

Caltech 336

T E S S M T W T F S S M T W

The campus community biweekly

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An aluminizing experience

Robert Tindol

Slowly and cautiously, Palomar Observatory superintendent Bob Thicksten leans over on a clean paper cloth to dab soapy water on the 14-ton Pyrex mirror that serves as the heart of the Hale Telescope. He has outfitted his assistants with high-quality sea sponges and has cautioned them to dab rather than rub so that the priceless 200-inch glass surface won't be scratched by dust grains.

Thicksten, a 22-year employee of the Caltech-owned observatory, is preparing the mirror surface so its thin aluminum coating can be stripped and another coating put on. The aluminum film, scarcely a hundredth the width of a human hair, has degraded due to exposure to the elements and no longer reflects as it did when deposited just a year ago.

"We realuminize the mirror about every two years on average, though we'd like to increase that to once a year," says Thicksten, while his crew runs water continuously over the surface of the mirror to keep water marks from forming.

Once he's satisfied that all loose grime has been removed, Thicksten and employees Pam Thompson, Dana Cuney, and Tammy Allen don protective clothing and masks so they can wash down the mirror surface with acid to remove the old aluminum. Again, Thicksten is literally in the middle of the work—standing on a plate jutting from the floor through the 41-inch center hole to avoid walking on the mirror surface itself. Because a dropped tool or misstep could damage the mirror's sur-

face, Thicksten does all the tricky work himself.

"I've got the ultimate responsibility, so the things that worry me the most are the things you'll find me doing," he says. One thing that's certain is that the mirror is virtually irreplaceable. No one—not even Corning, the original caster of the mirror blank—is making such monolithic pieces of glass the old way these days. In fact, when Caltech checked a few years back to see how much it would cost to replace the mirror in the event of a disaster, the Institute was told that a \$1 million study would be needed to even answer the question.

This isn't to say the 200-inch mirror is the largest ever cast—it's not. And in fact, there's a newer spin-casting technology that could be used to make a replacement. (Though it wouldn't be an exact replica, a spin-cast mirror would cost an estimated \$9 million.) But the days are over when tons of Pyrex were melted in a giant mold and the entire mass left to cool for many months.

When Palomar Observatory was dedicated in 1948, the facility instantly became the preeminent astronomical observatory in the world and its Hale Telescope the best existing instrument by far. Named after famed astronomer George Ellery Hale, the 200-inch remained the world's leading telescope until Caltech's Keck Observatory opened about a decade ago in Hawaii.

see Mirror, page 6

Collision wiped out dinosaurs, but life rebounded quickly

Though the dinosaurs fared poorly in the comet or meteor impact that destroyed two-thirds of all living species 65 million years ago, new evidence shows that various other forms of life rebounded from the catastrophe in a remarkably short period of time.

In the March 9 issue of the journal *Science*, a team including Caltech geochemists reports that life was indeed virtually wiped out for a period of time, but then reappeared just as abruptly only 10,000 years after the initial collision. Further, the evidence shows that the extinctions 65 million years ago, which mark the geologic time known as the Cretaceous-Tertiary (K-T) boundary, were most likely caused by a single catastrophic impact.

"There's been a long-standing debate whether the mass extinctions at the K-T boundary were caused by a single impact or maybe a swarm of millions of comets," says lead author Sujoy Mukhopadhyay, a Caltech graduate student. "In addition, figuring out the duration of the extinction event and how long it took life to recover has been a difficult problem."

see Dinosaurs, page 6



Varshavsky wins Wolf Prize

Mark Wheeler

For his discovery of a critical protein system that regulates normal cell division and many other biological processes, Caltech's Alexander Varshavsky has been named the corecipient of the 2001 Wolf Foundation Prize in Medicine.

Varshavsky, the Smits Professor of Cell Biology, will share the award with Avram Hershko of the Technion Israel Institute of Technology. The Wolf Prize was established in 1978, and is designed to promote science and art for the benefit of mankind. Specifically, the pair is being honored for the discovery of "the ubiquitin system of intracellular protein degradation and the crucial functions of this system in cellular regulation." The prize includes an honorarium of \$100,000 that will be split between the two awardees.

