practice is that the descendants wished to look on the faces of their people, so keeping their memory alive. Unfortunately, the ravages of time have led to the deterioration of the mummy's faces. The project described here demonstrates the use of forensic techniques to reconstruct the face of one mummy.

The mummy described here is Moimango, a leader, warrior and shaman, whose descendants still live in the village of Koke. Standard anatomical photos and measurements were taken of Moimango's skull. Tissue thickness depths, available from a 1903 study, and the photos and measurements were used to create lateral

and frontal sketches of Moimango's head. The headdress and nose ornament were included as per family memories. Photos were taken of the Koke villagers for additional reference.

This reconstruction will bring Moimango's face alive for his descendants, and represents an important development of the repertoire of techniques available for facial reconstruction.

337 *Analysis of an Offering of Cultural Materials Associated with Partially Mummified Remains from Sierra Gorda, Querétaro, México*, **ELIZABETH MEJÍA^{1*}**, **AURORA MONTUFAR²**, and **ALBERTO HERRERA¹** (¹INAH Querétaro, Andrés Balvanera #2 Centro, Querétaro, Qro., CP 76000, México; ²INAH, Laboratorios y Apoyo Académico; toluquilla2000@yahoo.com.mx).

An analysis was conducted to determine the context of a burial of partially mummified remains found in the southern part of Sierra Gorda, Querétaro, México. From the analyses of characteristic cultural objects, we present the results of their identification and their significance from a regional point of view.

338 *Haida Mummy Rediscovered*, **GWYN MADDEN** (Department of Anthropology, Grand Valley State University, 1167 Au Sable Hall, 1 Campus Drive, Allendale, MI 49401; maddeng@gvsu.edu).

In 1940, Julian Steward was led to a Haida internment site on Dall Island in Southeastern Alaska. The remains of four individuals were observed, three were skeletonized and one was well mummified. Images from the 1940 expedition show preservation was excellent, due to the individual's burial box resting off of the ground on top of wooden poles and sheltered under a rock overhang. Housed at the Smithsonian Institution, current observation presents an individual whose skin has been removed, organs likely disposed of, and most of the skeleton disarticulated. This research describes further the history of the find, the current state of the remains, the health of the individual, and comparisons to similar mummified remains reported in the literature.

339 *The German Mummy Project*, **HEATHER GILL-FRERKING***, **ANNA-MARIA BEGEROCK**, and **WILFRIED ROSENDAHL** (German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim, Germany; Heather.Gill-Robinson@mannheim.de).

The German Mummy Project (GMP) was created in 2004 following the discovery of 20 mummies in storage at the Reiss-Engelhorn Museums (rem) in Mannheim, Germany. The purpose of the GMP is three-fold: to undertake scientific analysis of the mummies of the rem and other institutions, to disseminate the results of the research in academic and public fora and to undertake conservation of the mummies to ensure their preservation for the future. To date, the German Mummy Project has developed research plans and begun preliminary research on more than 40 human mummies. The research of the GMP emphasizes the use of non-destructive methods, with limited physical sampling only permitted to answer specific research questions that could not be addressed through other non-destructive methods. All of the work of the GMP is conducted as part of an international, interdisciplinary collaborative team. This poster presents an overview of the diverse work undertaken by the German Mummy Project to date, and outlines some of the current research of the team.

340 *Standardizing Recording Forms for Mummy Studies*, **HEATHER GILL-FRERKING***, **ANNA-MARIA**

BEGEROCK, and **WILFRIED ROSENDAHL** (German Mummy Project, D5, Museum Weltkulturen, Reiss-Engelhorn Museums, 68159 Mannheim, Germany; Heather.Gill-Frerking@mannheim.de).

The importance of research planning and consistent data recording in mummy studies is irrefutable, but there are few guidelines and examples of documentation systems in mummy studies. The team of the German Mummy Project has developed a standard protocol that is applied to every mummy examined within the framework of the project, whether human or animal. This protocol includes the assignment of an individual identification number used for all documentation and sampling; the completion of an extensive documentation form and linking of the standard documentation form to computer files, images, medical image data, results of externally-conducted analyses, and publications relevant to the study of the mummy. The documentation protocol is under constant revision, including the planned development of a database to electronically link all data and images for each mummy in the project.

This poster presents the documentation system developed by the German Mummy Project for the recording and analysis of all mummies studied within the framework of the project. The team of the German Mummy Project welcomes the input of our mummy studies colleagues for the further development of a useful, effective documentation system for the study of mummies.

341 *X-ray Imaging and its Impact on Ancient DNA: A Monte Carlo-based Simulation*, **JOHANN WANER¹**, **LIZ PARVIN²**, and **FRANK J. RÜHLI^{1*}** (¹Centre for Evolutionary Medicine, University of Zürich, Switzerland; ²Faculty of Science, Open University, United Kingdom; johann.wanek@anatom.uzh.ch).

Major tools in diagnostic imaging of ancient mummies research are based on X-rays, such as computed tomography. CT is still considered as diagnostic gold-standard; the excellent image quality leads to higher diagnostic confidence e.g. for the identification of diseases. However, numerous ancient mummified remains undergo DNA analysis following such ionizing radiation exposures. In practice, the probability for an ancient DNA damage induced by X-rays is completely unknown because no experimental data are available, and the published literature is very limited in this field. We present statistical-based algorithms such as the Monte Carlo calculation to simulate physics processes in anthropomorphic phantoms. Using this method, the probability of X-ray induced ancient DNA degradation can be predicted eventually. First results show, e.g. that the absorbed energy in cells depends on the cell distribution in tissue if planar X-ray imaging is used.

342 *The North American Mummy Database: An Interdisciplinary Online Resource*, **S.J. WOLFE** (American Antiquarian Society, 185 Salisbury Street, Worcester, MA 01609; swolfe@mwa.org).

The North American Mummy Database is a work in progress which will culminate in a web-searchable compilation of information about all Egyptian mummies documented to have been imported into the United States and Canada. Researchers will be able to search on a number of access points in order to find information on any of the more than eight hundred "individuals" now represented in the database. Some of the access points are name, sex, location, dynasty, and whether or not still extant. At present twenty access points are defined. Each entity will connect from the database to a web page which will display information about the mummy, and links to other websites which have information about

that mummy. The database will not be static; as new information is received it will be added to the database so that there will be continuous updating and growth.

This poster session will show sample forms and pages, and list the present access points available for searching. The purpose of the poster session is to introduce the mummy community to the database and to solicit information about what sorts of data researchers would find useful as access points.

The database will be mounted by the Egyptologists Electronic Forum and accessible through their web site. It is hoped that the database will be up and running on the web by the end of 2011.

343 *New Findings on a Roman-period Egyptian Mummy at the University of Illinois*, SARAH U. WISSEMAN^{1*} and DAVID R. HUNT² (¹Director, Program on Ancient Technologies and Archaeological Materials, Illinois State Archaeological Survey, University of Illinois, 704 S. Neil St., Champaign IL 61820; ²Department of Anthropology, MRC112, National Museum of Natural History, P.O. Box 37012, 10th and Constitution Avenue, NW, Washington, D.C. 20013-7012; wisarc@illinois.edu; HUNTD@si.edu).

A Roman-period Egyptian mummy was CT scanned and analyzed by an interdisciplinary team at the Spurlock Museum of the University of Illinois during the early 1990s and again in 2011. The goals of the project were to study embalming techniques and the age, sex, and cause of death of the child inside the wrappings. Because of the museum's desire to display the mummy after analysis, no autopsy was performed, and initial analyses were conducted using non-destructive medical imaging. However, the deteriorating lower portion of the mummy yielded loose samples of resins, cloth, insects, wood, and bone, as well as pigment from the tinted stucco on the exterior. The red pigment, originally identified as a type of lead oxide, was reanalyzed two years ago by M. Svoboda of the J. Paul Getty Museum and M.S. Walton and K. Trentelman of the Getty Conservation Institute as part of a larger study on "red shroud" mummies. Molecular, trace element, and isotopic analyses of the red pigment from seven of the nine known mummies in this group show an identical composition. The pigment apparently originated outside Egypt, likely produced from silver refinement at Rio Tinto, Spain. This finding, along with similar iconographic and decorative features, suggests that these high-status mummies may have been prepared in the same embalming workshop.

344 *Mummified Baboons, Stable Isotopes, and the Location of Punt*, GILLIAN L. MORITZ^{1*}, GILLIAN A. O. BRITTON^{2*}, SALIMA IKRAM³, and NATHANIEL J. DOMINY⁴ (¹Department of Ecology and Evolutionary Biology, Dartmouth College, Hinman Box 5044; ²Department of Anthropology, Dartmouth College, Hinman Box 0409, Hanover, NH, 03755; ³Department of Sociology, Anthropology, Philosophy and Egyptology, American University in Cairo, AUC Aveue, P.O. Box 74, New Cairo 11835, Egypt; ⁴Department of Anthropology, Dartmouth College, 6047 Silsby Hall, Hanover NH 03755; Gillian.L.Moritz@Dartmouth.edu, Gillian.A.O.Britton@Dartmouth.edu).

The Ancient Egyptians recognized a neighboring political state called Punt. Two species of baboons were imported from Punt, among other valued commodities such as incense, electrum, and ebony. The precise location of Punt is unknown, but five geographic hypotheses have been advanced during the past century. To test among these competing views, we measured oxygen stable isotope ratios in the tissues of two XXth-Dynasty mummified baboons.

These animals, which were recovered from royal tombs and were likely pets, were contemporaneous with known expeditions to Punt. Oxygen stable isotopes vary predictably as a function of rainfall in a region, which in turn is paralleled in an animal's drinking water and incorporated into its bodily tissues. As a result, oxygen stable isotopes in the hair of an animal can be used as a chemical record of where it lived. To determine the isotopic signature associated with each putative Punt location, we collected and analyzed 185 modern baboon hair samples from Eritrea-Ethiopia, Mozambique, Somalia, Uganda, and Yemen. A match between one of these isotopically distinctive locations and the XXth-Dynasty mummified baboons is expected to help resolve a longstanding debate. Our findings agree well with hypothesized locations in Eritrea and northern Somalia.

345 *Backroom Treasures: CT Scanning of Two Ibis Mummies from the Peabody Museum Collection*, ANDREW D. WADE^{1*}, SALIMA IKRAM², GERALD J. CONLOGUE³, RONALD G. BECKETT³, ANDREW J. NELSON¹, and ROGER COLTEN⁴ (¹University of Western Ontario; ²American University in Cairo; ³Bioanthropology Research Institute, Quinnipiac University; ⁴Peabody Museum of Natural History; awade4@uwo.ca).

Museum collections of Egyptian human and animal mummies have great potential for research and museums often curate larger collections than those on exhibit. Scheduling access to medical imaging facilities is often complicated for mummies on display because of the important environmental controls under which they are kept. Collections in storage are often more readily available in terms of time and physical access than those on exhibit.

In the Fall of 2010, two Egyptian ibis mummies from Yale's Peabody Museum of Natural History, not currently on display, were made available for computed tomography (CT) scans at the Quinnipiac University's Diagnostic Imaging Program and Bioanthropology Research Institute. These ibises varied in position, were dispatched in a similar manner (spinal fracture), and demonstrated complete evisceration with replacement of a packet made up of the gizzard and its contents.

Application of CT to the study of mummified remains allows for detailed three-dimensional evaluations, without the difficulties of superimposition that characterize plain film radiographs. Three-dimensional visualization, multi-planar reformates (MPR), and curve-linear reconstructions of these mummies are essential for close examination of the complex curves of the spine and the contents of the gizzard. These manipulations are no less important in the study of animal mummies than they are for those of humans.

346 *Interpreting the Life of the Carlos Museum's Old Kingdom Mummy*, MONIQUE OSIGBEME^{1*}, CHENERE PIERCE RAMSEY², MALU TANSEY³, JOSHUA ROBINSON⁴, JOHN KINGSTON⁴, and ARRI EISEN⁵ (¹Undergraduate Class of 2012, Emory University, Atlanta, Georgia; ²School of public Health, Emory University, Atlanta, Georgia; ³School of Medicine, Emory University, Atlanta, Georgia; ⁴Anthropology Department, Emory University, Atlanta, Georgia; ⁵Biology Department, Emory University, Atlanta, Georgia; mosigbe@emory.edu).

The comprehensive conservation project undertaken in 2010-11 afforded an unprecedented opportunity to examine, analyze, and document the preserved human remains. Physical evaluation, radiographic imaging, microscopic examination, and stable isotope analysis of the bones and teeth were undertaken to gather clues about the individual's life and death, including diet and health. A

sample from what was presumed to be the brain was studied with the hope of confirming the tissue, typing blood, and obtaining genetic information.

347 Evidence of Trepanation in a 26th Dynasty Mummy from Akhmim, Egypt, JONATHAN P. ELIAS^{1*}, CARTER LUPTON², and ROBERT D. HOPPA³ (¹Akhmim Mummy Studies Consortium c/o AMSCRESEARCH, 525 N. Hanover Street, Carlisle, PA 17013; ²Milwaukee Public Museum, 800 West Wells St. Milwaukee, WI 53233; ³University of Manitoba, 435 Fletcher Argue Building, Manitoba, Canada R3T5V5; director@amscresearch.com).

Very few instances of surgical trepanation/craniotomy are seen in the Egyptian archaeological record. The rarity of the procedure reflects the tendency among ancient Egyptian physicians (reflected in the Edwin Smith Surgical Papyrus) to avoid operating on head injuries. Recent CT examinations of the 26th Dynasty embalmer Djedhor, whose mummy (Milwaukee Public Museum 10264) was found at Akhmim around 1886, have revealed evidence of a surgical opening in the summit of his cranium having substantial dimensions (53 mm AP x 43.5 mm R-L). This opening is arguably one of the boldest craniotomies carried out in ancient Egypt. The earliest scan carried out on Djedhor (1986) missed this feature altogether. A second scan (June 2006) detected the feature, and provided the basis for a 3D-printed model of the skull which showed a lesion in the upper margin of the subject's left orbit. This lesion is considered serious enough to have induced ancient physicians to have attempted trepanation as a means of reducing pressure for purposes of the subject's pain relief. The linkage of the two features is plausible. The latest CT exam (April 2011) was undertaken to provide better views of the edge of the trepanation hole to establish whether there is remodeling of the bone suggestive of healing, or whether the procedure was conducted post-mortem and as part of the ritual processing of Djedhor during mummification

348 The Weird and the Wonderful – The Scientific Study of a Miniature Mummy, LIDIJA MCKNIGHT^{1*}, NATALIE McCREESH¹, and ANDY GIZE² (¹KNH Centre for Biomedical Egyptology, University of Manchester, Stopford Building, Oxford Road, Manchester, M13 9PT, UK; ²School of Earth, Atmospheric, and Environmental Sciences, University of Manchester, Williamson Building, Oxford Road., Manchester, M13 9PL, UK; lidija.mcknight@manchester.ac.uk).

A human-faced oddity purported to be a 'human baby, animal mummy or fake' constructed in the ancient Egyptian style, was subjected to scientific analysis at the KNH Centre for Biomedical Egyptology, University of Manchester. The study aimed to ascertain the nature of the object, what it was made from, why, where and when and by whom it was made, in the hope of furthering our understanding.

The first stage of the investigation was a thorough non-destructive radiographic analysis using conventional radiography (X-ray) and computed tomography (CT scanning). This identified the nature of the bundle contents and helped to identify similarities with mummified animal bundles from ancient Egypt. Small samples were collected for study using Microscopy, Environmental Scanning Electron Microscopy (ESEM), Energy dispersive spectroscopy (EDS) and Gas Chromatography-Mass Spectrometry (GC-MS). ESEM was used to assess homogeneity of the sample which may be constructed from materials such as linen, resin, wood and plaster. EDS was used for elemental analysis. The substances

applied to the exterior of the bundle and/or the coffin, such as adhesives or 'embalming' materials were analysed using GC-MS to determine chemical composition.

As very few of this type of miniature mummy are thought to exist, they represent an intriguing area of Egyptological study, and as such they merit scientific examination. The results of the research has allowed for comparisons with contemporary human and animal mummies to be made.

349 DNA, EDAX, and Radiocarbon Analysis of Burials and Textiles from the BYU Excavation of the Fag el Gamous Cemetery in Fayoum, Egypt, ADDISON ALLEY^{1*}, CHRISTOPHER EPPICH^{1*}, MATTHEW BIGGS¹, GARRETT MULLINS¹, CARTER NEWAY¹, DAVID M. WHITCHURCH², RICHARD HECKMANN³, and R. PAUL EVANS¹ (¹Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT 84602; ²Department of Ancient Scripture, Brigham Young University, Provo, UT 84602; ³Department of Biology, Brigham Young University, Provo, UT 84602; evansp@byu.edu).

The Fag el Gamous cemetery is an expansive (125 hectares) and densely populated (an average of 1.7 burials exhumed per square meter) necropolis. Analytical bone, tissue and textile samples have been collected as permitted by and under the direction of the Supreme Council of Antiquities. The results of analyses of these samples have been used to inform and clarify the archaeological efforts.

