

2006 APS April Meeting

Dallas, TX

<http://www.aps.org/meet/APR06>

## Saturday, April 22, 2006 3:30PM - 5:00PM –

Session E4 FIP FPS: Science and Development: Innovation Systems for Fighting Poverty Hyatt Regency Dallas Marsalis A

**3:30PM E4.00001 UNESCO and the use of Science to Combat Poverty** TONY MARJORAM, UNESCO Senior Program Specialist —

**4:00PM E4.00002 The World Bank View of Science, Technology and Economic Development**, DANIEL LEDERMAN, Senior Economist, World Bank; Latin America & the Caribbean Under Secondment to the World Bank Development Research Group —

**4:30PM E4.00003 NSF and Development**, THOMAS A. WEBER, International Science and Engineering National Science Foundation —

## Sunday, April 23, 2006 3:15PM - 5:00PM –

Session L4 CSWP FPS: Women in Science Policy Hyatt Regency Dallas Marsalis A

**3:15PM L4.00001 What the Heck is Science Policy and Who Really Does It?**, AMY FLATTEN, American Physical Society — The objective of this discussion is to provide graduate students and others with insights regarding careers in science policy—how a scientific graduate degree can lead to opportunities beyond the laboratory, combining scientific expertise with diverse interests such as business, international affairs and national security. The topics covered will include: 1) an overview of the U.S. Government bodies and other stakeholders involved in science policy development; 2) case studies to exemplify the “process” of science policy formulation; and 3) where/how one might explore a career in science policy. The speaker served from 1999-2004 with White House Office of Science and Technology Policy.

**3:40PM L4.00002 A Capitol Hill Perspective**, CHRISTAL SHEPPARD, Senate Energy and Natural Resources Committee — Relatively few women receive advanced degrees in the sciences, and relatively few scientists find their way into staff positions on Capitol Hill. Yet in this staffer's experience, I count more female science Ph.D.s in my circle of colleagues than I counted female classmates in physics graduate school. Why, at least anecdotally, does it seem that women with advanced degrees in science are more likely than their male peers to leave the laboratory and join the policy lobby? My observations are based on my own work in energy and environmental policy as a staffer in both the U.S. Senate and the U.S. House of Representatives.

**4:05PM L4.00003 Science Oversight from the Inside: Views from Service on Capitol Hill and NASA**, JENNIFER WISEMAN, Johns Hopkins University — This abstract was not received electronically.

**4:30PM L4.00004 Discussion** —

## Monday, April 24, 2006 1:30PM - 3:18PM –

Session Q5 FPS FEd: Evolution: From the Big Bang to Us Hyatt Regency Dallas Pegasus B

**1:30PM Q5.00001 Evolution of the Universe**, JOEL PRIMACK, University of California, Santa Cruz — Cosmology is in the midst of a scientific revolution that is establishing its lasting foundations. The good agreement between many different sorts of observations and the predictions of the now-standard Lambda Cold Dark Matter (LCDM) theory gives us hope that this is humanity's first picture of the history of the universe as a whole that might actually be true. An unexpected feature of this new picture is that we humans appear to be central or special in many ways – for example, we are made of the rarest stuff in the universe (stardust); we are intermediate in size between the smallest possible size (the Planck length) and the largest size (the cosmic horizon); and we are living at a pivotal time: the period in the history of the universe when its expansion began to accelerate rather than slow down, and in the middle of the ten-billion-year lifetime of our solar system and of the billion year most habitable period of our planet, and at what must be the end of the exponential growth of human impact on the earth. This talk<sup>1</sup> will review key observations that support modern cosmology, describe some symbolic ways of understanding the modern cosmos, and discuss some possible implications of a cosmic perspective for our 21st century worldview.

<sup>1</sup>Based on a new book, *The View from the Center of the Universe: Discovering Our Extraordinary Place in the Cosmos*, by Joel R. Primack and Nancy Ellen Abrams (Riverhead Books, April 2006).