Proteins are biology's blue-collar workers. They are the catalysts that jump-start the various reactions of cellular life, telling cells when it's time to divide, differentiate, or die, and monitoring the timing of such events. When its specific job is done, it's often critical that a particular protein should be destroyed and thereby cease functioning.

Ubiquitin is a protein that attaches itself to other proteins within a cell, marking them for degradation (or destruction) by proteases, still another kind of specialized protein. Ubiquitin is, well, ubiquitous in all organisms other than bacteria, hence its name. Using both mouse cells and baker's yeast as model organisms, Varshavsky proved that ubiquitin is essential for protein degradation in living cells. His laboratory also showed that the ubiquitin system plays major roles in a number of biological processes, including cell growth and division, DNA repair, and responses to stress. Subsequent work by numerous laboratories uncovered many other functions of this remarkable system, including its multiple roles in the functioning of the brain (for example, memory formation), in the development of most

see Varshavsky, page 6

Detection of brown dwarf radio emission a first

Robert Tindol

A Caltech graduate student in astronomy recently led a team of researchers in finding the first radio emission ever detected from a brown dwarf, an enigmatic object that is neither star nor planet, but something in between.

The discovery, reported in the March 15 issue of the journal *Nature* by lead author Edo Berger and his colleagues, demonstrates that brown dwarfs can flare 10,000 times more intensely than theory predicted. The results will likely force experts to rethink their theories about magnetism in brown dwarfs and gas giants, says Shri Kulkarni, Berger's supervisor and Caltech's MacArthur Professor of Astronomy and Planetary Science.

Berger led a student team that made the discovery during a special National Science Foundation summer program at the NSF's Very Large Array (VLA) near Socorro, New Mexico (where Jodie Foster received extraterrestrial messages in the film *Contact*). The brown dwarf they observed is named LP944-20.

Berger and his colleagues decided to make a long-shot gamble in attempting to observe a brown dwarf from which X-ray

see Brown dwarf, page 2

NewsBriefs



A day at the races: joining Caltech's Alice Huang (left) and President David Baltimore in the winner's circle at Santa Anita on March 10 were jockey David Flores and John Dolan and I. S. Longo, whose mare Lazy Slusan won the sixth heat.

Honors and awards

Richard S. Ellis, professor of astronomy and director of the Palomar Observatory, has been appointed the Lansdowne Lecturer at the University of Victoria, in British Columbia. He will deliver at least three lectures during his visit: a public lecture for a general audience, a physics colloquium at the university's department of physics and astronomy, and one or more seminars for astronomers. The university awards this premier appointment in the physical sciences once every two years.

Benjamin H. Johnson, instructor in history, has received the Forest History Society's Ralph W. Hidy Award, which is presented each year for the best article in the field of environmental history. Johnson's article, "Conservation, Class, and Subsistence at the Birth of Superior National Forest," examines the effects of early conservation measures on the economy, politics, and ecology of communities near the Superior National Forest.

Nai-Chang Yeh, professor of physics, has received the 2001 Achievement Award of the Chinese-American Faculty Association of Southern California, which cites "her outstanding contributions to experimental condensed matter physics, particularly in the areas of high-temperature superconductivity and state-of-the-art frequency standards." She has also been elected a fellow of the Institute of Physics and granted the title of chartered physicist.

Personals

New positions

Hossein Jadvar joined Caltech's faculty on February 14 as a visiting associate in bioengineering; he will give lectures and participate with Institute and JPL scientists in collaborative research on various bioengineering projects related to cardiac physiology and imaging assessment of physiological changes induced by microgravity environments. An assistant professor of radiology at USC's Keck School of Medicine, he received his BS in chemical engineering from Iowa State University; an MS in biomedical engineering from the University of Wisconsin-Madison; an MS in computer engineering and a PhD in bioengineering from the University of Michigan, Ann Arbor; and an MD from the University of Chicago. His appointment at Caltech is for one year and is expected to be renewed on an annual basis.

Births

Eloisa Imel, manager of staff operations for the Division of the Humanities and Social Sciences, gave birth to a daughter, Eleanor, on March 4. Her husband, David, who received his PhD in physics from Caltech in 1990, is a member of the technical staff at JPL.