Burial shafts in the cemetery are uniformly oriented on an east-west axis with multiple interments in a single shaft providing a temporal gradient of burial practices and potential population genetic structure. The deepest (3 meters) and thus oldest burials are oriented head east (HE). Burials in the same shaft at depths of 1.5 meters and less are interred with a head west (HW) orientation. The head west orientation is generally associated with the arrival and adoption of Christianity. Comparison of HE and HW mitochondrial DNA control sequences show evidence of adoption of the HW burial practice by the extant population using Fag el Gamous as well as immigration of a new group. EDAX analysis of the red ribbons associated solely with HW burials confirm that the dye is an ochre pigment. The chronology of head west burial practice adoption was quantified using AMS radiocarbon dating of tissue and bone samples of vertically adjacent HE and HW burial "pairs" from the same shaft. The head west burial practice adoption in the Fag el Gamous cemetery occurred in the late third to fourth centuries CE.

350 Rethinking Burial Dates at a Graeco-Roman Cemetery (Fag el Gamous, Fayoum, Egypt), DAVID M. WHITCHURCH^{1*} and R. PAUL EVANS² (¹Department of Ancient Scripture, ²Department of Microbiology and Molecular Biology, Brigham Young University, Provo, UT 84602; dwhitchurch@byu.edu).

Since 1981, Brigham Young University under the direction of Dr. C. Wilfred Griggs, has been excavating in the Fag el Gamous cemetery located at the western edge of the Fayoum. The authors of this paper have been excavating for the past decade. We express gratitude to the Supreme Council of Antiquities for permission to continue this work.

The Fayoum functioned for centuries as a cultural and religious melting pot where Greek and Roman colonizers integrated with native Egyptian populations. Burial shafts in the Fag el Gamous cemetery are oriented on an east-west axis with slight seasonal variations due to solar alignment. Older burials generally occur at

a depth between one to two and a half meters with a head toward the east orientation. Reversal or head-west burials consistently are found above head-east burials. It has been argued that the directional shift of these burials occurred as early as late first to early second century CE, and may be attributable to Christian influences.

While methods in dating pottery are well accepted and can be quite reliable in many archaeological sites, contamination due to soil disturbances from later burials and sandy soil conditions preclude balks with well-defined demarcation of substratum and add significant problems of dating bias. This presentation reports on the historical context of the Fayoum during the Graeco-Roman period. Tissue samples of burials were subjected to AMS radiocarbon dating. The directional shift of burials occurs in the late third to fourth century CE, challenging the previous dating schema for this cemetery.

351 Parasitology of the Piraino 1 Mummy, Sicily, Italy, KELSEY J. KUMM^{1*}, KARL J. REINHARD², DARIO PIOMBINO-MASCALI³, ADAUTO ARAÚJO⁴, and SCOTT L. GARDNER⁵ (¹College of Education and Human Sciences, 231 Mabel Lee Hall, University of Nebraska-Lincoln, Lincoln, NE 68508; ²School of Natural Resources, Hardin Hall 719, University of Nebraska – Lincoln, Lincoln NE 68583-0987; ³Istituto per le Mummie e l’Iceman, EURAC, Viale Druso 1, I-39100, Bolzano, Italy; ⁴Fundação Oswaldo Cruz, Escola Nacional de Saúde Pública, 1480 Rua Leopoldo Bulhões, 1480 21041-210, Rio de Janeiro, Brazil; ⁵School of Biological Sciences, W529 Nebraska Hall, University of Nebraska-Lincoln 68508; kjkumm02@gmail.com).

The EURAC “SicMum Project” is aimed at investigating the numerous mummies of Sicily. Researchers analyzed 26 bodies of religious dignitaries displayed in the crypt of the Piraino Mother Church, in the Province of Messina. According to the information collected in the Parish Archives, the “Sepulcher of the Priests” was funded in 1771 and was used between 1773 and 1858. During a 2008 mummy examination, supported by the National Geographic Society, coprolites were recovered from the abdomen of one individual labeled as “Piraino 1.”

Piraino 1 is a clothed body that belonged to an unidentified adult male, and can be considered a spontaneous-enhanced case of mummification. The coprological analysis using archeoparasitology methods revealed an intense trichurid infection. The calculated egg concentration was 34,529 eggs/gram of coprolite. This is the highest recorded egg concentration ever recorded from an archaeological specimen. We compared our measured eggs to other *Trichuris* species and concluded that the eggs were consistent with *T. trichiura*, the whipworm of humans. Epidemiologically, whipworm is a common infection today that is found dispersed worldwide. Archaeological findings point to high prevalence in the past. In the world today, and in the archaeological record of Europe, *T. trichiura* infection is usually associated with *Ascaris lumbricoides*. The presence of *T. trichiura* and absence of *A. lumbricoides* has two explanations in acquired immunity and used of medicinal compounds.

352 Forensic Palynological Analysis of Piraino 1, Sicily, Italy: Diet, Medicine, and Season of Death, MELISSA LEIN^{1*}, DARIO PIOMBINO-MASCALI², and KARL J. REINHARD³ (¹Forensic Science Degree Program, 202 Entomology Hall, University of Nebraska-Lincoln, Lincoln, NE 68583-0816; ²Istituto per le Mummie e l’Iceman, EURAC, Viale Druso 1, I-39100, Bolzano, Italy;

³School of Natural Resources, Hardin Hall 719, University of Nebraska – Lincoln, Lincoln NE 68583-0987) mlein28@huskers.unl.edu).

Pollen from intestinal contents of mummies provides important clues to foods, medicines, and season of death. Intestinal contents were recovered from the “Piraino 1” mummy from the “Sepulcher of the Priests”, Piraino Mother Church, in the Province of Messina, Sicily.

Using standard palynological methods and pollen concentration technique, we quantified the numbers of pollen grains per gram of coprolite. The pollen spectrum was dominated by Polygalaceae, the Milkwort Family. Polygalaceae pollen is rarely found in archaeological sites. Based on comparison to published keys and consultation with Polygalaceae experts, we determined that the pollen came from a species of *Polygala*. *Polygala* contains medicinal species. It is possible that this is evidence of medicine for pulmonary problems suffered by Piraino 1.

We found nine other pollen types. Traces of *Potamogeton* (pondweed) was observed in preliminary scans. Multiple grains of Brassicaceae (mustard family), cereal grains (cultivated grains), *Typha* (cattail) and cheno am were found. Cheno am refers to a similar pollen morphology produced by over 1,000 species in the goosefoot family Chenopodiaceae and the pigweed genus *Amaranthus*. Single grains of *Castanea* (chestnut), Fabaceae (bean family), *Salix* (willow), and Solanaceae (tomato family) were found. The preservation of the pollen was poor except for *Polygala* and the cereal pollen. Brassicaceae and cheno am have been part of the natural pollen spectrum in Sicily since ancient times. Brassicaceae pollen is also consumed with broccoli. Cereal grains were consumed with prepared food. Importantly, background arboreal pollen was nearly absent. This indicates that Piraino 1 died in winter.

353 Macrofossils, Microfossils and Dietary Interpretations for Piraino 1, Sicily, SARA LEROY-TOREN^{1*}, DARIO PIOMBINO-MASCALI², and KARL J. REINHARD³ (¹Lincoln Public Schools Science Focus Program, 1222 S 27 Street, Lincoln, Nebraska 68502; ²Istituto per le Mummie e l’Iceman, EURAC, Viale Druso 1, I-39100, Bolzano, Italy; ³School of Natural Resources, Hardin Hall 719, University of Nebraska – Lincoln, Lincoln, NE 68583-0987; storen@lps.org).

The last meals of decedents can be reconstructed from vestiges of food in the intestinal tract. Microfossils and macrofossils were recovered from a coprolite within Piraino 1, the mummy of a Sicilian religious figure. In reconstructing the details of cuisine, macroscopic analysis must be interpreted in context of microscopic remains.

The presence and absence of fossils from the same food source can show how food was prepared and eaten. For example, cereal grains are represented in Piraino 1 by chaff and pollen, but not by starch. This indicates that the cereal grains were prepared in a way that dissolved starch but preserved more durable structures. One plausible interpretation is that grains were eaten in the form of bread.

Easier interpretations come from pine nuts which were typically consumed in a nearly-raw state. Pine nuts (pignoli) are small with thin shells and it is likely that by cracking the nuts with his teeth, pine nut fragments were ingested. In contrast, grapes are represented by seeds, stems, and microscopic seed fragments. This collection of remains could represent the consumption of a mash of grapes or jam. Leaf and stem tissue is represented only by xylem

and phloem sections. These generalized plant structures would come from a variety of leafy foods. Tiny sections of intestine were found impacted in the matrix of other food. Microscopic analysis indicates that this could have come from natural casing used in traditional sausages.

The diversity of foods shows that Piraino 1 had a nutritious and diverse diet.

354 Forensic Palynological Analysis of Intestinal Contents of a Korean Mummy, PAULETTE ARGUELLES^{1*}, KARL J. REINHARD², and DONG HOON SHIN³ (¹Forensic Science Degree Program, 202 Entomology Hall, University of Nebraska-Lincoln, Lincoln, NE 68583-0816; ²School of Natural Resources, Hardin Hall 719, University of Nebraska – Lincoln, Lincoln NE 68583-0987; ³Division of Paleopathology, Institute of Forensic Medicine, 28, Yongon-dong, Chongno-Gu, Seoul National University, College of Medicine, Seoul 110-799, South Korea; paulette_arguelles@yahoo.com).

Experimental studies show that pollen resides in the intestinal tract for a minimum of seven days to at least 21 days. Because of this long residence time, pollen analysis is an important avenue of forensic research. Pollen provides evidence of the environment of the decedent as well as foods and medicine. We analyzed a coprolite recovered from a Korean mummy. The decedent was a high-ranking general who lived during the 16th or 17th centuries.

Eighteen pollen types were recovered. These ranged from hundreds to tens of thousands of pollen grains per gram of coprolite. Importantly, comparison of the coprolite pollen spectrum to modern aeropalynology studies of Korea suggest that the General died in winter between mid-December and early-February.

Dietary pollen types include pollen from the Apiaceae (carrot family), Caryophyllaceae (carnation family), Solanaceae (tomato-chile pepper family). The Solanaceae family was restricted to Americans in prehistoric times and represents the introduction of economic plants, possibly chiles, to Korea from the Americas. Cereal grain pollen was also present and represents rice. Pollen consistent with dandelion is present and may represent its use as food. Buckwheat pollen is also present. Buckwheat was cultivated in Korea and was used for making noodles.

Tens of thousands of grains from water plants, pondweed or cattail, dominate the pollen spectrum. We believe that this was introduced with water. The large numbers of water-related pollen suggest that the General consumed broth, tea, or soup for a considerable time before death.

355 Parasitism of the Zweeloo Woman Bog Body with Overview of Bog Body Helminths, NICOLE SEARCHEY^{1*}, KARL J. REINHARD², SCOTT L. GARDNER³, DON BROTHWELL⁴, WIJNAND VAN DER SANDEN⁵, FRANK MAIXNER⁶, DARIO PIOMBINO-MASCALI⁶, ALBERT ZINK⁶, and RAFFAELLA BIANUCCI^{7,8} (¹School of Biological Sciences, 348 Manter Hall, University of Nebraska-Lincoln, Lincoln, NE 68588; ²School of Natural Resources, Hardin Hall 719, University of Nebraska-Lincoln, Lincoln NE 68583-0987; ³H.W. Manter Laboratory of Parasitology, University of Nebraska-Lincoln, Lincoln NE 68583-0514; ⁴BioArch, Department of Archaeology, University of York, The King's Manor, York Y01 7EP, United Kingdom; ⁵Drents Plateau, Stationsstraat 11, 9401 KV Assen, The Netherlands; ⁶EURAC-Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ⁷Laboratory of Criminalistic Sciences, Department of

Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ⁸Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseilles, Boulevard Pierre Dramard, 13344 Marseilles, France; nicole.searchey@huskers.unl.edu).

Parasitological examination of bog mummies is frequently productive. A review of findings includes *Ascaris lumbricoides*, *Trichuris trichiura*, and false parasites introduced into the digestive tract with animal foods. We undertook the analysis of Zweeloo Woman to assess her parasitic state.

The Zweeloo Woman is a bog mummy from the Netherlands dating to the Roman Period (78- 233 AD). Microfossils were washed from an intestine section. Although only 0.1 milliliters of sediment were recovered, a variety of microfossils were found. The original analysis goal was the recovery of parasite eggs. Previously, other researchers had described an infection of the lancet fluke *Dricocoelium dendriticum* in the liver. We anticipate finding eggs of this parasite. Although the mummy was positive for eggs of *A. lumbricoides* and *Trichuris trichiura*, no *D. dendriticum* eggs were found. This shows that intestinal analysis is not always reliable in checking for helminth infection. The reasons for the absence of the eggs are explored in this presentation and may related to sample size, low egg production or taphonomic problems.

The *A. lumbricoides* and *T. trichiura* findings are of interest. Compared to mummies from arid regions the eggs are not well preserved. We discuss the reasons for the less than perfect preservation of Zweeloo Woman's parasite eggs.

356 Microfossil Analysis of the Zweeloo Woman Bog Body, KARL J. REINHARD^{1*}, DON BROTHWELL², WIJNAND VAN DER SANDEN³, FRANK MAIXNER⁴, DARIO PIOMBINO-MASCALI⁴, ALBERT ZINK⁴, and RAFFAELLA BIANUCCI^{5,6} (¹School of Natural Resources, Hardin Hall 719, University of Nebraska – Lincoln, Lincoln, NE 68583-0987; kreinhard1@mac.com; ²BioArch, Department of Archaeology, University of York, The King's Manor, York Y01 7EP, United Kingdom; ³Drents Plateau, Stationsstraat 11, 9401 KV Assen, The Netherlands; ⁴EURAC-Institute for Mummies and the Iceman, Viale Druso 1, 39100 Bolzano, Italy; ⁵Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Corso Galileo Galilei 22, 10126 Turin, Italy; ⁶Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, Secteur Nord, Batiment A- CS80011, University of Marseilles, Boulevard Pierre Dramard, 13344 Marseilles, France; kreinhard1@mac.com).

The methods of mummy coprolite analysis have long been established. However, the analysis of apparently empty intestinal sections is a challenge and methods are still in the development stage. We demonstrate that even empty sections can contain microfossils. One important consideration is contamination potential. This can be address by taking control samples in the mummy's environment. However, sometimes analysis is done decades after the excavation as taken place and control samples are simply unavailable. Such is the case of the analysis of a section of intestine from the Zweeloo Woman.

The yield of microfossils from the interior of the intestine was high. Potential dietary remains were represented by a diversity of starch grains from several plant sources. Some starch was apparently eaten raw, but some grains show alteration due to cooking and fermentation. Rodent hair fragments were also found. This suggests

that rodents were eaten. Previously, the analysis of Grauballe Man revealed protozoan cysts from a dietary squirrel source. Perhaps small mammals were a common part of Iron Age and Roman Period diet.

Also, an abundance of pollens and spores were found. Even though examination of the intestinal wall showed no perforations, some pollen grains may have infiltrated the section from the surrounding bog. A method of interpreting the contamination potential for pollen grains is presented. This analysis provides one more case study that will contribute to the establishment of standard methods for the analysis of seemingly empty intestine.

357 Hounsfield Units Ranges in CT-scans of Bog Bodies and Mummies, CHIARA VILLA and NIELS LYNNERUP* (Laboratory of Biological Anthropology, Institute of Forensic Medicine, University of Copenhagen, Denmark; chiara.villa@forensic.ku.dk; NLY@sund.ku.dk).

Mummification processes, either artificial or natural, preserve the tissues from postmortem decay, but change them from their original state. In this study we provided the first comprehensive set of Hounsfield Unit (HU) ranges specific for tissues mummified under different environmental conditions (peat bog, cold-dry, and hot-dry environments). We also analyzed the impact of different museal preservation techniques on the HU ranges, as e.g. in the Tollund Man and Grauballe Man, bog bodies from Denmark. The mummies were compared with forensic cases, cremated, and inhumated ancient human skeletal remains, and fossil animal bones.

Knowledge of the typical HU range for the different tissues in mummies may prevent misinterpretation of increased or reduced radiodensity as evidence of paleopathological conditions. Finally, we demonstrated the practical benefit of using our refined HU ranges by showing the improved results of 3D visualization from automatic segmentation in an Inca mummy from Mount Lullallaico.

358 Taphonomic Studies on the Joseon Mummies in Korea, CHANG SEOK OH^{1,2*}, MYEUNG JU KIM³, and DONG HOON SHIN^{1,2} (¹Department of Anatomy, ²Institute of Forensic Medicine, Seoul National University College of Medicine, 28 Yongon-dong, Chongno-gu, Seoul 110-799, Korea; ³Department of Anatomy, Dankook University College of Medicine, Cheonan 330-714, Korea; oxman@snu.ac.kr).