**2:06PM Q5.00002 Evolution of a Habitable Planet**, JAMES KASTING, Penn State University — Earth has remained habitable, and inhabited, over most of its 4.5-Gyr history despite an appreciable (30%) increase in solar luminosity over time and despite catastrophic events such as asteroid impacts and “Snowball Earth” episodes that have threatened biological survival on a global scale. Life has survived partly because of the resilience of the biota and partly because of feedback mechanisms that help to stabilize Earth's global climate. In particular, buildup of volcanic CO<sub>2</sub> during times when the climate is cold provides a strong negative feedback that helps keep Earth within the temperature regime favorable to life. The same processes that help stabilize Earth's climate should operate on other Earth-like planets, if they exist; thus, it is plausible that life could exist elsewhere. This hypothesis is now on the verge of being tested. NASA's twin *Terrestrial Planet Finder (TPF)* missions, which could be launched as early as 2015-2020, will look for Earth-like planets around nearby stars and, if they are found, provide spectroscopic information on their atmospheres. Between them, these missions should be able to look for absorption bands of O<sub>2</sub>, H<sub>2</sub>O, CO<sub>2</sub>, and O<sub>3</sub>. Both O<sub>2</sub> and O<sub>3</sub> are considered to be good indicators of life for planets orbiting within the liquid water habitable zone of their parent star. NASA should be encouraged to give these missions high priority, so that we can answer these fundamental questions about the distribution of life in the universe.

**2:42PM Q5.00003 Evolution of Biological Diversity**, DUANE JEFFERY, Brigham Young University — A conservative estimate posits approximately ten million species presently inhabiting Earth, and these are clearly only a small fraction of those that have existed throughout Earth's history. Although various types of selective mechanisms have been identified as generating this diversity, and several chance mechanisms as well, the relative importance of these mechanisms is not firmly resolved. We review the current status of the discussion and some of the associated political and social ramifications.

## Monday, April 24, 2006 3:30PM - 5:54PM –

Session S4 FHP FPS: FHP/FPS Award Session Hyatt Regency Dallas Marsalis A

### 3:30PM S4.00001 Pais Prize Lecture: History and Physics , JOHN HEILBRON, UC Berkeley —

Modern history and experimental physics entered the university together, in the course of the eighteenth century. They shared several practices and projects. Historians began to emphasize physical factors, and so drew on, and occasionally contributed to, meteorology and physical geography; and they developed ancillary disciplines, like numismatics, diplomatics, and paleography, which required the analysis of metals, paper, and inks, and the careful comparison of material objects. In physics, historical reviews of newer subject matters, such as electricity, optics, and pneumatics, guided instruction where neither the facts nor their interpretation compelled consensus. The inherently historical science, geology, was a favorite subject of the age: the earth received a history, and the cosmos, too; evolutionary ideas found applications everywhere. The new physics and the new history became potent weapons of Enlightenment. A product of their collaboration is the lengthiest history of physics ever written, J.G. Fischer's *Geschichte der Physik* (8 vols., 1801-1808). It appeared within a series edited by Johann Gottfried Eichhorn, Germany's leading exponent of the "higher criticism," the corrosive application of historical and literary considerations to the stories of the Old Testament. The writings of historians like Eichhorn were more subversive than the work reported by Fischer in so far as humans are more concerned with their place in the world than with the details of its behavior. The coincidental matriculation of modern history and experimental physics, and its consequences, will be discussed.

### 4:06PM S4.00002 Szilard Prize Lecture: Seismic Monitoring of Nuclear Explosions , PAUL

RICHARDS<sup>1</sup>, Columbia University — Seismic monitoring of the more than 2000 nuclear test explosions since 1945 has been vigorously pursued, both to track the weapons development of potential adversaries, and to support initiatives in nuclear arms control, including various test ban treaties. Major funding from the US Department of Defense built up new global seismographic networks and over several decades established practical capability in monitoring nuclear explosions "teleaseismically" (i.e. from distances more than about 1500 km), for tests that the testing nation did not attempt to conceal. What then is the capability to monitor compliance with, for example, the Comprehensive Nuclear-Test-Ban Treaty (CTBT) of 1996, particularly if evasion scenarios are considered? Note that the CTBT, though not ratified by some countries (including the US), is now being monitored by networks that include seismographic stations at "regional" distances (< 1500 km) from candidate explosion locations. Years of R and D have shown that regional signals can be used to monitor down to yields significantly lower than can be detected and identified teleaseismically. A US National Academy of Sciences study in 2002 concluded that "an underground nuclear explosion cannot be confidently hidden if its yield is larger than 1 or 2 kt." About 1000 earthquakes and chemical explosions are now detected per day, and documented via seismic data, providing plenty of challenges for nuclear explosion monitoring organizations. Explosion monitoring capability will improve in many parts of the world, due to the growth of networks that monitor even small earthquakes to study seismic hazard. But political problems can impede improved international explosion monitoring, due to national restrictions on data access.

<sup>1</sup>A member of the American Geophysical Union

### 4:42PM S4.00003 Burton Award Lecture: A.Q. Khan and Illicit Nuclear Trade , DAVID ALBRIGHT,

Institute for Science and International Security — This abstract was not received electronically.