Campus authors

Medieval power examined

In a new book, Caltech assistant professor of history **Warren Brown** looks at the role of central authority in local societies of the early Middle Ages. Titled *Unjust Seizure: Conflict, Interest, and Authority in an Early Medieval Society*, the book explores how people involved in local disputes responded to a king's claims to jurisdiction and control. Drawing on the recent work of anthropologists and political scientists on topics such as dispute resolution and the dynamics of conquest and colonization, Brown considers larger issues than conflict resolution. For example, how might a ruler have exercised power without the coercive resources available to the modern state? And in what ways might a people respond to military conquest?

Unjust Seizure is due to be published in April by Cornell University Press.

Suburban lit analyzed

Princeton University Press has published *White Diaspora: The Suburb and the Twentieth-Century American Novel*, by **Catherine Jurca**, assistant professor of literature at Caltech. In the book, Jurca traces the emergence of the suburb as a setting for and subject of the 20th-century American novel. In cases ranging from the Tarzan novels of Edgar Rice Burroughs (who as a real-estate developer created Tarzana, California) to Richard Wright's *Native Son* and John Updike's Rabbit books, she finds a preoccupation with the suburb as a place under siege, the fortunate as powerless, and the property owner as dispossessed, a "fantasy of victimization" and self-pity.

The book will be available in April as both a hardcover and a paperback.

Celebrating 15 years of Mozart on campus

Continuing a favorite campus tradition, the 15th annual All-Mozart Concerts will be performed on Friday, April 6, at 8 p.m. and Sunday, April 8, at 3:30 p.m. in Dabney Lounge. The concerts, free and open to the public, "play consistently to standing-room-only audiences," says Don Caldwell, Caltech Chamber Singers director and concert organizer.

This year's program will feature the Chamber Singers and a piano soloist, sophomore Dana Sadava. The musicians will perform Mozart's *Requiem* and his Piano Concerto No. 23 in A Major, K. 488. According to Caldwell, the powerful and poignant *Requiem*, one of the composer's most popular and enduring works, is usually associated with massive choirs and professional soloists. "In this case," he says, "the chorus and solos will all be performed by students, in an ensemble numbering only 16 voices—something most musicians would find pretty astounding." He describes the piano concerto as "quintessential Mozart, with engaging melody, probing thought, and great vitality and style."

Over the years, the Mozart Concert has evolved into a format that usually includes choral, orchestral, and chamber works, with the Chamber Singers as mainstays. Participants have included members of the Caltech Chamber Music program, directed by Delores Bing; the Caltech Wind Ensemble, directed by Bill Bing; and the Caltech Chamber Orchestra, directed by Allen Gross. The concert programs have included "symphonies, serenades, opera scenes, a great variety of chamber music, and almost the entire Mozart choral repertoire," Caldwell says.

The all-Mozart concert tradition was born in 1986 through a fortuitous set of circumstances. As a faculty lecturer in the humanities, Caldwell was teaching a course on the composer, and three of his students, a violinist, clarinetist, and singer, were talented musicians who had performed Mozart works. Additionally, Wendy Caldwell had been demonstrating some of Mozart's piano concerti to the class, and to top it off, the Chamber Singers were learning one of his missae brevis (a short setting of the mass).

It seemed natural that the collective idea should arise: why not have the class put on an all-Mozart concert? The clarinetist, who also happened to be the ASCIT president, "was able to wheedle some money from the dean"; an open date in Dabney was reserved; and the first concert was set.

"What really led to the tradition was the unexpected audience response," Caldwell says. The musicians, looking to play for a group of friends and family, were stunned to face an overflow crowd, with people lining the back walls. They'd failed to take note of the composer's recent resurgence in popularity. "This was right on the heels of the movie *Amadeus*, and Mozart was 'in'!"

Caldwell concludes, "Needless to say, it seemed like such a good thing that we thought, why not give it another go? And here we are 15 years later, anticipating another packed house."

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Brown dwarf, from page 1

flares had been recently discovered with NASA's Chandra X-ray satellite. "We did some background reading and realized that, based on predictions, the brown dwarf would be undetectable with the VLA," he said. "But we decided to try it anyway."

After consulting with Dale Frail, an astronomer at the National Radio Astronomy Observatory (NRAO), Berger and his colleagues decided to utilize a block of observing time traditionally dedicated to the summer students.