Though the environment in archaeological site of Korea is not favorable for preservation of human and cultural artifacts, very well-preserved human remains have been discovered in the form of mummies, from the Joseon tombs that were firmly encapsulated by lime soil mixture barrier (LSMB). We originally suspected that various environmental factors (e.g. the presence of LSMB, coffin, clothes, charcoal, humidity and pH) might concern with the mummification in Korea. In order to get the answers to these questions, for the past several years, we performed a series of animal experiments that were designed to show the possible mechanism of mummification in Korea. We will introduce herewith our experiences on animal experiment for studying the mechanism of mummification in the lab environment.

This study was achieved with the support of national R&D project hosted by National Research Institute of Cultural Heritage of Cultural Heritage Administration (NRICH-1107-B09F-1).

359 Examples of Paleopathological Studies on Korean Mummies, MYEUNG JU KIM^{1,a,*}, YI-SUK KIM^{2,a}, CHANG SEOK OH^{3,4}, JAI-HYANG GO⁵, IN SUN LEE⁶, and DONG HOON SHIN^{3,4} (¹Department of Anatomy, ²Department of Pathology, Dankook University College of Medicine, Cheonan, 330-715, Korea; ²Department of Anatomy, Ewha Womans University School of Medicine, 911-1, Mok-6-Dong, Yangcheon-gu, Seoul 158-710, Korea; ³Department of Anatomy, Dankook University, College of Medicine, Cheonan 330-715, Korea; ⁴Institute of Forensic Medicine, ⁶Department of Radiology, Seoul National University College of Medicine, 28, Yongon-dong, Chongno-gu, Seoul 110-799, Korea; mjukim99@dankook.ac.kr; cuteminjae@gmail.com).
^aThese two authors have equally contributed to this study.

We studied a number of Korean mummies who were buried in Joseon Dynasty tombs of 16th – 19th century. In this study, we summarize our scientific studies on the Korean mummies; and will present one special case which could not be easily met for the several year-experiences of our studies. In the case, to identify the presence of diseases, computed tomography (CT) scanning was performed on the whole body of the mummy. CT images showed that calcifications were found in the coronary artery and aorta as well as hilar region of lung, indicating characteristic sign of tuberculosis. As for differential diagnosis, dissection was done on the mummified body; and we could discover longitudinal fatty streaks in the wall of aorta. The obstruction of left anterior descending artery was clearly identified, which might be a possible cause of death of the Joseon female. In the histological study of the aorta sections, localization of calcification between the tunica intima and media was also observed, strongly suggesting the acute myocardial infarction due to coronary arterial disease. Considering good state of preservation of human remains and artifacts found in lime soil mixture barrier (LSMB) tombs, not to mention the rich supplementary information available from historical documents, more interesting studies could be challenged in near future. This study was achieved with the support of national R&D project hosted by National Research Institute of Cultural Heritage of Cultural Heritage Administration (NRICH-1107-B09F-1)

360 Leishmaniasis in 15th Century Italian Nobles and Mercury Treatment, ANTONIO LANZIROTTI¹, RAFFAELLA BIANUCCI^{2,3,4}, CLIFFORD QUALLS⁵, EZIO FERROGLIO⁶, ANDREAS G. NERLICH⁷, VALENTINA GIUFFRÀ⁴, GINO FORNACIARI⁴, and OTTO APPENZELLER^{8*} (¹National Synchrotron Light Source, Brookhaven National Laboratory, Upton, NY 11973, USA; ²Laboratory of Criminalistic Sciences, Department of Anatomy, Pharmacology and Legal Medicine, University of Turin, Italy; ³Biocultural Anthropology Unit, UMR 6578 CNRS-EFS, Faculty of Medicine, University of Marseilles, France; ⁴Division of Paleopathology, History of Medicine and Bioethics, Department of Oncology, Transplants and Advanced Technologies in Medicine, University of Pisa, Italy; ⁵Department of Mathematics and Statistics, University of New Mexico, Albuquerque, NM, USA; ⁶Laboratory of Parasitology and Parasitic Diseases, Department of Animal Production, Epidemiology and Ecology, University of Turin, Italy; ⁷Institute of Pathology, Academic Teaching Hospital München-Bogenhausen, Munich, Germany; ⁸NMHEMC Research Foundation, Albuquerque, NM 87122, USA (ottoarun12@aol.com).

The European 15th century saw an epidemic of syphilis. Treatment for all skin lesions at that time, including syphilitic ulcers,

was by mercurial ointments copiously applied to all rashes without regard to etiology.

We examined muscle and hair from Ferrante of Aragon, King of Naples (1469-1496), and bone and hair from Isabella of Aragon (1470-1524). We used immunoassays to detect leishmaniasis and malaria on bone and muscle, hydrogen isotope ratios along the length of hair, and microfocused synchrotron X-ray fluorescence analyses of single hairs from both nobles.

We found Isabella and Ferrante positive for antibodies to visceral leishmaniasis, but it is not known whether they suffered from syphilis. Both had high levels of mercury in their hair. Ferrante's hair, over a period of two days, contained mercury reaching 10,000 ppm, whereas the remaining two days analyzed were around 150 ppm. This implies that a portion of the mercury was externally applied to the hair rather than accumulated by metabolic processes. The growth of Ferrante's hair was 12 cm/year, Isabella's hair 2 cm/year (normal growth rate ~16-17 cm/year). Tests for malaria were negative in both individuals. Biologic rhythms, as judged from power spectra of the hydrogen isotope ratios and of mercury levels at micrometer intervals along the lengths of the hairs of both individuals, were severely disrupted.

Our results extend the possible therapeutic range of mercury ointments to leishmaniasis in Renaissance Europe.

361 Rethinking Anthracosis: A Critical Re-examination of a Diagnostic Trend, (Case Study from a 19th Century West Virginian Mummy), JULIA WOODWARD^{1*}, CATHERINE GAITHER¹, RAMONE GONZALEZ², RONALD G. BECKETT², GERALD J. CONLOGUE², CARLYNE COOL^{3,4}, and STEVE GROSHONG⁴ (¹Metropolitan State College of Denver, Denver, CO; ²Quinnipiac University, Hamden, CT; ³University of Colorado, Denver, CO; ⁴National Jewish Health; jhwoodw@yahoo.co.uk).

The specific aims of the study was to first biopsy a lesion noted on plane radiographs and computed tomography scan taken in 2001 and then to rehydrate and examine the tissue for pathology.

The biopsy was performed on a female mummy from West Virginia, who had died in 1888. The procedure was done at the Barbour County Historical Society Museum in Philippi, West Virginia. Approximately half the lesion was removed for processing. Samples were processed at National Jewish Health laboratories using a modified version of the Sandison technique to rehydrate. They were then placed in a tissue processor, embedded in paraplast x-tra, mounted on slides, and routinely stained with hematoxylin and eosin.

Outcomes: Severe emphysema and moderate to marked anthracosis were found. Research into anthracosis revealed generalized use of the term to describe black carbon pigmentation in the lungs, despite the fact that medical literature defines anthracosis as a form of pneumoconiosis marked specifically by the presence of coal dust in the lungs. Because the mineral source determines particle distribution and subsequent lesion development, differential diagnosis between the different forms of pneumoconiosis, such as silicosis, should be employed. Determining the source of the pigmentation may be a vital regional or economic determinate.

362 Dental Morphology of a Juvenile Mummy from the Shelton Expedition: Observations and Measurements Made from CT Scans and Stereolithography, HEATHER EDGAR^{1*} and SHARA BAILEY² (¹Department of Anthropology and Maxwell Museum of Anthropology, University of New Mexico, Albuquerque, NM

87131; ²Department of Anthropology, New York University, 25 Waverly Place New York, NY 10003; hjhedgar@unm.edu).

Dental morphology is an effective method with which to trace intra- and inter-population relationships. Dental morphological studies analyze data from observations of standardized morphological characteristics found on the crown surfaces of teeth, such as shovel-shaped incisors and Carabelli's trait. The fact that dental morphology is genetically controlled, evolutionarily conservative and comparable through time makes it ideal for exploring biological distance among groups as well as individuals' relationships to populations.

Usually dental morphological data is gathered through direct observations of teeth. However, such observations are often impossible when studying mummies. For this study, highly precise computed tomography images of a mummy from the 1920 Shelton Expedition to Egypt were employed to permit non-destructive observations of tooth morphology. First, the images of the teeth were isolated from the image of the surrounding tissue, so that the surfaces of the teeth could be visualized. Second, the tomographic images were used to direct stereolithographic "printing" of the teeth for direct observation and measurement.

The resulting images and "printed" teeth were examined in order to score dental morphological variants of the occlusal and dentin-enamel surfaces of the deciduous and permanent teeth. These observations were then compared with dental trait frequencies from various populations that inhabited the geographic area at the time of the mummy's life. This data provides information about the mummy's biological affiliation that would not have been possible non-destructively without the use of advanced imaging techniques.

363 Preliminary Analysis by FTIR Spectroscopy of Ancient Egyptian Embalmed Heads from the Museum of Anthropology and Ethnography of the University of Turin, Italy, (MARIA GRAZIA BRIDELLI¹, ALIDA DELL'ANNA¹, ROSA BOANO^{2*}, and SERGIA DE IASIO³ (¹Physics Department, University of Parma, Italy; ²Department of Animal and Human Biology, University of Turin, Italy; ³Human and Animal Biology Department, University of Parma, Italy; rosa.boano@unito.it).

FTIR spectroscopy has been employed to verify the preservation state of some Egyptian embalmed heads stored in the Museum of Anthropology and Ethnography of Turin (Italy). The aim of the research is to document preserved molecular information, cultural treatment and general condition of the tissues in order to plan modern conservation procedures. Eight embalmed heads and one naturally mummified were tested. Infrared absorption measurements were performed in transmission mode, within the 4000-250 cm⁻¹ wavenumber range on pellets obtained by mixing ~1.5 mg of sample with KBr (100 mg). The infrared spectra of the ancient skin specimens were compared with the spectrum of a modern skin sample. The preservation of the samples state was evaluated on the base of the position and shape of the proteins characteristic bands: Amide A, B, I II and III) and lipids ($\nu_{as}(\text{CH}_2)$ and $\nu_s(\text{CH}_2)$, $\delta_{sciss}(\text{CH}_2)$ and $\delta_{rock}(\text{CH}_2)$). Different degrees of deterioration were observed: some

samples were in a quite good preservation state and other ones displayed a rather high protein deterioration evidenced in the deformation of Amide I and II features, the preservation degree growing with the depth of the layers of collected skin. One of them showed a very high degradation state testified by huge modifications of the protein and lipid bands and by the presence of some adipocere characteristic absorption bands. The naturally mummified sample seemed the best preserved. The occurrence in the spectra of some features extraneous to the biological nature of the samples has been related to embalming chemicals.

AAAS, Pacific Division Monday, starting at Noon in KIPJ Rooms C and D

HEALTH SCIENCES

364 Association of Marijuana Use and Active Caries in a National Probability Sample, MONIQUE R. BELIN*, **EUGENIO AQUINO***, **YAN WANG**, **HONGHU LIU**, and **MARVIN MARCUS** (California Endowment Pipeline Program, Division of Public Health and Community Dentistry, UCLA School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095; monique.belin@email.saintleo.edu, Aquino_Eugenio11@yahoo.com).

According to the National Health and Nutrition Examination Survey (NHANES), there were approximately 86 million participants that reported ever using marijuana. Marijuana users are known to develop dry mouth and to eat snacks after smoking. This study examines the association between marijuana use and active caries, considering demographic and behavioral characteristics, in a national probability sample. This cross-sectional analysis utilizes NHANES 2005-2006 data. The study sample represents a total weighted population of 146 million adults ages 20 to 59. The dependent variable is the presence or absence of active decay. Marijuana use is the independent variable, with sociodemographic variables as covariates. Using a multivariate logistic regression analysis with complex survey design, the weighted results indicate that marijuana is a significant factor when demographic and behavioral variables are included. Furthermore, marijuana users are 34% more likely to have caries present than non-users. Females are 26% less likely than males to have active caries. Those with the lowest education (less than 9th grade) were almost 6 times more likely as those with the highest education (above college); obese people are 36% more likely as non-obese. African Americans were more than 2 times more likely to develop dental caries as whites, while Mexicans were 50% more likely. There was no difference between non-Mexican Hispanics and whites. Unexpectedly, sugar intake and age were not significant. This analysis indicates that marijuana is a risk factor for caries, which may be related to other behavioral, healthcare access, or variables not included in this study.

365 Vitamin D Deficiency in Humans Associates with Delayed P300 Latency and Reduced Voltage Predicting Cognitive Decline, ERIC R. BRAVERMAN¹, KENNETH BLUM^{2,3*}, KENNETH PERRINE¹, and UMA J. DAMLE² (¹Department of Neurological Surgery, Weill Cornell College of Medicine, 525 East 68th St, New

York, NY 10065; ²Path Foundation NY, 304 Park Ave South, 6th Fl, New York, NY 10010; ³Department of Psychiatry, University of Florida, 100 Newell Drive, Gainesville, FL 32610; drd2gene@aol.com).

Low levels of Vitamin D are associated with substantial cognitive decline in the elderly using MMSE. To date, no study has evaluated cognitive decline in Vitamin D deficient patients attending a multidisciplinary medical clinic utilizing ERP P300 measurements.

80 patients having varied clinical diagnoses were assessed (mean age=53.99; [19.5y, 79.7y]). They were 58.75% female and 41.25% male. We compared serum 25(OH)D deficient (<25 nmol/L) patients (N=28) to those with normal 25(OH)D levels (>25 nmol/L).

Patients with Vitamin D deficiency had average P300 latency and voltage of 335.52ms and 4.720microV, respectively; the normal Vitamin D group had average P300 results of 327.71ms and 5.36microV, respectively. The average PTH levels were 36.11pg/mL and 45.52 pg/mL, for the Vitamin D deficient and normal group, respectively.

ANOVA of gender and Vitamin D levels was not significant for P300 latency, but the interaction term, gender x Vitamin D level, in the ANOVA for P300 voltage was significant (F=4.40, p=.039). Examination of the means showed that for males, P300 voltage was significantly greater (t=-2.33, p=.027) in the normal (5.83) vs low (3.39) Vitamin D groups. Although the overall model for PTH was not significant, examination of the means showed a trend for females, such that PTH was significantly greater (t=-2.33, p=.024) in the normal (45.40) vs low (32.19) Vitamin D groups.

Our data concurs with reports suggesting Vitamin D deficiency is associated with increased odds of cognitive decline in the elderly. Further exploration of a possible causal relationship between Vitamin D deficiency and cognitive decline is warranted.

366 Relationship Between Adiposity and Physical Function in Older Adults, ANPALAKI J. RAGAVAN (Department of Biomedical Engineering, University of Nevada, Reno, NV 89557; ragavan@unr.edu).

Mobility related disability is directly related to markers of adiposity such as body mass index(BMI) and percentage of fat mass. Experts even recommend maintaining weight to prevent excessive loss of muscle mass in old age. Limited studies have analyzed the ability of markers of central adiposity to predict future disability in adults. In this study direct measures of physical function (sit to stand (STS), biceps curl (BCL), balance (BAL) and back scratch (BCT)) were analyzed in relation to BMI and age in 333 participants both male and female. Participants were divided into six age groups (<30years(n=37), 30-40years(n=53),40-50years(n=92), 50-60years (n=92), 60-70years(n=51) and >70years(n=8)) and the mean scores from physical function tests for older obese (BMI≥30kg/m²) and non obese(BMI<30kg/m²) participants were compared to that from the younger reference group (<30years). STS and BCT in the ≥=60 year old obese group were more than one standard deviation below the mean of the young reference group, and is associated with a two- to threefold increased risk of disability. Scores from all function tests significantly decreased with age (p<0.01 for all) in the obese group. Only BCT significantly decreased (p=0.008) with age in the non-obese group. Overall scores from all function tests except BCL were significantly lower (p<0.0001) in the obese compared to the non obese group. Large BMI may be an indication of low extremity performance related to future mobility limitation in older adults.

367 Role of Muscle Mass in Weight Loss Among Obese Women, ANPALAKI J. RAGAVAN (Department of Biomedical Engineering, University of Nevada, Reno, NV 89557; ragavan@unr.edu).