### 5:18PM S4.00004 Sakharov and the Grey Zone: Difficult Areas of Human Rights Activity ,

YURI ORLOV, Laboratory for Elementary-Particle Physics, Cornell University — Drawing on my experience in human rights work and my discussions with A. D. Sakharov, I will explore some difficult areas of human rights activity in which human rights defenders cannot reach a consensus on how to proceed, and even on how to define the problem.

## Monday, April 24, 2006 5:30PM - 6:30PM –

Session T4 FPS: FPS Business Meeting Hyatt Regency Dallas Marsalis A

### 5:30PM T4.00001 FPS Business Meeting –

## Tuesday, April 25, 2006 10:30AM - 12:15PM –

Session W5 FPS: Abrupt Climate Change Scenario Hyatt Regency Dallas Pegasus B

### 10:30AM W5.00001 Negative Emissions Technology , DANNY DAY, EPRIDA —

Although 'negative emissions' of carbon dioxide need not, in principle, involve use of biological processes to draw carbon out of the atmosphere, such 'agricultural' sequestration' is the only known way to remove carbon from the atmosphere on time scales comparable to the time scale for anthropogenic increases in carbon emissions. In order to maintain the 'negative emissions' the biomass must be used in such a way that the resulting carbon dioxide is separated and permanently sequestered. Two options for sequestration are in the topsoil and via geologic carbon sequestration. The former has multiple benefits, but the latter also is needed. Thus, although geologic carbon sequestration is viewed skeptically by some environmentalists as simply a way to keep using fossil fuels—it may be a key part of reversing accelerating climate forcing if rapid climate change is beginning to occur. I will first review the general approach of agricultural sequestration combined with use of resulting biofuels in a way that permits carbon separation and then geologic sequestration as a negative emissions technology. Then I discuss the process that is the focus of my company—the EPRIDA cycle. If deployed at a sufficiently large scale, it could reverse the increase in CO<sub>2</sub> concentrations. I also estimate of benefits—carbon and other—of large scale deployment of negative emissions technologies. For example, using the EPRIDA cycle by planting and soil sequestering carbon in an area about 3X the size of Texas would remove the amount of carbon that is being accumulated worldwide each year. In addition to the atmospheric carbon removal, the EPRIDA approach also counters the depletion of carbon in the soil—increasing topsoil and its fertility; reduces the excess nitrogen in the water by eliminating the need for ammonium nitrate fertilizer and reduces fossil fuel reliance by providing biofuel and avoiding natural gas based fertilizer production.

**11:05AM W5.00002 Cool Roofs to Save Money and Delay Global Warming** , ARTHUR ROSENFELD, California Energy Commission — White roofs, and now cool-colored roofs, with a high reflectivity or 'albedo' have a long history (best known around the Mediterranean) of keeping buildings and cities cool. In modern times, cool roofs have been shown to reduce air conditioning (a-c) demand and slow the formation of ozone (smog). Studies establishing a typical 10% reduction in a-c demand and electricity savings due to white roofs in California (CA) resulted in the 2005 CA new building energy efficiency standard prescribing that low-slope roofs be white, but exempting sloping roofs for aesthetic reasons. The advent (thanks to physicists' efforts) of inexpensive colored pigments with high albedo has led to 2008 CA standards requiring that even sloping roofs be cool. Here, I show that cooling the planet by reducing urban albedo through white and other cool roofs is a direct effect, much larger and immediate than the 2nd-order cooling from reduced CO<sub>2</sub> from reduced a-c use. I then investigate widespread deployment of cool roof in major tropical and temperate cities, which cover 2% of global land area and have a proportionately higher albedo impact due to lower latitude. Here, cool roofs and cooler pavements can raise urban albedo by 10%. This directly drops the global average temperature by ~0.05 /deg C. Though small compared to a likely 3 /deg C rise by 2060, an immediate drop of 0.05 /deg C represents a reprieve in global warming of 1 year, and represents avoiding a year's current annual world emissions of CO<sub>2</sub>, i.e. 25 GT(CO<sub>2</sub>). At a trading price of \$25/tCO<sub>2</sub>, this is worth ~\$625B. Cooling the planet also could save annually hundreds of \$billions on a-c electric bills. Finally I suggest policies to increase cool roof deployment, for example, developed world Kyoto signatories could use its CDM (Clean Development Mechanism) for cool roof programs in developing countries.