The day after they collected their data, the students gathered at the NRAO array operations center in Socorro to process the data and make the images. Berger, who had prior experience processing VLA data, worked alone in a room while the other students worked together on another computer. Berger finished first and was shocked at his image.

"I saw a bright object at the exact position of the brown dwarf, and was pretty sure I had made a mistake," he said. He waited for the others, who were working under the guidance of another NRAO astronomer. Ten minutes later, the others also produced an image on the screen in which the same bright object showed up at the brown dwarf's location.

Berger then began breaking up the approximately 90 minutes' worth of data into smaller segments. His results showed that the brown dwarf's radio emission had risen to a strong peak, then weakened, demonstrating that the brown dwarf had flared.

"Then we got real excited," Berger said, adding that the students immediately sought and received additional observing time. Soon they had captured two more flares.

"The radio emission these students discovered coming from this brown dwarf is 10,000 times stronger than anyone expected," Frail said. "This is going to open up a whole new area of research for the VLA."

The existence of brown dwarfs—objects with masses intermediate between stars and planets—had long been suspected but never confirmed until 1995, when Kulkarni made the first observation at Caltech's Palomar Observatory. Since then, a large number of brown dwarfs have been identified in systematic surveys of the sky. Astronomers now believe that there are as many brown dwarfs as stars in our galaxy.

Flaring and quiescent radio emissions have been seen previously from stars and from the giant planets of our solar system, but never before from a brown dwarf. Moreover, the strength of the magnetic field near the brown dwarf—as inferred from the radio observations—is well below that of Jupiter and orders of magnitude below that of low-mass stars, said Kulkarni. Conventional wisdom would require large magnetic fields to accelerate the energetic particles responsible for the radio emissions. The same conventional wisdom says that brown dwarfs are expected to generate only short-lived magnetic fields. However, the persistence of LP944-20's radio emission shows that the picture isn't complete, Kulkarni said.

"I am very pleased that a first-year Caltech graduate student was able to spearhead such an undertaking, which led to this big discovery," said Kulkarni. "This discovery will spur theorists into obtaining a better understanding of magnetism in stars and planets."

Additional information on the discovery is available at the NRAO Web site at www.nrao.edu/pr/browndwarf.html.

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March 26–April 1, 2001

M T W T F S S

Events in roman type are open to the public
Events in *italic type* are open to the Caltech community only

Monday, March 26

Special Condensed Matter Physics Seminar

114 E. Bridge, 3 to 4:15 p.m.—“Natural Patterns and Their Defects,” Professor Alan Newell, Arizona Center for Mathematical Sciences, University of Arizona, Tucson, and University of Warwick, England.

Computation and Neural Systems Seminar

24 Beckman Labs, 4 p.m.—“How Lateral Inhibition Generates Simple Cells in the Visual Cortex,” Robert Shapley, professor of neural science, psychology, and biology, New York University.

Control and Dynamical Systems Seminar

119 Kerckhoff, 4 p.m.—“Modeling the Cell Division Cycle,” Bela Novak, professor of biochemical technology, department of agricultural chemical technology, Budapest University of Technology and Economics. Refreshments, 3:45 p.m.

William Bennett Munro Memorial Seminar

Judy Library, 110 Baxter, 4 p.m.—Topic to be announced. Peter C. Perdue, professor of history, MIT. Refreshments.

Wednesday, March 28

Molecular, Cellular, and Developmental Biology Seminar

119 Kerckhoff, 4 p.m.—“Roles of AML1 Transcription Factor During Hematopoiesis and Angiogenesis,” Professor Toshio Watanabe, Institute of Development, Aging and Cancer, Tohoku University, Japan.

Get to know and love the @Caltech calendar

The editors of the *Caltech 336* and online @Caltech calendars have received comments that the online calendar doesn’t include as much information in a one-page format as does the printed version. The following is a representative compilation of such letters. We hope that you’ll find this response helpful in navigating the online calendar to find the information that you want.

Dear Ms. Bradbury,
I would like to print the online calendar each week and post it on my bulletin board, but as you know, it’s a compressed version that doesn’t provide such details as the name of the speaker or the title of a talk or whatever—you have to follow another link to get the whole story. I wonder whether you would consider the possibility of providing an online calendar that contains all the information I’m used to in the printed version, on a single page.