Low muscle mass associated with decreased function, can be an indicator of higher body weight. Loss of muscle mass with weight loss may not be fully recovered with weight gain in old age. The influence of age, percent body fat(PFAT), muscle mass(MM), body water content(BWC) and body mass index(BMI) on weight loss(WL) over a period of 12 weeks was investigated in two groups of obese (BMI \geq 30), i) insulin resistant (fasting insulin level \geq 15 μ U/mL, n=44) and ii) insulin sensitive (fasting insulin level $<$ 15 μ U/mL, n=46) women. Age of participants in both groups varied between 20 and 65 years. Participants were devoid of any other conditions. PFAT, MM and BWC were measured at baseline and at 12 weeks. WL and BMI were estimated from weights in kg, measured at 4-weeks interval. WL followed a log normal distribution. Repeated measures analysis of variance with generalized liner mixed models was performed after transforming WL(dependent variable), linear. In the insulin sensitive group older women ($p=0.0133$) and women with larger BMI ($p<0.0001$), PFAT ($p=0.0190$) or BWC($p=0.0133$) but smaller MM($p<0.0001$) showed smaller WL. In the insulin resistant group WL was not related to age, PFAT or BWC but significantly increased with MM ($p<0.0021$) and decreased with BMI ($p<0.0001$). Results indicate that MM plays a significant role in weight loss in obese women. Part of the patients' body weight and subsequent positive results in weight loss could be due to pure fat, muscle mass or body water or some interaction among the three.

368 Frequency of Pregnancies and Long-Term Effects of Periodontal Disease in a National Probability Sample, LOLIYA BOB-MANUEL*, MARISOL CEBALLOS*, JOSE M. RODRIGUEZ*, YAN WANG, HONGHU LIU, and MARVIN MARCUS (California Endowment Pipeline Program, Division of Public Health and Community Dentistry, UCLA School of Dentistry, 10833 Le Conte Avenue, Los Angeles, CA 90095; loliya.bobmanuel@gmail.com, marisol.d.ceballos@gmail.com, jorodriguez76@gmail.com).

Research shows an association between pregnancy and gingival bleeding, a transitory condition of periodontal disease (PD). This study examines whether there is an association between the frequency of pregnancies and long-term effects of PD, specifically loss of attachment (LOA): loss of bone supporting the teeth measured using ≥ 4 mm as indicative of the presence of PD. The 2003-2004 National Health and Nutrition Examination Survey (NHANES), representing 74 million US women, aged ≥ 18 , was used. The dependent variable is loss of attachment (LOA). The independent variable is number of pregnancies. The covariates consist of demographic, need and health indicators. A complex survey design and the statistical techniques, bivariate chi square (χ^2) test and a multivariate logistic regression analysis, were used to determine whether the number of births would be a strong predictor for LOA. The χ^2 analysis found that there was a significant relationship between frequency of pregnancies and LOA ($P < .0001$). The multivariate model showed no statistical relationship between LOA and number of pregnancies controlling for socio-demographic, need, and health indicators. Age was expectantly found to be highly correlated with LOA; compared to the youngest age group, the middle and oldest groups were 5 and 10 times, respectively, more likely to have LOA. Those who perceived the need for gum treatment were almost 4 times more likely than those who did not. Although there was no relationship between pregnancy and PD; perceived need for

gum treatment is associated with LOA, indicating that perceived need for treatment predicts clinically determined need.

SOCIAL, ECONOMIC AND POLITICAL SCIENCES

369 How to Live to Be 100: Utah Centenarians in Their Own Words, THOMAS W. DRAPER* and ELENA OLIVER (School of Family Life, Brigham Young University, 2102B JFSB, Provo, UT 84602; draper@byu.edu).

Previous research has stressed the need for more studies about successful aging. From 2007 to 2010 the 315 different centenarians living in Utah were asked by the Utah State Division of Aging and Adult Services to state the reasons for their longevity. 159 responded. Their replies were grouped into 12 different categories by three independent raters. The categories in descending order of how frequently they were mentioned were: diet (67%), exercise (60%), attitude (44%), work (42%), people (36%), faith and religion (30%), heredity (28%), luck (14%), practices to avoid (12%), things to do (9%), medical assistance (8%), and other (6%). The statements by the centenarians have a certain face validity and charm. Examples of dietary advice were: "Always eat fresh foods" and "There is always room for dessert!" An example from the "other" category was, "I guess the Lord don't want me and the devil doesn't know what to do with me!" Since 90% of the stated reasons were actions the individuals had control over, the responses were considered in terms of self-attribution theory. The tendency toward positive self-attributions might result in reasons like heredity, luck, and medical assistance being underrated, whereas some of the other factors may be overrated. On the other hand, perhaps a strong belief in one's ability to positively affect the outcome of one's life, not to mention being able to see the humor in the involuntary celebrity status that often comes with successful aging, are factors in longevity.

COMPUTER and INFORMATION SCIENCES

370 Quadcopter Aerial Monocular Vision for Improved Autonomous Robot Navigation, KENNY LEI (Walnut High School, 400 N. Pierre Road, Walnut, CA 91789; leifamily3@yahoo.com).

Conventional ground robot navigation and path finding is often inefficient and time-consuming, especially in a maze-like environment. Aerial vision, however, provides a novel perspective in finding the path finding for robot navigation. Aerial vision in combination with ground robot was compared to solely ground robot navigation for operational time.

A ground robotics platform was based off an iRobot Create and laptop. Aerial vision was achieved through the Parrot AR.Drone quadcopter with a built-in camera. A laptop was connected to the camera feed of the quadcopter via socket connections to its wireless network. Java programming language was used for both quadcopter control and image processing. The quadcopter was initiated and hovered above the robot and maze environment. Images acquired were initially processed to classify regions as either obstacle or traversable area. Start and end point regions were then classified within the image. A breadth first search (BFS) algorithm was employed to determine the shortest navigational path that avoids obstacles. When a traversable path between the detected start and end points is found, the ground robot is sent movement

vector commands to navigate around the obstacles.

After a series of trial runs, the novel navigation yielded an average run time of 38.45 seconds while the conventional navigation resulted in an average run time of 140.57 seconds. The addition of aerial vision from the quadcopter resulted in a 72.6 percent improvement in operation time for the ground robot. These findings demonstrate rich data provided from aerial imagery significantly enhances and improves robot navigation.

371 An Algorithm to Determine Protein Structure Using Secondary and Tertiary Structure Prediction, VIKRAM SUNDAR (The Harker School, 500 Saratoga Ave, San Jose, CA 95129; 14vikrams@students.harker.org).

Protein structure prediction is key to finding cures for diseases such as cancer. Today biochemists spend years determining protein structure. Determining how a protein folds into a three-dimensional shape is a complex problem. Protein structure has four levels: primary, the sequence of amino acids; secondary, the local structure; tertiary, the location of a subunit's atoms; and quaternary, the overall structure. Secondary structure is classified into motifs, such as helices or sheets. I wanted to predict tertiary structure by using residue propensity, the probability that a given amino acid forms a particular motif. To validate the results an RMSE analysis calculated the error in the predicted structure. The goal for this algorithm was to achieve a low RMSE in 80% of all proteins. My algorithm built a table of residue propensities by reading the entire Protein Data Bank. Using this data, it predicted secondary structure given the amino acid sequence. Then, the algorithm performed threading, i.e. using the structure of known proteins with similar sequences to complete the predicted structure. Finally, my algorithm calculated the coordinates of the central atoms of each amino acid in the protein based on this information. To allow viewing of the predictions sample pdb files were produced, which can be viewed using Jmol. My algorithm was successful in producing low-RMSE predictions in 80% of cases tested. It is fail-fast, meaning that confidence values are high for predicted structures. In addition, my algorithm predicted structures within thirty minutes, a major improvement over the years biochemists need.

AGRICULTURE and HORTICULTURAL SCIENCE

372 Non-Cytotoxicity of Novel Antifungal Aminoglycosides in Mammalian Cells, SANJIB SHRESTHA^{1,3*}, CHENG-WEI TOM CHANG^{2,3}, MARINA FOSSO², YUKIE KAWASAKI¹, MICHELLE GRILLEY¹, and JON Y. TAKEMOTO^{1,3} (¹Department of Biology, Utah State University, 5305 Old Main Hill, Logan, UT 84322; ²Department of Chemistry and Biochemistry, 0300 Old Main Hill, Logan, UT 84322; ³Synthetic Biomanufacturing Center (USTAR), 620 North 600 East, Utah State University, Logan, UT 84341; sanjib.shrestha@usu.edu).

Many neamine-based aminoglycosides, such as kanamycin, and streptomycin, are antibiotics that effectively kill bacteria. In contrast, novel aminoglycosides FG08, FG03 and K20, derived from kanamycins, are inhibitory to fungi and oomycetes, but they do not inhibit bacteria. The latter compounds share the structural feature of a C8 alkyl chain containing a glycosyl moiety attached to the neamine core. As potential fungicides for use in agriculture and medicine, the effects of these novel compounds on mammalian cells are of interest. The purpose of this study was to examine

the cytotoxicity potential of FG08, FG03, and K20 against mammalian cells. FG08 and FG03 were synthesized from kanamycin B and K20 from kanamycin A. Cytotoxicity activities were evaluated in mammalian cell lines C8161.9 (melanoma) and NIH3T3 (mouse fibroblast) by measuring the activity of cellular reductase that reduces 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyltetrazolium bromide (MTT) to formazan. Antifungal activities were determined as minimal inhibitory concentrations (MICs) using microbroth dilution growth inhibition assays. FG08, FG03, and K20 showed dose-dependent cytotoxicities to C8161.9 and NIH3T3 cells. Half-maximal cytotoxicity (LC50) values for C8161.9 and NIH3T3 cells ranged between 500 to 650 $\mu\text{g mL}^{-1}$ and 250 to 650 $\mu\text{g mL}^{-1}$ respectively. FG08 was the most and K20 the least cytotoxic. FG08, FG03 and K20 showed antifungal MICs ranging between 7.8 and 62.5 $\mu\text{g mL}^{-1}$ against *Fusarium graminearum* and 15.6 and 65.5 $\mu\text{g mL}^{-1}$ against *Pythium ultimum*. FG08, FG03, and K20 are not cytotoxic to mammalian cells at concentrations equivalent to their antifungal MICs. These novel aminoglycosides appear attractive for applications as fungicides in medicine and agriculture.

373 Scalable Production of Syringomycin E as an Organic Compatible Agrifungicide, YUKIE KAWASAKI*, MICHELLE GRILLEY, and JON TAKEMOTO (Department of Biology, Utah State University, 5305 Old Main Hill, Logan, UT 84322; yukie.kawasaki@usu.edu).

Syringomycin E (SRE) is a cyclic lipodepsipeptide produced by the plant-associated bacterium *Pseudomonas syringae*. It displays fungicidal properties and may have a role in microbial competition on plant surfaces. SRE is lethal to a broad range of phytopathogenic fungi and is not antibacterial or toxic to animal cells. As a natural product, SRE has potential for use as an organic compatible agrifungicide. For such applications, standards as specified by the USDA National Organic Program must be met. The aims of the project are to develop *P. syringae* strains, cell growth parameters, and SRE purification procedures to facilitate SRE's use as an organic agrifungicide. *P. syringae* B301D was subjected to ultraviolet light mutagenesis and selection procedures to obtain isolates with enhanced SRE production. Growth was conducted in an Omni-culture (VirTis) bioreactor, and SRE was purified after isopropanol extraction, XAD-2 chromatography and HPLC. Isolate G10 displayed enhanced SRE production in a newly formulated and organic-compatible growth medium (ISM) (50 $\mu\text{g L}^{-1}$ SRE in 48 h). Approximately 50% of the SRE produced was recovered after extraction and chromatographic purification using organic-compatible isopropanol throughout the process. A *P. syringae* isolate (G10), a growth medium formulation, and purification procedures were developed for the scalable production of SRE using materials and processes compatible with USDA National Organic Program standards.

EARTH SCIENCES

374 Modeling the Climate Effects of 21st Century Global Warming on Selected Ski Resorts in Western Canada, MICHAEL PIDWIRNY (Unit 2: Biology and Physical Geography, Irving K. Barber School of Arts and Sciences, University of British Columbia, Science Building, 1177 Research Road, Kelowna, British Columbia, Canada, V1V 1V7; michael.pidwirny@ubc.ca).

The Intergovernmental Panel on Climate Change (IPCC)

believes the continued emission of greenhouse gases by human activity will further increase average global temperatures by 1.1 to 6.4° C by the end of the 21st century. Being able to predict how global warming will modify human economic systems is important for developing adaptation and mitigation strategies. One human economic system that may be detrimentally influenced by warmer temperatures and changes in precipitation is recreational skiing and snowboarding. To date, research on the influence of global warming on this recreational sport has been rudimentary. The reason for this is the lack of quality climate data for analysis. This research uses spatially interpolated climate data to determine the effect of global warming on six ski resorts in Western Canada for the years 2050 and 2080. Three climate variables were selected to determine the influence of climate change on the viability of the ski resorts: snowfall, number of frost days, and degree days <0° C. Computer model output suggests a range of possible predicted outcomes for the ski resorts depending on GCM model and emission scenario used. Despite the range of outcomes, it is clear from the analysis that resorts closest to west coast of Canada will be most influenced by global warming, while locations in the interior will be least affected. For the resorts studied, changes in snowfall are less of a problem than changes in the two temperature related variables.

SCIENCE and TECHNOLOGY EDUCATION

375 *Mosquito Biodiversity in San Diego: Human and Environmental Health Concerns*, **AMALIA R. BERSIN***, **LILIA GALVEZ***, and **JAY S. VAVRA** (High Tech High, 2861 Womble Road, San Diego, CA 92106; mbersin@gmail.com).

Mosquitoes are vectors for a variety of lethal pathogens from devastating malaria, to the current widespread West Nile virus which extends to other vertebrates. To effectively act on global health threats the talents of people from many disciplines are needed. A new approach to science education is necessary to solve such complex, real world problems. As an integral part of High Tech High's Biotechnology Program, the approach is inquiry-driven project-based learning, where students learn and practice vital lab skills while conducting original research. In this project molecular tools were used to study the biodiversity of mosquito populations of the San Diego Region. Multiple sub-disciplines of biology were applied throughout this project including: molecular biology, ecology, pathology, and evolution. Additionally, this study examined the role climate change plays in the spread of disease and the biogeography of mosquitoes.

Groups of students initially gathered background information on mosquito biology, methods of eradication and human/environmental health issues. Mosquito biodiversity was surveyed by each student creating their own collecting site within their backyard using a 3 liter plastic tub filled with water and algae. Mosquito larvae were found in multiple locations and samples were collected for species identification. Larval morphology was documented with microscopy and DNA barcoding used to identify individual specimens at the species level. The study identified five different species of mosquitoes. A research manuscript was compiled which includes the process of studying mosquito populations and provides a meaningful and authentic curriculum for the most relevant current human and environmental health issues.

376 *Development and Implementation of a Workshop on Inclusive Teaching for Undergraduate and Graduate Teaching Assistants by Postdoctoral Scholars at UCSD*, **SANDRA L. CLEMENT***, **SAURABH JOSHI**, **SUZANNE R. LEE**, **EVAN C. MERKHOFFER**, **STEFANIE OTTO**, **MARTA VICENTE-CRESPO**, and **GABRIELE WIENHAUSEN** (Division of Biological Sciences, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0322; slclement@ucsd.edu).

The loss of talented students from Science, Technology, Engineering and Math (STEM) majors is a major challenge for U.S. technological advancement and global competitiveness in the 21st century. Although inclusive teaching strategies can help student retention, formal instruction in pedagogy has not traditionally been a part of STEM graduate education and is often completely absent from postdoctoral training. Thus, increased access to training in pedagogy for student teaching assistants (TAs) and postdoctoral scholars has the potential to improve the quality of instruction in the STEM classroom. In order to provide TAs with the advice and tools they need to create a safe learning environment that respects student diversity and encourages learning, a group of postdoctoral scholars in the Division of Biological Sciences at UCSD have developed a TA training workshop on inclusive teaching. We began our development of this workshop by reviewing a series of relevant readings and discussing the roles that identity, diversity, and unconscious bias play in the classroom. Currently, our workshop uses a combination of self-reflective and group activities to personalize diversity issues and model best practices for inclusive teaching. Based on participant pre- and post-surveys, this workshop has been successful in promoting awareness of unconscious bias and providing strategies that participants can use in their classrooms to facilitate and encourage student learning. We will discuss the format for our workshop as well as the process for preparing postdoctoral facilitators and efforts to ensure sustainability and replicability.

ATMOSPHERIC and OCEANOGRAPHIC SCIENCES

377 *Analysis of Climate and Tree Growth over the Last 1000 Years Using Tree Rings from the Qinghai-Tibetan Plateau*, **ARMAND ANSELMO*** and **ZHI-YONG YIN** (Department of Marine Science and Environmental Studies, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; aanselmo-10@sandiego.edu).