**11:40AM W5.00003 Lessons from Katrina: Flood Management Technology Strategies for the US** , GERALD GALLOWAY, University of Maryland — Coastal and riverine flooding and hurricane-driven storms have long plagued those in the United States who live or work on or near the shoreline or the rivers edge. The devastation wrought by Hurricane Katrina brought the challenge of protecting against such events to the political and technical forefront. The predicted impacts of global warming strongly suggest that our floodplains and coastlines could be at greatly increased risk. This presentation will review the development of the U.S. program for providing structural protection, discuss the effectiveness of employing levees, dams, floodways, beach nourishment and storm barriers in this struggle, highlight the changes over the last two decades that have gradually shifted the focus from a structural-only approach to one that includes the non-structural approaches such as wise land use, wetland restoration, relocations, insurance, floodproofing, and emergency warning and evacuation. Using post-Katrina planning as an example, it will explore what new approaches can be taken. Should New Orleans take a 'levees only' approach to its protection? or should attention to New Orleans be part of a coastal Louisiana integrated flood damage reduction and coastal restoration strategy. The nation needs to make changes in its water resources policies and investment strategy to deal with the new threat that it now faces.

**Tuesday, April 25, 2006 12:15PM - 2:00PM –**  
**Session X5 FPS: Elements of a Real Energy Strategy** Hyatt Regency Dallas Pegasus B

**12:15PM X5.00001 Scientific challenges in sustainable energy technology** , NATHAN LEWIS, California Institute of Technology — We describe and evaluate the technical, political, and economic challenges involved with widespread adoption of renewable energy technologies. First, we estimate fossil fuel resources and reserves and, together with the current and projected global primary power production rates, estimate the remaining years of oil, gas, and coal. We then compare the conventional price of fossil energy with that from renewable energy technologies (wind, solar thermal, solar electric, biomass, hydroelectric, and geothermal) to evaluate the potential for a transition to renewable energy in the next 20-50 years. Secondly, we evaluate - per the Intergovernmental Panel on Climate Change - the greenhouse constraint on carbon-based power consumption as an unpriced externality to fossil-fuel use, considering global population growth, increased global gross domestic product, and increased energy efficiency per unit GDP. This constraint is projected to drive the demand for carbon-free power well beyond that produced by conventional supply/demand pricing tradeoffs, to levels far greater than current renewable energy demand. Thirdly, we evaluate the level and timescale of R&D investment needed to produce the required quantity of carbon-free power by the 2050 timeframe. Fourth, we evaluate the energy potential of various renewable energy resources to ascertain which resources are adequately available globally to support the projected demand. Fifth, we evaluate the challenges to the chemical sciences to enable the cost-effective production of carbon-free power required. Finally, we discuss the effects of a change in primary power technology on the energy supply infrastructure and discuss the impact of such a change on the modes of energy consumption by the energy consumer and additional demands on the chemical sciences to support such a transition in energy supply.

**12:50PM X5.00002 Hybrid Vehicle Technologies and their potential for reducing oil use** , JOHN GERMAN, American Honda Motor Co. — Vehicles with hybrid gasoline-electric powertrains are starting to gain market share. Current hybrid vehicles add an electric motor, battery pack, and power electronics to the conventional powertrain. A variety of engine/motor configurations are possible, each with advantages and disadvantages. In general, efficiency is improved due to engine shut-off at idle, capture of energy during deceleration that is normally lost as heat in the brakes, downsizing of the conventional engine, and, in some cases, propulsion on the electric motor alone. Ongoing increases in hybrid market share are dependent on cost reduction, especially the battery pack, efficiency synergies with other vehicle technologies, use of the high electric power to provide features desired by customers, and future fuel price and availability. Potential barriers include historically low fuel prices, high discounting of the fuel savings by new vehicle purchasers, competing technologies, and tradeoffs with other factors desired by customers, such as performance, utility, safety, and luxury features.

**1:25PM X5.00003 Nuclear Power Now and in the Near Future** , WILLIAM BURCHILL, Texas A&M University — The presentation will describe the present status of nuclear power in the United States including its operating, economic, and safety record. This status report will be based on publicly-available records of the U.S. Department of Energy, the U.S. Nuclear Regulatory Commission, and the Institute of Nuclear Power Operations. The report will provide a brief description and state the impact of both the Three Mile Island and Chernobyl accidents. It will list the lessons learned and report significant improvements in U.S. nuclear power plants. The major design differences between Chernobyl and U.S. nuclear reactors will be discussed. The presentation will project the near future of nuclear power considering the 2005 Energy Bill, initiatives by the U.S. Department of Energy and industry, and public opinions. Issues to be considered include plant operating safety, disposition of nuclear waste, protection against proliferation of potential weapons materials, economic performance, environmental impact and protection, and advanced nuclear reactor designs and fuel cycle options. The risk of nuclear power plant operations will be compared to risks presented by other industrial activities.