One of the most abundant and reliable climate proxies available to scientists today is in the form of tree-ring samples. Through further analysis of tree-ring chronologies, scientists have been able to extract climate variation patterns relating to specific environmental variables, such as soil moisture, precipitation, and temperature. Qilian junipers, *Sabina przewalskii* Kom., from the northeastern Tibetan Plateau have been used to produce extensive tree-ring chronologies. This project uses tree-ring chronologies to investigate the climate of two 200-year periods, 1100-1300 CE and 1600-1800 CE, in comparison with the climate of 1800-2000 CE. These three periods coincide with periods of unusual climate over the past 1000 years, i.e. "Medieval Warm Period", "Little Ice Age", and "Post-Industrial Warming" (IPCC 2007), respectively. Statistical methods, such as various descriptive statistics, correlation analysis, and inferential tests, were used to investigate how tree growth varied during these time periods. It was found that climate and tree-growth have statistically significant relationships, and that these relationships differ with elevation. In addition, it was found

that tree-growth fluctuated between each 200-year time period, with the greatest growth occurring during the “Post-Industrial Warming” period (1800–2000 C.E.). The results also show that high elevation tree growth correlated well with low elevation growth during the “Post-Industrial Warming”, but high and low elevation tree growth did not correlate during the “Little Ice Age”. This shows that growth conditions were similar at high and low elevations during the “Post-Industrial Warming” and different during the “Little Ice Age”, which reflects the climatic inconsistencies between these two periods.

378 *The Bioclastic Composition of Carbonate Sediments in Hurricane Hole and other Coral Reef Environments, St. John, USVI*, **CASEY CHAPMAN*** and **SARAH GRAY** (Department of Marine Science and Environmental Studies, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; caseych-10@sandiego.edu).

Tropical corals tend to grow in clear waters with minimal suspended sediments, however in Hurricane Hole, a bay located on St. John, USVI, a coral community has managed to flourish at the head of the bay’s mangrove habitat. Few studies have been conducted in this bay and little is known about the coral’s health and method of survival. My research focused on the carbonate portion of the bays’ bottom sediment. The main goals of my research were to identify the composition of carbonate sediment in Hurricane Hole, determine how the composition varies with distance from the shore, and to compare the carbonate composition of Hurricane Hole to other established coral reef environments around St. John. Bottom samples were collected in Hurricane Hole and wet sieved into size fractions >500 μ and 250–500 μ , then identified and point counted up to 300 grains. In the >500 μ size fraction, the primary sources of grain production were echinoderms and *Halimeda*; no coral was found. In the 250–500 μ size fraction however, coral was found to be one of the main bioclasts, along with echinoderms and *Halimeda*. The fact that the corals in this bay are contributing to smaller size fractions of sediment may indicate the health and productivity of the community. This information is important in gaining an overall understanding of this unique coral habitat.

ECOLOGY, ORGANISMAL BIOLOGY and ENVIRONMENTAL SCIENCES

379 *Scrubbing the Air: Reducing Carbon Dioxide Levels with Frageria californica, Galvezia speciosa, Heteromeles argutifolia, and Salvia clevelandii*, **CAROLINE FROST** (Chaminade College Preparatory School, Los Angeles, CA and Loyola Marymount University, Los Angeles, CA; Frost_Owen@yahoo.com).

The purpose of this study is to explore the impact on a plant’s photosynthetic rate as atmospheric CO₂ concentrations are increased. I used the following four plants, native to Southern California: *Frageria californica*, *Galvezia speciosa*, *Heteromeles argutifolia*, and *Salvia clevelandii*. My hypothesis was that there would be an initial increase in rate, but that as CO₂ increased, the stomata would start to shut the leaf down. To test my hypothesis, I used a LI-COR 6400XT Portable Photosynthesis System, in the lab of Dr. Phillipa Drennan at Loyola-Marymount University. The LI-COR machine uses gas exchange principals in a sealed leaf chamber to determine the amount of CO₂ consumed in the photosynthetic process. Five plant specimens of each species were tested and the results averaged to

limit the influence of experimental error. Independent variables such as atmospheric pressure, illumination level and lab air temperature were limited by calibrating the LI-COR machine before each test. In addition, for each concentration level of CO₂, the leaf chamber was allowed to reach a steady state before measurements were taken. The study analyzed the photosynthetic rate and the efficiency of that photosynthetic rate for CO₂ atmospheric concentrations of 250 ppm, 400 ppm 550 ppm and 700 ppm. The result of the study showed an illumination of 1500 uMoles flux, *salvia clevelandii* had an increase in photosynthetic rate and efficiency for all concentration levels. *Frageria californica*, and *Galvezia speciosa* demonstrated increased inefficiency demonstrating that the biochemical machinery cannot make use of the available CO₂.

380 *Examination of Physiological and Behavioral Effects on White Seabass Atractoscion nobilis in a Closed Recirculating System*, **SAMUEL M. HOLLEY** (Huntington Beach High School, 1905 Main Street, Huntington Beach, California, 92648 USA; samuelmholley@gmail.com).

Over the past 25 years the white seabass, *Atractoscion nobilis*, has been propagated in open seawater systems as a means to sustain population of the commercially important fish. This study examines the feasibility of, and baseline parameters necessary for, growing white seabass in a closed recirculating system. Juvenile white seabass were obtained from Hubbs-Seaworld Research Institute and held for 90 days in aquaria containing artificially mixed saltwater. Water flow, water chemistry system design, light conditions, seawater composition, behavior, feeding rate, growth rate, stocking density, and animal stresses were documented. The fish were held at an average temperature of 19.0 °C. Other than water chemistry and lighting, the conditions and behaviors for the fish were very similar to that of the open water systems. Throughout the study, the main discrepancies occurring in an artificial environment rather than in a natural one were periods of high nitrate and nitrite levels, fish eating behavior, and color changes in the fish based on lighting. At the end of the 90 day trial period, 91% of 22 fish survived. Loss of only 9% of the animals is well within the acceptable losses that occur in white seabass cultured in open water systems. While this study documents the feasibility and baseline parameters necessary for the propagation of white seabass, additional experimentation is needed to optimize fish growth.

ANTHROPOLOGY and ARCHAEOLOGY

381 *Analysis of Hair Attributed to an Unidentified Species of Primate*, **KYLE GRAGG**, **JEFF MELDRUM***, and **HENNER FAHRENBACH** (Department of Biological Sciences, Idaho State University, 921 S. 8th Ave, Pocatello, ID 83209; meldd@isu.edu).

Multiple samples of hair of unknown source collected independently from forested habitats throughout western North America were characterized and contrasted with samples of human and non-human primates, as well as various wildlife species common to the region. Under light microscopy the samples exhibit many distinct but remarkably consistent characteristics. The samples range in color from dark reddish black to blonde, resulting from varying proportions of eumelanin and pheomelanin pigment granules; wavy to slightly curly in parts; mean diameter of 65 μ m (range 58–73 μ m); cross-section round to slightly flattened entire length; non-medullated, or minimal fragmentary medulla; cuticle an irregularly waved mosaic; scale distance intermediate; margins smooth

to mildly crenate; 9-12 scales per 100 μm linear distance. Most hairs had smoothly rounded, worn, uncut termini. A sample from Texas was of particular note, due to the quantity of hair rolled into a “dreadlock.”

Comparisons of the samples with hair characteristics of common wildlife, human and non-human primates resulted in no positive match. However, the sample exhibits both human and non-human primate characteristics. Heavy pigment granule concentration differs from human, where pigment is concentrated near the medulla or the center of the cortex. The sample seems to have a more robust cuticle than that of a human hair. This evidence suggests that there is an unidentified species of primate in North America that has a mosaic of human and non-human primate hair morphology.

382 Incomplete Lumbar Spine and Its Applications in the Estimation of Sex, MARIA JELACA-TAVAKOLI^{1*} and MARY E. LEWIS² (¹Department of Behavioral Sciences, Southwestern College, 900 Otay Lakes Rd., Chula Vista, CA 91910, USA; ²University of Reading, Department of Archaeology, Whiteknights, Box 226 Reading RG6 6AB United Kingdom; mtavakoli@swccd.edu).

The estimation of the sex of unknown individual is a critical step for any forensic anthropologists, but due to missing elements or poor preservation of the remains this often may not be possible. This blind anthropometric study concentrates on lumbar spine because it often survives various pre and post mortem assaults. The study further reconfirms that sexual dimorphism in human lumbar spine exists and that it can be used for the estimation of sex through means of osteometry, even in cases in which one or more vertebral segments are missing and all while fully disregarding ethnic background. The Maximum Lumbar Length (ML) of L4 and L5 (144 vertebra, N= 46 and N=98 female and male) were collected from the Maxwell Collection. The sex of the skeletal population was first estimated when ML's of L4 and L5 were combined and compared to vertebral standard (23.30 cm) resulting in 76% accuracy. Missing vertebral dimensions L1, L2 and L3 were supplemented by its standards and added to previous estimates (resulting in total of 39.00 cm) which when compared to pre-recorded biological sex showed that in 19 out of 72 individuals or 74% of the cases resulted in accurate estimates. Durability of the lumbar spine and attributes of the ML as well as applications of the supplement vertebral standards for missing spinal elements advocate further research and use of the sexually dimorphic features of the lumbar spine of *Homo sapiens* aiding identification of sex regardless of ethnic background in clinical, anatomical, forensic and osteoarchaeological contexts.

ORAL BIOLOGY and DENTAL MEDICINE

383 Developing a Rat Model of Facial Inflammation, CHARDON-NAY WARD^{1*}, YATENDRA MULPURI², and IGOR SPIGEL-MAN² (¹Howard Hughes Medical Institute Pre-College Science Education Program, ²UCLA School of Dentistry, 10833 Le Conte Avenue, 63-007 CHS, Los Angeles, CA 90095; rance4@verison.net).

Chronic pain is pain that persists after recovery from tissue injury; common chronic pain symptoms include allodynia and hyperalgesia. Various factors lead to the transition from acute pain to chronic pain. This experiment is part of an ongoing endeavor to generate an animal model of orofacial pain models. **Objective:** Development a rat model of inflammation. Perform behavioral

testing to study the factors involved in the transition from acute pain to chronic pain. **Methods:** Hind-paw baseline withdrawal thresholds were measured for 2 rats over 6 days in response to mechanical or thermal stimulus. Then 0.1 ml of 1% kappa carrageenan in saline solution was injected into the right hind-paw of each rat to induce acute inflammation in the right hind-paw. Mechanical and thermal withdrawal measurements were done post-injection. **Results:** Baseline withdrawal threshold was 41.2g \pm 3.0g (\pm SEM) before carrageenan injection, and decreased mechanical stimulus withdrawal threshold (8.6g \pm 1.3g) and gradually returned to baseline withdrawal threshold values over the course of 2 weeks. Surprisingly thermal withdrawal latency remained unchanged compared to baseline measurements for the duration of the experiment. **Conclusion:** This research has shown that there is a drastic decrease in withdrawal thresholds to a mechanical stimulus but no change in response to a thermal stimulus.

384 Chronic Inflammation and Epigenetic Gene Regulation in Oral Keratinocytes, REBECCA UDOKOP^{1*} and KI-HYUK SHIN² (¹Howard Hughes Medical Institute Pre-College Science Education Program; ²UCLA School of Dentistry, Los Angeles, CA 90095; Rjustme11@aol.com).

Previously, Dr. Shin's laboratory reported that chronic inflammation further transformed oral keratinocytes, leading to differentiation resistance, and down-regulation of 29 differentiation-related genes. This is important because cancer cells do not differentiate, as such it is important to study this link between gene expression and differentiation resistance. **Objective:** To determine if the down-regulation of differentiation-related genes is caused by inflammation induced epigenetic regulation, specifically changes in DNA methylation. **Methods:** Among those 29 genes previously identified, 14 genes were further investigated in this study. Oral keratinocytes experienced chronic inflammation and for 3 days were then treated with 5-aza-cdr, a demethylating agent. The genes were then amplified using real-time PCR. **Results:** A 3-fold criteria was used to determine if the genes were methylated, such that if the gene expression increased by 3-fold or higher, the genes were thought to be methylated. Four genes were found to be methylated. These 4 will be tested further to discover if DNA methylation is the cause of the down-regulation of genes found in the cells. **Conclusion:** Of the 14 genes that were tested, 4 genes showed a 3-fold or higher increase in gene expression. The remaining 10 genes that did not show the 3-fold or higher criteria will also be examined by the lab for other potential expression differences. This study suggests that chronic inflammation may down-regulate differentiation-related genes by DNA methylation.

385 UBC9 Expression in Oral Cancerous Cells, BERENICE FLORES^{1*}, MICHELLE PICENO^{1*}, CHENXI SONG², MIN ZHANG², and SHEN HU² (¹Howard Hughes Medical Institute Pre-College Science Education Program, ²UCLA School of Dentistry, 10833 Le Conte Avenue, Room 63-070 CPL, Los Angeles, CA 90095, 2 Section of Oral Biology; berenicescience@aol.com, michellepiceno@yahoo.com).

Ubiquitin Conjugating Enzyme (UBC9) is an E2-conjugating enzyme expressed in all human cells and functions in transferring small ubiquitin modifier (SUMO) to targeted proteins. SUMO adjusts protein function through post-translational covalent attachment to specific amino acids in targeted proteins throughout the sumoylation pathway. We proposed that this enzyme may play

a role in oral cancer tumorigenesis. **Objective:** To examine the expression level of UBC9 in oral cancer cells, UM1 and UM2, and in Normal Human Oral Keratinocytes (NHOK) cells. UM1 is more invasive than UM2. **Methods:** We used Western blot analysis to determine the protein expression level of UBC9 in three cell lines. SDS PAGE was used to separate the protein samples from NHOK, UM1, and UM2 cells. Subsequently Western blot analysis with anti-UBC9 was used to determine the expression level UBC9 in three different samples. **Results:** The normalized intensity for UBC9 was 0.004677 in NHOKs, 1.028168 in UM1 cells, and 0.010393 in UM2 cells. UBC9 was over-expressed in the UM1 cells compared to both UM2 cells and NHOKs. **Conclusion:** Our study showed that UBC9 is up-regulated in the more invasive oral cancer cell line, suggesting that UBC9 may play a role in oral cancer invasion and metastasis.

386 Susceptibility of Oral Cancer Stem Cells to NK Cell Death versus their Differentiated Counterparts, CAMILLE BROWN^{1*}, CANDY MACIAS^{1*}, HELEN TSENG², CAITLIN LANZON², and ANAHID JEWETT² (¹Howard Hughes Medical Institute Pre-College Science Education Program, UCLA School of Dentistry, 10833 Le Conte Avenue, 63-007 CHS, Los Angeles, CA 90095; ²The Weintraub Center for Reconstructive Biotechnology, UCLA School of Dentistry, 10833 Le Conte Avenue 63-014 CHS, Los Angeles, CA 90095; camillebrown11@gmail.com, candy.macias93@gmail.com).

Stem cells are more sensitive to Natural Killer (NK) cell directed cell death versus their differentiated counter parts. **Objective:** To compare the differences in killing ability of NK cells in different tumor cell lines such as Oral Squamous Carcinoma Cell (OSCCs) versus Oral Squamous Carcinoma Stem Cells (OSCSCs) and Mature Laryngeal Tumor Cells (HEp2-VEC) versus Laryngeal cancer re-programmed stem cells (HEp2-IkB (S32AS36A)). **Methods:** The OSCCs and OSCSCs were isolated from patients' tongue tumors and the NK cells were drawn from healthy blood donors and purified. The OSCCs, OSCSCs, the HEp2-VEC, and the HEp2-IkB (S32AS36A) were then each treated with four treatments regimen: NK untreated, NK+anti-CD16, NK-IL2 treated, and NK+anti-CD16+IL2. A Chromium 51 release assay was run to determine the amount of Chromium 51 released during the NK cell induced cell death process. Following this experiment an ELISA binding assay was run to measure the concentration of the cytokine interferon-gamma (IFN-gamma) secretion in the supernatant samples. This assay helps determine the effect of the NK cells on the supernatant samples. **Results:** There were high levels of cytokine secretion in both the natural and the re-programmed stem cells but low levels in the differentiated cells. **Discussion:** Research on techniques of combined procedures may benefit from the results as simultaneous use of two different methods may help in fighting cancer. However, this warrants further research. **Conclusion:** The combination of chemotherapy, radiation and NK cell death processes on cancerous stem cells and their differentiated counterparts is a possibility for the elimination of oral cancer.

387 Combined Effects of TGF-beta1 and TNF-alpha on Dental Pulp Stem Cell Differentiation, XAVIER BROOKS^{1*}, ESMERALDA ALVAREZ^{1*}, JU EUN OH², SHEBLI MEHRAZARIN², SUSAN BAE², and MO KANG² (¹Howard Hughes Medical Institute Pre-College Science Education Program, UCLA School of Dentistry, 10833 Le Conte Avenue 63-007 CHS, Los Angeles, CA 90095; ²UCLA School of Dentistry, 10833 Le Conte Avenue 63-014 CHS, Los Angeles, CA 90095; xavierbrooks007@gmail.com, alvarezesmeralda17@yahoo.com).

com, alvarezesmeralda17@yahoo.com).

Dental Pulp Stem cells (DPSC) are mesenchymal stem cells that terminally differentiate into odontoblasts to protect the pulp in response to dental carries. **Objective:** To explore the combined phenotypic effects of cytokines, TNF-alpha and TGF-beta1, on DPSC proliferation and differentiation into mineralizing cells. **Methods:** DPSCs were cultured (37°C) and treated with 3.5µl of each cytokine. Four experimental groups were used: 1) control (no cytokine) 2) TNF-alpha, 3) TGF-beta1, 4) and both TNF-alpha and TGF-beta1. Each experimental group had two different growth media used: basal media or induction media, media was changed every 3-4 days. To measure the level of ALP compared between experimental groups and media types Western blot assays were done. Alkaline Phosphatase (ALP) activity assays were performed to measure the activity of ALP also between media type and cytokine treatment. **Results:** Qualitative analysis showed no apparent difference in DPSC proliferation upon treatment with any of the cytokine treatments. Cells treated with TNF-alpha showed decreased expression of ALP compared to control for both the cells treated with basal and induction media. Cells treated with TGF-beta1 showed lower levels of ALP when grown in induction media as compared to basal media. Treatment with combined TNF-alpha and TGF-beta1 produced relatively no sign of ALP activity. **Conclusion:** Western blotting showed that TNF-alpha does inhibit the differentiation of DPSCs and that TGF-beta1 promotes differentiation as seen by the expression level of ALP. ALP activity assay showed no discernable effects of TNF-alpha and TGF-beta1, together, on proliferation of DPSCs.

CELL and MOLECULAR BIOLOGY

388 The Effect of Ginkgo biloba on the Mouse Hippocampus, ALEXA ARANJO (Chadwick School, 26800 South Academy Drive, Palos Verdes Peninsula, CA 90274; University of Southern California, Department of Biological Sciences, Neurology and Biomedical Engineering, Los Angeles, CA 90089; alexaaranjo@gmail.com).

Ginkgo biloba leaf extracts have been used for nearly 5,000 years to treat asthma and bronchitis and more recently, to enhance memory and concentration. Full mouse brain homogenates were treated with different concentrations of a flavone glycoside supplement. The sample's concentrations of cytoskeletal proteins actin and spectrin were found by Western blotting. Similarly, acute hippocampal slices were treated in varying amounts of the supplement, and actin and spectrin concentrations were determined via Western blotting. Cultured hippocampal neurons were treated with the supplement for varying amounts of times to see the effects within individual neurons; no significant increase of activity was noted. The results of the Western blots showed that increased concentrations of *Ginkgo biloba* lead to higher concentrations of actin. Increased amounts of cytoskeletal proteins are indicative of enhanced long-term potentiation in synaptic plasticity.

389 Identifying Myostatin in Yellowtail (Seriola lalandi) using Degenerate PCR, ALYSSA BERNARDI* and MARY SUE LOWERY (Department of Biology, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; alyssabernardi-12@sandiego.edu).

In recent years, gene expression associated with increased muscle growth rates in livestock and finfish aquaculture has become a focus of research. Myostatin (MSTN) is a negative regulator of

skeletal muscle growth in vertebrates, including fish, and has been associated with limiting the size of muscle masses and fiber diameter, thus affecting fish growth. Primers were designed for degenerate polymerase chain reaction (PCR) based on the conserved MSTN sequence in other bony fish. Using Yellowtail genomic DNA as template, two fragments of the California Yellowtail (*Seriola lalandi*) MSTN gene were then amplified, cloned and sequenced. The Yellowtail MSTN sequence will be used to design primers for qPCR in order to study the effects of exercise on expression of myostatin in juvenile fishes reared under elevated current velocity.

390 *The Effects of Exercise on the Expression of Insulin-like Growth Factor in Juvenile Yellowtail*, SARAH JONES* and MARY SUE LOWERY (Department of Biology, University of San Diego, 5998 Alcalá Park, San Diego, CA 92110; sarah.jones-11@san Diego.edu).

Insulin-like growth factor (IGF-I) plays an important role in animal development and juvenile growth. Exercise has been shown to increase IGF expression, especially in the skeletal muscle. It has also been suggested that IGF-I induces hypertrophy of the red muscle, which we also saw increased with exercise. To test whether exercise stimulates an increase in expression of IGF-I in the red muscle, DNA primers were designed for IGF and two internal controls, beta-actin and beta-2-microglobulin. Using quantitative PCR we compared the relative expression of IGF to our internal controls in exercised and unexercised fish. When normalized to beta-2-microglobulin, IGF expression in the red muscle increased with three days of exercise at 60% maximal aerobic speed. Our results demonstrated that exercise did affect the expression of beta-actin and it cannot be used as an internal control. We intend to test muscle samples from fish exercised for longer periods to determine whether the upregulation IGF-I continues.

391 *Identification of a Second Site Suppressor of cdc24 in Schizosaccharomyces pombe*, SHANI M.C. CHAPMAN* and SALLY G. PASION (Department of Biology, San Francisco State University, 1600 Holloway Avenue, San Francisco, CA 94132; chapman@mail.sfsu.edu).

Cdc24 protein in *Schizosaccharomyces pombe* (fission yeast) is a novel protein that is involved in maintaining genome stability. Even though the exact function of this protein is unknown it has been implicated in DNA replication, DNA repair, telomere maintenance and sister chromatid cohesion. At the restrictive temperature, *cdc24* cells arrest in S phase, exhibit chromosome breakage and have reduced cell viability. As in other *cdc* mutants, *cdc24* mutants also have an elongated morphological phenotype at the restrictive temperature. We have isolated a genetic suppressor, *csc1* of *cdc24* that suppresses the *cdc24-G1* temperature sensitive phenotype: in the presence of this suppressor, the mutant *cdc24* can form colonies at 34°C. The genetic suppressor has a cold sensitive phenotype, which is not suppressed by *cdc24*. Further analysis will allow us to characterize the genetic suppressor. Identifying a new genetic interaction will help provide insight into the elusive role of *cdc24* in *S. pombe*.

392 *Ah Receptor Interacts with Activated Stat1 to Promote Cell Proliferation*, CHERI L. LAMB*, BRIAN ELLSWORTH, and KRISTEN A. MITCHELL (Department of Biological Sciences, Boise State University, Boise, ID 83278-1515; cherilamb@u.boi-sestate.edu).

The aryl hydrocarbon receptor (AhR) is a soluble,

ligand-activated transcription factor that mediates the toxic effects of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) and related chemicals. AhR activity has been shown to regulate cell cycle progression both in vitro and in vivo, although the mechanisms are unclear. Recent evidence indicates that the AhR may regulate cell differentiation and inflammatory responses by interacting with Stat1, a cytoplasmic signaling protein that regulates the transcription of genes required for cell growth, survival and differentiation. The goal of this study was to determine if alterations in STAT1 signaling contribute to the suppression of proliferation observed in TCDD-treated cells. Rat 5L hepatoma cells were serum-starved for 24 hr and released with serum in the presence or absence of TCDD (6nM). After 24 hr, cell lysates or fractions were analyzed by co-immunoprecipitation and western blotting. The addition of serum induced proliferation and increased levels of STAT1 protein in the nucleus of vehicle-treated cells, but not in TCDD-treated cells. Furthermore, phosphorylated STAT1 (pSTAT1) coimmunoprecipitated with AhR in vehicle-treated cells. In contrast, the AhR did not appear to interact with either phosphorylated or unphosphorylated STAT1 in TCDD-treated cells. Based on these results, it is conceivable that the AhR-pSTAT1 interaction facilitates cell cycle progression and that TCDD treatment suppresses cell cycle progression by a mechanism that involves disruption of the AhR-pSTAT1 interaction.

393 *Effects of the Orail Gene on the Skull Formation*, AYANA USSERY¹*, ROSA NAPOLES¹, HYE-WON CHOI², and JEANNE NERVINA³ (¹Howard Hughes Medical Institute Pre-College Science Education Program, UCLA School of Dentistry; ²UCLA School of Dentistry, Box 951668, Los Angeles, CA 90095; ³University of Michigan School of Dentistry, Dentistry 2518, Ann Arbor, MI 98109; adussery@yaoo.com).

Orail is a calcium channel protein that, when mutated, causes hereditary severe combined immunodeficiency in humans. Mice lacking *orail* also have cyclical alopecia, eyelid abnormalities and are smaller than their wildtype (WT) littermates. **Objective:** To examine the role of *orail* on mouse skull formation. Our hypothesis was that *orail* is required for normal skull development. **Methods:** Intact skulls from WT and *orail*^{-/-} knock-out (*orail* KO) mice were dissected, cleared of soft tissue and fixed in ethanol for three days. The skulls were then placed in alcian blue (3mg/ml) at 37°C for 11 days to stain cartilage. Skulls were then washed in 1% KOH for 24 h and rinsed overnight in tap water. The skulls were then stained with alizarin red (0.1% in solution) for 4 h in order to visualize mineralization. Finally, the skulls were rinsed with 1% KOH and 20% glycerol. Skull anatomy, suture formation and mineralization were visualized with a Leica S6D surgical microscope. **Results:** We measured the lengths of the *orail* KO mice (n=4; 2.5 mm ± 0.02), and a t-test comparison showed no significant difference from the WT mice (n=4; 2.4 mm ± 0.1; p=0.51). **Conclusion:** Currently no significant differences in skull anatomy, suture formation or mineralization between *orail* KO mice compared to WT littermates have been measured. Future work will compare larger numbers of animals and measure other developmental features.

INDEX OF NAMES

Numbers *less than 61* refer to the page(s) where a name appears in the program.
Numbers *61 and greater* refer to the page(s) on which an author's abstract may be found.

A

Aali, Abulfazi 47, 116
Abar, Aydin 47, 116
Abramzon, Fernando..... 48, 117
Achtemeier, Gary 28, 77
Adams, Judith E. 35, 95
Afable, Patricia O..... 36, 97
Aganovic, Lejla..... 42, 54, 136
Agenbroad, Larry 44, 113
Aguilar, Guillermo 28, 77
Aitken, Janice P..... 35, 37, 95, 98
Aldrich, Mark..... 53, 134
Ali, Abdul-Mehdi 44, 113
Alley, Addison..... 56, 142
Altamirano, Alfredo 27, 75
Alvarez, Esmeralda 59, 153
Amgalantugs, Tsend..... 49, 123
Anselmo, Armand 58, 150
Appenzeller, Otto 31, 44, 57, 85, 113,
145
Appenzeller, Peter 31, 85
Aquino, Eugenio 58, 147
Arabone, Eric 28, 76
Aranjo, Alexa 59, 153
Araújo, Aduato 56, 143
Arguelles, Paulette 57, 144
Ariaeenejad, Shohreh..... 52, 130
Ariaza, Bernardo 55, 138
Arp, Alissa J. 2, 5, 13, 20
Asingh, Pauline 22, 63
Atherton, Stephanie..... 49, 119, 120
Atoche, Pablo..... 20, 31, 61, 86

B

Bachmeier, Beatrice 27, 76
Bachofer, Steven 5, 32, 88
Bae, Susan..... 59, 153
Bailey, Shara 57, 146
Bain, Alan L..... 5, 35
Baitzel, Sarah I..... 38, 55, 100, 138
Ball, Markus..... 27, 39, 76, 104
Bar-Gal, Gila Kahila 34, 94
Barkhordarian, Andre.. 5, 38, 39, 101
Bartolome, Christian..... 28, 77
Beckenbach, Heidi 23, 65
Becker, Sara K. 38, 55, 100, 137

Beckett, Ronald G.. 5, 46, 48, 49, 55,
56, 57, 118, 119, 120, 138, 139,
141, 146
Begerock, Anna-Maria... 49, 56, 122,
140
Belin, Monique R..... 58, 147
Bem, Daryl J. 29, 81
Benavente, Martha 49, 121
Beniamini, Paz 30, 83
Bernardi, Alyssa..... 59, 153
Bernardo, Luca..... 49, 122
Berry, William B.N. 5, 37
Bersin, Amalia R..... 58, 150
Bertsch, Hans 50, 52, 125, 131
Besnoy, Amy 5, 24, 25, 45
Bessen, Erica J. 23, 64
Bianucci, Raffaella... 5, 27, 43, 44, 47,
57, 74, 76, 110, 113, 115, 144, 145
Biers, Trisha M..... 55, 137
Biggs, Matthew 56, 142
Bitzer, Andreas..... 47, 114
Blackman, David..... 52, 129
Black, Sue 37, 98
Blin, Nikolaus 39, 104
Blum, Kenneth 58, 147
Boano, Rosa 55, 57, 138, 146
Bob-Manuel, Loliya..... 58, 148
Bock, Michael 47, 114
Boenke N. 47, 116
Boisguerin, Valesca..... 39, 104
Bolin, Celeste..... 52, 130
Böni, Thomas..... 47, 48, 114, 117
Bosch, Pedro 41, 107
Bostrom, Kristina I..... 52, 130
Boswell, Alicia..... 38, 100
Bos, Wouter..... 28, 78, 79
Bourne, Philip 25, 70
Bouwman, Abigail 27, 76
Bowman, Brianna J..... 23, 64
Brancalfon, Antonio 48, 117
Braverman, Eric R. 58, 147
Brazil, Reginaldo Pecanha..... 27, 75
Bridelli, Maria Grazia 57, 146
Brier, Bob... 5, 30, 31, 32, 41, 85, 89,
107
Britton, Gillian A.O..... 56, 141
Brkljacic, Boris 42, 54, 136
Brockhoff, Sharlaine 23, 64
Bronson, Bennet..... 35, 96

Brooks, Xavier 59, 153
Brothwell, Don. 43, 47, 57, 110, 116,
144
Brown, Brian..... 51, 126
Brown, Camille 59, 153
Brown, Emma 44, 55, 113, 138
Brucker, Kyle A. 28, 79
Buikstra, Jane 21
Bukowski, John F..... 31, 86
Bunje, Paul 37
Burkhart, Hugh 26, 72
Bush, Stephanie L. 29, 81

C

Cadwallader, Lauren 44, 55, 112, 138
Campion, Kelsey R. 23, 65
Cannell, John J..... 5, 13, 20, 45, 62
Carli, Alberto..... 42, 109
Carrasco, Guillermo A. Cock 55, 137
Carr, Claudia J..... 53, 134
Carroll, John J. 5
Carroll, Stephen 32, 88, 89
Carson, Virginia R..... 32, 88
Carter, Sasha 29, 80
Castagnoli, Giuseppe 24, 68
Castilla, Gustavo A. Ramírez 48, 117
Castro, Mario M..... 44, 113
Cathcart, Eric 14
Cavka, Mislav 42, 54, 136
Ceballos, Marisol 58, 148
Chalmers, John H..... 31, 86
Chamberlain, Thomas E..... 53, 134
Chang, Cheng-Wei Tom..... 58, 149
Chapman, Casey 58, 151
Chapman, Shani M.C..... 59, 154
Chianese, Robert L.. 5, 26, 52, 53, 73
Chiappelli, Francesco.. 5, 38, 39, 101
Choi, H.K. 5, 51
Choi, Hye-Won 59, 154
Choi, Yongki 23, 66
Christensen, Colleen 43, 111
Christiansen, Robert L. 5
Christianson, Roger G..... 5
Cipollini, Giovanna. 39, 47, 103, 114
Clement, Sandra L. . 50, 58, 124, 150
Clercx, Herman 28, 76
Cockitt, Jenefer A..... 35, 48, 95, 118
Cogan, Christopher B..... 50, 124

- Cohen, Eliahu..... 30, 83
Colacicco, Giovanni. 32, 47, 90, 114, 115
Collins, Philip G..... 5, 23, 66
Colten, Roger 56, 141
Combs, Elijah..... 124
Conlogue, Gerald J. 5, 46, 49, 55, 56, 57, 120, 138, 141, 146
Cook, Della Collins..... 49, 122
Cool, Carlyne 49, 57, 120, 146
Corbin, Joshua G..... 33, 92
Cordy-Collins, Alana 5, 48, 54
Core, Andrew 51, 126
Cornell, Ken..... 52, 130
Corso, Brad L..... 23, 66
Cortés, María Bárbara Zepeda 26, 71
Creel, Sarah C. 31, 86
Crippen, Kent J. 40, 105
Crosignani, B. 30, 83
Currie, Katherine..... 49, 120
Curry, Adam M. 29, 82
Czworkowski, John..... 5, 40, 105
- D**
- Dagefoerde, Kati..... 47, 115
Daizo, M. Belén 48, 117
Dallman, A. 28, 79
Damle, Uma J..... 58, 147
Dansie, Lorraine..... 33, 92
Dascanio, Kristin M..... 23, 64
David, A.R. 35, 48
Davis, Jeff 36
Day, Jasmine 34, 49, 93, 121
De Gruchy, Cindy 33, 91
De Iasio, Sergia..... 57, 146
Delay, James 49, 121
Dell'anna, Alida 57, 146
Delorme, Arnaud..... 29, 82
Delre, E. 30, 83
Demerjian, Gary..... 39, 101
Denault, Seraphina..... 51, 126
De Neef, George R..... 51, 127
Deneer, Harry..... 43, 112
Derisi, Joseph..... 51, 126
De Souza, Sheila Mendonca .. 21, 48, 117
Dietrich, Anne..... 47, 115
Diporto, P. 30, 83
Di Sabatino, S. 28, 30, 79, 83
Dobyns, York 29, 82
Dominy, Nathaniel J..... 56, 141
Dommermuth, Douglas G..... 28, 79
Donoghue, Helen D. 27, 75
Doolittle, Coley J. 52, 130
- Dore, Bruno..... 55, 138
Dorfman, Konstantin E. 30, 84
Draper, Thomas W. 58, 148
Drew, Rose..... 48, 118
Duffy, Lawrence K..... 32, 89
Dupras, Tosha L. 44, 112
Duraj, Halina..... 5, 26
Durán, Mariel..... 41, 107
- E**
- Edgar, Heather 57, 146
Eisen, Arri 41, 56, 108, 141
Elias, Jonathan P..... 56, 142
Elitzur, Avshalom C. 24, 30, 83
Ellsworth, Brian 59, 154
Elitzur, Avshalom C. 68
Eppich, Christopher 56, 142
Erolin, C.D. 37, 98
Estrella, Kathleen F..... 50, 123
Ethell, Douglas W. 33, 92
Ethell, Iryna M..... 33, 92
Evans, R. Paul.... 42, 51, 54, 56, 126, 135, 142
- F**
- Fahrenbach, Henner 59, 151
Falbo, C.E. 51, 129
Farge, Marie 28, 78, 79
Farnum, John B. 33, 91
Fatemi, Mohammad Reza 52, 130
Fedoroff, Nina V..... 5
Fernando, Harinda J.S.. 5, 13, 19, 27, 28, 61, 79
Fernicola, Vito C..... 43, 110
Ferroglio, Ezio 27, 57, 76, 145
Filho, José D. Andrade..... 27, 75
Finch, Caleb E..... 42, 108
Fisler, Shara 50, 124
Flores, Bernice 59, 152
Flores, Carlos 41, 107
Fornaciari, Gino 27, 44, 57, 76, 113, 145
Fosso, Marina..... 58, 149
Fox, Ronald L. 31, 87
Franke, Andre..... 39, 47, 104, 114
Freeland, Deborah M. Hussey 53, 133
Frerking, Christopher..... 43, 111
Fricker, Helen A. 29, 80
Frohlilch, Bruno 49, 123
Fronsdal, Christian..... 37, 99
Frost, Caroline..... 58, 151
Frost, Stephen 5
Fuller, Elliot J..... 23, 66
- G**
- Gad, Yehia Z. 43, 110
Gaither, Catherine ... 49, 57, 120, 146
Galdamez, K.M. 24, 67
Galindo, Armando J. 5
Gall, Christine M. 33, 92
Gallien, Veronique 47, 115
Galván, Veronica..... 5, 33, 91
Galvez, Lilia..... 58, 150
Ganus, Melissa 32, 88, 89
Garamella, J.T. 24, 30, 67, 84
Garcia-Caceres, Uriel..... 48, 117
Garcia, Danielle N. 29, 80, 81
Gardner, Scott L..... 56, 57, 143, 144
Garvin, Greg 49, 120
Gath, Eldon 26, 72
Gazzolo, Brandn 28, 78
Gelfand, Julia 25, 69
Gibson, Carl H. 28, 79
Gilbert, James G..... 35, 95
Gille, Sarah T. 29, 80
Gill-Frerking, Heather..... 33, 39, 42, 43, 49, 56, 91, 104, 111, 121, 122, 140
Giuffra, Valentina 27, 44, 57, 76, 113, 145
Giusiani, Mario 44, 113
Gize, Andy 56, 142
Gledhill, Andrew..... 44, 113
Glick, Robert..... 26, 73
Glover, Winifred 35, 95
Go, Jai-Hyang 57, 145
Goldman, Crystal 5, 24, 25, 70
Goldstein, Paul S. 5, 38, 55, 100, 137
Gonzalez, Leticia 41, 106
Gonzalez, Ramone .. 49, 57, 120, 146
Gonzalez, Tania..... 26, 72
Goodwin, Lindsay..... 50, 124
Gosliner, Terrence 5
Gostner, Paul... 43, 47, 110, 114, 115
Graefen, Angela ... 33, 34, 39, 47, 91, 94, 104, 114
Graeff, Roderich W..... 37, 99
Gragg, Kyle..... 59, 151
Gray, Sarah..... 58, 151
Greenblatt, Charles L..... 27, 75
Green, Ulrike M..... 38, 100
Greider, Kristen N..... 23, 65
Grilley, Michelle 58, 149
Gritzner, Jeffrey 53, 133
Groshong, Steve..... 49, 57, 120, 146
Grumer, Astrid 33, 39, 91, 102
Guillén, Sonia 55, 138

Guillon, Francois..... 47, 115
 Guntheroth, Warren G..... 51, 127

H

Haas, Cordula..... 33, 90
 Haas-Gebhard, Brigitte ... 42, 54, 136
 Haas, Jan 39, 104
 Habibi-Rezaei, Mehran 52, 130
 Hafernik, Carolyn T. 51, 128
 Hafernik, John..... 5, 51, 126
 Hager, E. Randolph..... 31, 87
 Harker, Joshua..... 37, 99
 Harkins, Kelly M. 27, 74
 Harkins, Timothy 39, 104
 Harper-Beckett, Katherine 55, 138
 Harris, Mervyn..... 49, 122
 Harvey, Wendy A. 52, 130
 Harvig, Lise..... 22, 63
 Hawass, Zahi..... 43, 110
 Healey, Colleen 33, 91
 Heckmann, Richard..... 56, 142
 Heckman, Paul 5, 36, 37
 Héctor M. Pucciarelli 48, 117
 Helly, John J..... 29, 80
 Herrera, Alberto 49, 56, 121, 140
 Ho, Chuimei..... 36, 96
 Hofmann, Maria-Ines..... 47, 115
 Holly, Samuel M. 59, 151
 Hölzl, Stefan 42, 54, 136
 Hoppa, Robert D. 56, 142
 Horn, Peter 42, 54, 136
 Houlton, Tobias 37, 56, 98, 139
 Houston, Derek 51, 126
 Huang, Alice S. 5
 Humphrey, Elaine 43, 111
 Hunt, David R. 13, 19, 49, 56, 61,
 123, 141
 Huntsman, Molly M..... 33, 92
 Hunt, Steven R. 23, 66
 Hu, Shen..... 59, 152

I

Ibison, Michael 24, 68
 Ikram, Salima 33, 39, 56, 91, 102, 141
 Ismail, Somaia..... 43, 110
 Ivanac, Gordana 42, 54, 136
 Ivers, Jonathan 51, 126

J

Jabur, Alaa..... 44, 112
 Jacobitz, Frank G. ... 5, 27, 28, 51, 78,
 79
 Jacob, Reed B..... 52, 129

James, Matthew J..... 5
 Jamili, Shahla 52, 130
 Janaway, Rob 44, 55, 113, 138
 Janko, Marek..... 43, 110
 Jankovic, Ivor..... 42, 54, 136
 Jasco, Peter..... 25, 69
 Jesudason, Christopher G..... 38, 99
 Jewett, Anahid..... 59, 153
 Johannes, Jeff..... 31, 87
 Johnson, Ronn..... 5, 23, 64, 65, 66
 Jones, Sarah..... 59, 154
 Jorcyk, Cheryl L..... 5, 52, 131
 Jordan, Andrew N. 24, 68
 Joshi, Saurabh 50, 58, 124, 150

K

Kakareka, Joseph 53, 133
 Kandeia, Yukio..... 28, 78
 Kang, Mo 59, 153
 Kanz, Fabian 37, 98
 Karsten, Jordan 48, 118
 Kastner, Ruth E. 24, 68
 Katus, Hugo 39, 104
 Katzenberg, M. Anne 44, 113
 Kaufmann, Ina..... 22, 62, 63
 Kaufmann, Ronald S.... 5, 28, 29, 80,
 81
 Kaufmann, Walter E..... 33, 92
 Kawasaki, Yukie..... 58, 149
 Keefe, Peter D. 37, 99
 Keller, Andreas..... 39, 47, 104, 114
 Khairat, Rabab 39, 104
 Kim, Myeung Ju..... 34, 57, 93, 145
 Kim, Yi-Suk 34, 57, 93, 145
 King, Jerry..... 31, 85
 Kingston, John 41, 56, 108, 141
 Kloock, Carl 50, 124
 Kooba, Benjamin 56, 139
 Kostic, Milivoje M..... 38, 100
 Kozieradzka-Ogunmakin, Iwona . 49,
 122
 Krutak, Lars 35, 43, 96, 110
 Kumm, Kelsey J..... 56, 143
 Kyle, Wesley 55, 138

L

Lacovara, Peter 41, 107
 Lamb, Cheri L. 59, 154
 Lanzirrotti, Antonio.. 44, 57, 113, 145
 Lanzon, Caitlin..... 59, 153
 Laporte, Léo..... 5
 Larson, Don..... 15
 Lau, Tammy 15, 36, 98

Lauterborn, Julie C..... 33, 92
 Leboreiro, Ilán..... 5, 41, 106, 107
 Lee, Clarence 39, 104
 Lee, In Sun..... 57, 145
 Lee, Suzanne R. 50, 58, 124, 150
 Lehn, Christine..... 42, 54, 136
 Leidinger, Petra 39, 104
 Lei, Kenny..... 58, 148
 Lein, Melissa..... 56, 143
 Leo, L. 28, 79
 Leroy-Toren, Sara 56, 143
 Leshner, Alan I. 5
 Lesyk, Sonia..... 48, 117
 Leveque, Mimi..... 41, 108
 Leviton, Alan E. 5
 Levy, Sharon 14, 20, 62
 Lewis, Mary E..... 59, 152
 Lichter-Peled, Anat 34, 94
 Liechtenstein, Lukas 28, 78
 Link, Karl..... 47, 116
 Liu, Honghu 58, 147, 148
 Loesch, Sandra.... 27, 42, 54, 76, 136
 Lombardi, Guido P..... 21, 48, 117
 Lonfat, Bettina M. Kreissl 22, 62, 63
 Longstaffe, Fred J. .. 39, 55, 104, 137
 Lord, Constance 49, 119, 120
 Lowery, Mary Sue..... 29, 59, 80, 81,
 153, 154
 Loy, Gareth 31, 86
 Lupton, Carter 56, 142
 Lynch, Gary..... 33, 92
 Lynnerup, Niels 5, 22, 39, 47, 57, 62,
 63, 102, 145
 Lyons, Mary 13, 19
 Ly, Pearl 5, 25, 45
 Lywood, Victoria..... 56, 139

M

Macias, Candy..... 59, 153
 MacKenzie, Mark 31, 85
 MacNeil, Michael D..... 5
 Madden, Gwyn..... 48, 56, 118, 140
 Mahalingam, Shankar 28, 77
 Maida, Barbara Yablon 53, 132
 Maida, Carl A.... 5, 26, 36, 37, 53, 73
 Maixner, Frank 33, 34, 39, 43, 47, 57,
 91, 94, 102, 103, 104, 110, 114,
 144
 Malcom, Shirley..... 14, 36
 Malgora, Sabina 49, 122
 Malicky, David M. 31, 87
 Mallett, Xanthe 37, 98
 Mallin, D.J. 24, 30, 67, 84
 Mallory, Chris 52, 129

- Mankowske, Faye 52, 131
 Mansilla, Josefina..... 5, 41, 106, 107
 Marcus, Marvin..... 37, 58, 147, 148
 Markwyn, Abigail 36, 97
 Marlett, Cathy Moser 50, 125
 Martin, Brandon S..... 33, 92
 Martín, Conrado Rodríguez ... 13, 19,
 20, 31, 61, 86
 Maruyama, Magoroh..... 53, 134
 Massa, Emma Rabino 55, 138
 Mathis, Jason..... 51, 126
 Mattutino, Grazia 43, 110
 Matzas, Mark 39, 104
 May, Edwin C. 29, 82
 Mayer, Jens 39, 104
 Mayer, Michael S. 14
 Maynard, Trevor 28, 77
 McCarthy, Cheyenne..... 56, 139
 McCreesh, Natalie..... 56, 142
 McDougal, Owen M. 5, 52, 129
 McGraw, Donald J. 5, 52, 53, 132
 McGuire, J.B..... 30, 84
 McKnight, Lidija.... 49, 56, 119, 120,
 142
 McLaughlin, Stephen..... 39, 104
 Meder, Benjamin..... 39, 104
 Meese, Eckart..... 40, 104
 Mehrazarin, Shebli 59, 153
 Meier-Augenstein, Wolfram ... 37, 98
 Mejia, Elizabeth 49, 56, 121, 140
 Meldrum, D. Jeffrey... 5, 50, 59, 125,
 126, 151
 Menendez-Taboada, María Teresa 41,
 107
 Merkhofer, Evan C.. 50, 58, 124, 150
 Metcalfe, Ryan J. 42, 48, 54, 118, 135
 Meyer, Carol Anne..... 25, 70
 Michel, Leena 29, 82
 Mihram, Danielle 50, 53, 125, 132
 Mihram, G. Arthur .. 50, 53, 125, 132
 Mitchell, Kristen A.. 52, 59, 130, 154
 Mitchell, Paul..... 50, 125
 Mitterer, Christian..... 34, 94
 Moddel, Garret 24, 29, 82
 Molteni, Valeria E. 25, 69
 Monge, Janet M. 42
 Monsalve, María Victoria . 5, 43, 111
 Montufar, Aurora 56, 140
 Moody, Issa 23, 66
 Moosavi-Movahedi, Alia 52, 130
 Moreno, Victor 41, 106
 Moritz, Gillian L. 56, 141
 Morse, Michael S. 53, 135
 Mullins, Garrett..... 56, 142
 Mulpuri, Yatendra 59, 152
 Munns, Bill 50, 126
 Murphy, Eileen..... 35, 95
 Murray, John M..... 51, 53, 127, 133
 Murray, Steven A. 16
 Murray, Wendy V. 53, 133
- N**
- Napoles, Rosa 59, 154
 Nash, Stephen E. 35, 96
 Nelson, Andrew J. 48, 49, 56, 118,
 119, 120, 123, 139, 141
 Nelson, Sky E..... 29, 83
 Nerlich, Andreas G. 5, 27, 42, 54, 57,
 74, 75, 76, 136, 145
 Nervina, Jeanne..... 59, 154
 Nesteruk, Rachel Sewell 50, 126
 Newell, Patrick..... 25, 70
 Newey, Carter 56, 142
 Nielles-Vallespin, Sonia.. 42, 54, 136
 Nishimura, Ishiro 12, 19
 Nishita, J. Kenneth..... 5, 53
 Nuhfer, Edward B. 50, 124
 Nunes, Nicole..... 40, 104
- O**
- Oeggl, Klaus 47, 114
 Oehstroem, Lena 47, 114
 Oh, Chang Seok 34, 57, 93, 145
 Oh, Ju Eun..... 59, 153
 Okamoto, Naoya 28, 78
 Oliver, Elena 58, 148
 Olmos-Serrano, Jose Luis 33, 92
 Oluwasemilore, Ifeoma Ann... 25, 70
 O'Madden, Nicholas F. 23, 66
 Osborn, Karen J. 29, 81
 O'Shea, Thomas T..... 28, 79
 Osigbeme, Monique 41, 56, 108, 141
 Otto, Stefanie 50, 58, 124, 150
- P**
- Padman, Laurie 29, 80
 Palacios, Patricia 38, 100
 Paluszkiwicz, Scott M. 33, 92
 Pan, Hansheng..... 28, 77
 Panzer, Stephanie 32, 42, 90, 109
 Paolo, Fernando S. 29, 80
 Papageorgopoulou, Christina... 5, 32,
 33, 43, 47, 89, 90, 110, 115, 116
 Parsons, Xuejun H. 52, 131
 Parvin, Liz..... 56, 140
 Pasion, Sally G..... 59, 154
 Pathak, Abhishek..... 37, 99
 Paulsen, Katja 33, 90
 Pearl, Alison..... 26, 73
 Pearlstein, Kristen 49, 123
 Pellegrini, Gerald 30, 84
 Perkins, Kala 51, 128
 Pernter, Patrizia 43, 110
 Perrine, Kenneth 58, 147
 Peschel, Oliver 42, 54, 136
 Petty, Anita..... 5, 30, 31, 85
 Phillips, Genevieve 31, 85
 Phommahaxay, Kelly 33, 92
 Photinos, Panos 5, 23, 24, 67
 Piceno, Michelle 59, 152
 Pichler, Barbara..... 39, 102
 Pidwirny, Michael 58, 149
 Pijoan, Carmen..... 41, 107
 Pilotte, Julie..... 33, 91
 Pinar, Guadalupe 39, 103
 Piombino-Mascalì, Dario 5,
 39, 42, 43, 47, 56, 57, 102, 103,
 109, 110, 114, 143, 144
 Plunger, Elizabeth M..... 38, 55, 100,
 137
 Pollard, Mark 47, 116
 Pompa, Sandra 41, 106
 Pournazeri, Sam 28, 77, 78
 Poursasan, Najmeh..... 52, 130
 Powell, Mary Lucas 49, 122
 Press-Dawson, Andee 37
 Press, William 5
 Princevac, Barko 28, 77
 Princevac, Marko 28, 77, 78
 Pusch, Carsten..... 40, 104
 Pusch, Carsten M. 27, 43, 76, 110
- Q**
- Qualls, Clifford .. 31, 44, 57, 85, 113,
 145
 Quaroni, Luca 43, 111
 Quock, Christopher 51, 126
- R**
- Radin, Dean..... 29, 82
 Ragavan, Anpalaki J..... 58, 147, 148
 Raghavan, Maanasa 47, 115
 Ramírez, Angeles 20, 31, 61, 86
 Ramsey, Chenere Pierce. 41, 56, 108,
 141
 Randall, Tori..... 49
 Rasmussen, Morten..... 41, 106
 Rattei, Thomas 39, 103
 Raubener, Sarah 38, 100
 Raubenheimer, Sarah 55, 138

- Rauen, Kenneth M. 30, 84
 Rawson, David A. 34, 93
 Razak, Khaleel 33, 92
 Redman, Emily T.H. 53, 132
 Redman, Samuel 36, 96
 Reifer, Thomas 26, 71
 Reinhard, Karl J. 39, 56, 57, 103,
 143, 144
 Reisenbichler, Kim R. 29, 81
 Reiter, Gert 42, 54, 136
 Renée, Stein 41, 108
 Rentsch, Katharina 47, 115
 Richardson, Dennis J. 55, 138
 Roberts, Charlotte 27, 76
 Robinson, Jalisa J. 52, 130
 Robinson, Joshua 41, 56, 108, 141
 Robison, Bruce H. 29, 81
 Rodgers, Victor G.J. 51, 128
 Rodrigues-Carvalho, Claudia. 21, 48,
 117
 Rodriguez, Jose M. 58, 148
 Rodriguez, Marco Antonio.... 41, 106
 Rodriguez, Rusty..... 50, 126
 Rogers, J. David..... 26, 71, 72
 Rollo, F.U..... 43, 110
 Roque, Rouel S. 5
 Rosendahl, Wilfried . 39, 49, 56, 104,
 121, 122, 140
 Rotschafer, Sarah 33, 92
 Rottman, James W..... 28, 79
 Rowe, Marvin 5, 30, 31, 85
 Rühli, Frank J..... 5, 22, 32,
 33, 39, 43, 47, 48, 56, 62, 63,
 89, 90, 102, 103, 110, 114, 115,
 116, 117, 140
 Runckel, Charles 51, 126
 Rydell, Robert W..... 35
 Rynn, Christopher 37, 98
- S**
- Saedi, Sahand..... 47, 116
 Saffon, Teri..... 48
 Saied, Adel 30, 85
 Samadelli, Marco. 33, 39, 40, 43, 47,
 91, 103, 104, 110, 114
 Saner, Gary B..... 53, 135
 Santos, Diego M..... 48, 117
 Sarkar, Sutanu 28, 76
 Sarmiento, Esteban 50, 125
 Sartori, Alexander 39, 104
 Savoy, Johnnie 37
 Sawrey, Barbara 40, 105
 Schanandore, James 49, 121
 Schmidt, Larry 25, 71
 Schneider, Kai 5, 27, 28, 78, 79
 Schoenian, Gabriele 27, 74, 76
 Schoeninger, Margaret J. 38, 55, 100,
 138
 Schraut, Bettina..... 27, 75
 Schroffenegger, Franz..... 39, 102
 Schrunk, David G..... 53, 135
 Schubert, Thomas F..... 5, 31
 Schulman, L.S..... 24, 30, 67, 83
 Schulte, Nico..... 28, 77
 Schwartz, Rebecca F. 51, 127
 Scully, Marlan O. 30, 84
 Seapy, Dave..... 30, 85
 Searchey, Nicole 57, 144
 Seethaler, Sherry 5, 40
 Seiler, Gretchen..... 5
 Seiler, Roger..... 39, 47, 103, 115
 Selim, Ashraf..... 43, 110
 Semigran, Stu..... 37
 Seo, Min..... 34, 93
 Serano, Ana 41, 107
 Shachter, Amy 5, 32, 89
 Shaheen, Ronald 31, 87
 Shah, Minita 39, 104
 Shahmirian, Laurine J. 52, 130
 Shaw, David E..... 5
 Sheehan, Daniel P. 5, 24, 30, 66, 67, 84
 Sherlock, Rob E. 29, 81
 Shin, Dong Hoon ... 5, 34, 57, 93, 94,
 144, 145
 Shin, Ki-Hyuk 59, 152
 Shiozawa, Dennis K..... 51, 126
 Shoup, Richard..... 24, 68
 Shrestha, Sanjib..... 58, 149
 Shrimpton, Sarah..... 35, 95
 Shved, Natallia.... 32, 33, 47, 90, 116
 Shyy, John Yj 51, 128
 Siapno, Travis 51, 126
 Sims, Patrick C..... 23, 66
 Sison, Jay 39, 101
 Smith, Bernadette E. 52, 132
 Smith, Christopher D. 51, 126
 Smith, Colin 41, 106
 Smith, Jr., Kenneth L. 29, 81
 Smith, Julia I. 124
 Somerville, Andrew D. ... 38, 55, 100,
 137
 Song, Chenxi..... 59, 152
 Soria, Enrique Chacón 41, 105
 Spangler, Jessica 39, 104
 Speier, Peter 42, 47, 54, 114, 136
 Spigelman, Igor..... 59, 152
 Spigelman, Mark..... 5, 27, 34, 75, 94
 Spilde, Mike..... 31, 44, 85, 113
 Sprintall, Janet..... 29, 80
 Staninger, Steven 5, 25
 Stapp, Henry P..... 29, 81
 Steelman, Karen L. 31, 85
 Stephenson, Jr., Don R. 29, 80
 Sterflinger-Gleixner, Katja.... 39, 103
 Stern, Ben..... 44, 55, 113, 138
 Stöllner, Thomas 47, 116
 Stratton, Stephen 25, 70
 Struck, Ulrich 42, 54, 136
 Sturz, Anne A. 5, 25, 26, 28, 29
 Steward, Oswald 33, 92
 Suchey, Judy Myers 49, 120
 Sullivan, Julie..... 13
 Sundar, Vikram 58, 149
 Sviszinsky, Anatoly A. 30, 84
 Swanston, Treena 43, 112
 Sydler, Christina..... 48, 117
- T**
- Takemoto, Jon Y..... 58, 149
 Talley, Drew M. 16
 Tanner, Kimberly D. 5, 37, 124
 Tansey, Malu 41, 56, 108, 141
 Tan, Si 28, 77
 Tavakoli, Maria Jelaca 59, 152
 Tawara, Ken 52, 130
 Taylor, Timothy..... 44, 55, 113, 138
 Tejada, Francisco A..... 48, 117
 Terrazas, Alejandro 49, 121
 Thompson, Randall C. 5, 42, 108, 109
 Tibbetts, Ian 51, 127
 Tomanek, Debra..... 40, 105
 Treloar, Elizabeth Baker 14
 Trisciuglio, Anna..... 27, 76
 Tseng, Helen 59, 153
 Tukeman, Gabriel L. 50, 123
 Tyson, Rose..... 5, 48, 54
- U**
- Udokop, Rebecca 59, 152
 Ukachi, Ngozi Blessing 25, 70
 Unmack, Peter..... 51, 126
 Uranic, Igor..... 42, 54, 136
 Ussery, Ayana..... 59, 154
- V**
- Valdiosera, Christina 41, 106
 Van Buskirk, Richard W..... 5, 50
 Vandeburgt, Melissa Minds.... 25, 70
 Vanderklish, Peter W..... 5, 33, 91
 Van der Sanden, Wijnand 43, 57, 110,
 144

INDEX

Van Doren, Gregory S. 32, 89
Vandrangi, Prashanthi 51, 128
Van Uum, Stan 55, 137
Vavra, Jay S. ... 5, 37, 50, 58, 123, 150
Velo, Ani P. 5, 31
Venkatram, Akula 28, 77, 78
Vernet, Maria 29, 80
Vicente-Crespo, Marta ... 50, 58, 124,
150
Vieten, Cassandra 29, 82
Vigl, Eduard Egarter 33, 39, 40, 43, 47,
91, 102, 103, 104, 110, 114, 115
Villa, Chiara 57, 145
Viviano, Carolyn 32, 88
Von Waldburg, Hendrik 47, 114
Vu, Henry 28, 77

W

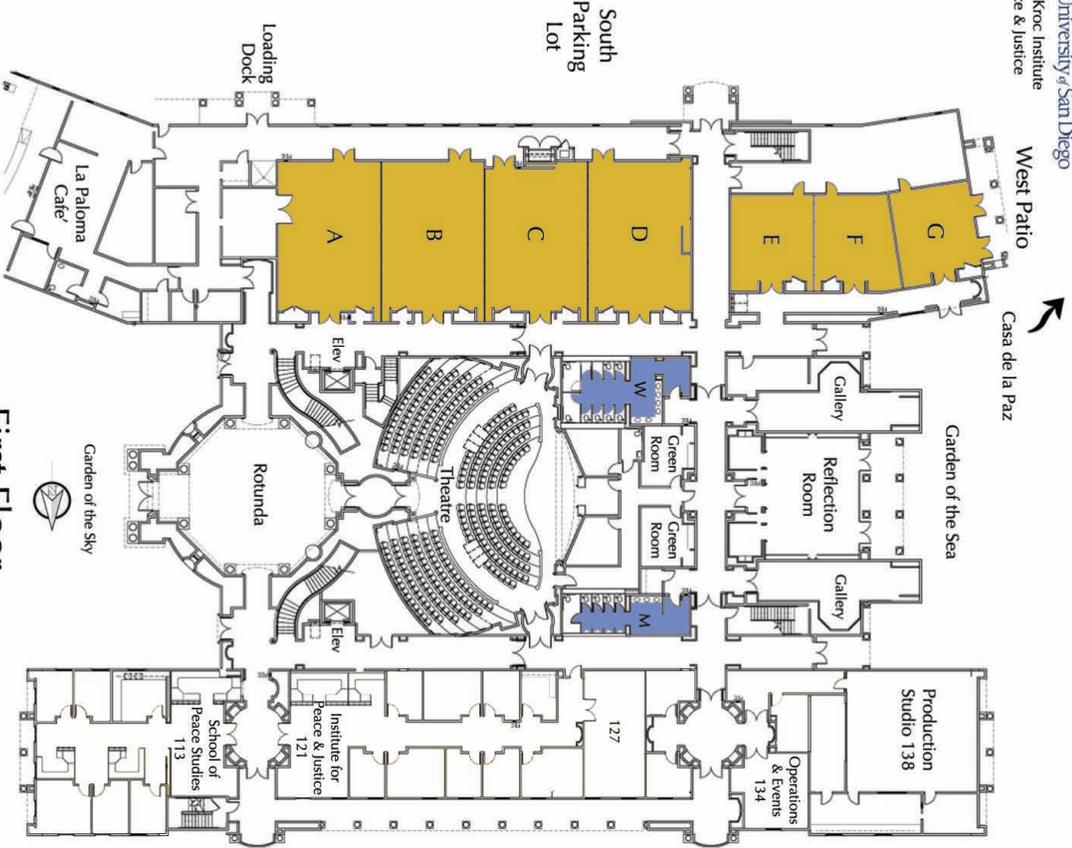
Wade, Andrew D. ... 49, 56, 120, 123,
141
Walker, David 43, 111
Walker, Ernie 43, 112
Walther, Markus 47, 114
Wanek, Johann ... 32, 39, 56, 90, 102,
140
Wang, Yan 58, 147, 148
Wann, L. Samuel 42, 108
Ward, Chardonnay 59, 152
Warinner, Christina 47, 116
Webb, Emily 55, 137
Weibel, Deana 36, 97
Weise, David R. 28, 77
Weiss, Gregory A. 23, 66
Wharton, Ken 24, 67
Wheeler, Sandra M. 44, 112
Whitchurch, David M. 42, 54, 56,
135, 142
White, Christine D. . 39, 55, 104, 137
Wienhausen, Gabriele 50, 58, 124,
150
Wilkinson, Caroline 5, 35, 37, 95, 98
Willerlev, Eske 41, 106
Williams, Jocelyn S. 5, 43, 44, 113
Williams, Lana J. 44, 112
Wilson, Andrew S. 5, 43, 44, 55, 113,
138
Wisseman, Sarah U. 56, 141
Woitek, Ulrich 48, 117
Wolfe, S.J. 5, 34, 56, 93, 140
Wolf, Fred Alan 29, 83
Wood, Gregory 50, 124
Woodward, Julia 49, 57, 120, 146
Wortmann, Franz-Josef 44, 112
Wortmann, Gabriele 43, 112

Y

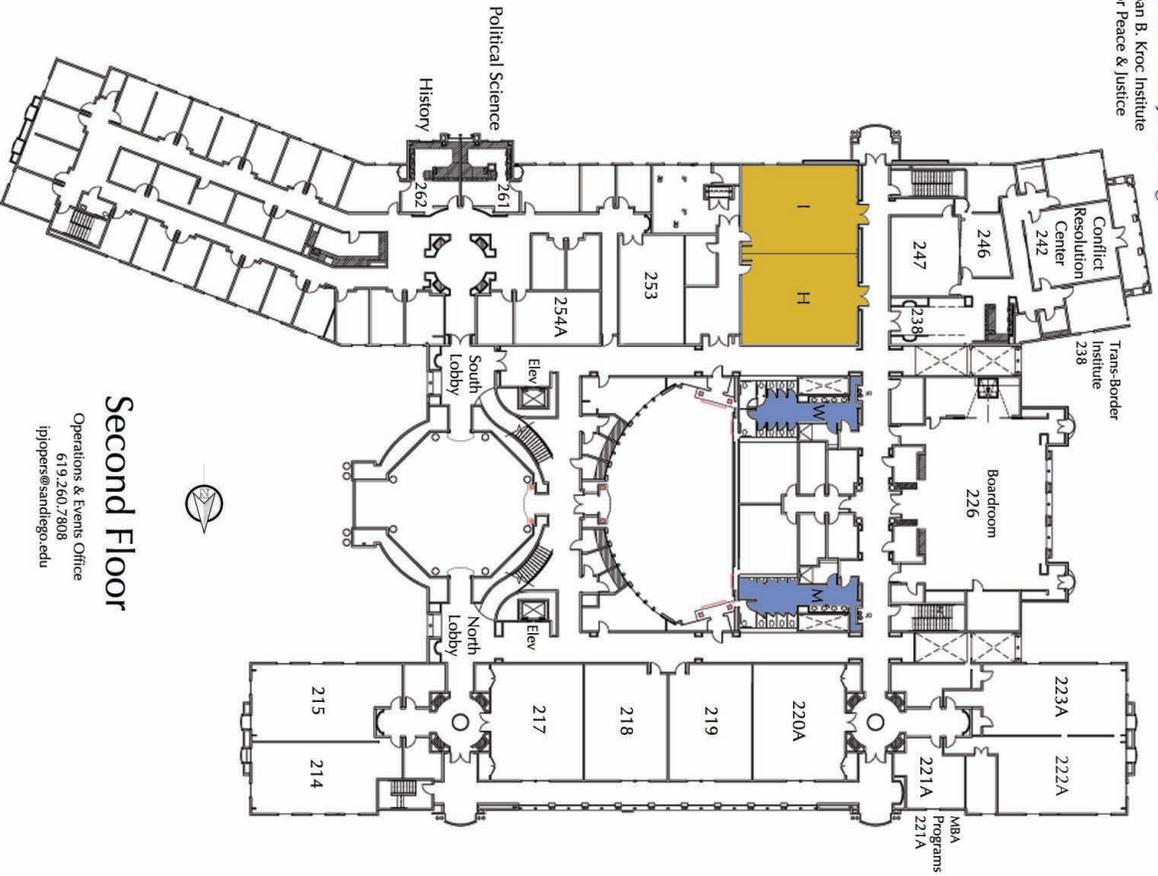
Yamamoto, Yoshiko 36, 97
Yin, Zhi-Yong 58, 150
Yoshimatsu, Sunori 28, 78
Yzurdiga, Linda 38, 55, 100, 138

Z

Zavon, Bonnie 25, 69
Zhang, Min 59, 152
Zhu, Zixu 29, 82
Zimmerman, Barbara H. 49, 119
Zimmerman, Michael R. 49, 119
Zink, Albert 5, 27, 33, 34, 39, 40, 42,
43, 47, 57, 75, 91, 94, 102, 103,
104, 109, 110, 114, 115, 144



First Floor
 Operations & Events Office
 619.260.7808
 ipjopers@sandiego.edu



Second Floor
 Operations & Events Office
 619.260.7808
 ipjopers@sandiego.edu