Sincerely,
Wilson E. Del Mar

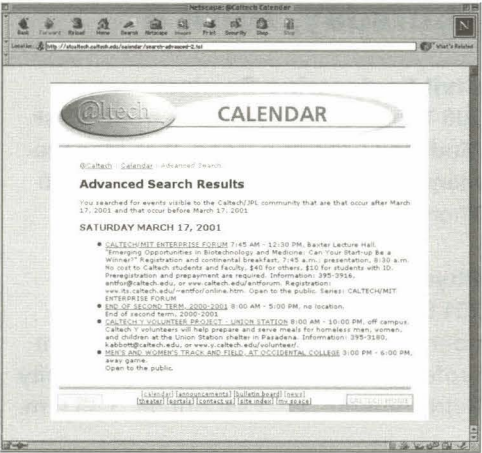
Dear Mr. Del Mar,
Yes, you can print out the online calendar with the same information that appears in *Caltech 336*. True, it’s a longer operation, but it’s quite fast and easy, and it will give you exactly what you want.

First of all, go to <http://atcaltech.caltech.edu/>. Once there, click on the box that says CALENDAR. At the top of the screen, click on SEARCH FOR PAST, FUTURE, OR SPECIFIC EVENTS. Scroll down that page to where you enter the dates you’re interested in. After filling in the dates, hit the search button, and your advanced search results will give you the absolutely same information that is in the *336* calendar, both academic and campus events. (If you just wanted to see all the conferences and seminars, you could click on the appropriate categories in the Category box.) These listings are what we call the “short description.” Please remember that by clicking on the title of the event, you’ll get a “long description” that may have much more detailed information about the event than is included in the *336* calendar. In any case, my point is that the advanced search gives you the same information you see on the printed *336* calendar.

Another important point I’d like to make is that by going online, you’ll actually find events that didn’t get to us in time for inclusion in *336*. So, by printing out this searchable calendar daily or weekly, you’ll have the most up-to-date information available.

In any case, you can have what you want in a very short amount of time. I’ve done it myself, so I feel confident in saying this.

Debbie Bradbury, Calendar Editor



The advanced search function in the online @Caltech calendar will yield a list of events just like the printed 336 calendar.

Tirrell awarded Baxter grant

Deborah Williams-Hedges

The BioScience business of Baxter Healthcare Corporation, Hyland Immuno, has awarded \$250,000 to Caltech faculty member David Tirrell, the McCollum-Corcoran Professor and professor of chemistry and chemical engineering, and chair of the Division of Chemistry and Chemical Engineering.

Glendale-based Hyland Immuno awarded the unrestricted grant to Tirrell to continue his research in the design and synthesis of novel proteins and protein-like materials for applications in biology, biotechnology, and medicine. He and his coworkers use biological cells to make proteins, just as nature does, but the cells are reprogrammed to produce specific materials that are targeted toward important biomedical technologies.

“I am delighted by this award, which will allow us to move our research forward much more rapidly,” said Tirrell. “The link to Baxter will also help us connect our programs more directly to important clinical problems.”

Said Norbert Riedel, president of Hyland Immuno’s recombinant business, “One of our keys to growth is the collaboration with world-class academic research centers like Caltech. We are pleased to provide this grant to Dr. Tirrell to further his important work in protein design.”

Baxter Healthcare Corporation is the principal U.S. subsidiary of Baxter International Inc. (NYSE:BAX), a global medical products and services company that focuses on critical therapies for people with life-threatening conditions.

The Hyland Immuno business of Baxter Healthcare Corporation develops and produces therapeutic proteins from plasma and through recombinant methods to treat hemophilia, immune deficiencies, and other blood-related disorders. Hyland Immuno’s portfolio of therapies includes coagulation factors, immune globulins, albumin, wound-management products, and vaccines.

April 2–8, 2001

M T W T F S S

Events in roman type are open to the public
Events in *italic type* are open to the Caltech community only

Monday, April 2

Aeronautics Seminar
101 Guggenheim Laboratory, Lees-Kubota Lecture Hall, 1 p.m.—Topic to be announced. Sarita Thakoor, JPL.

Geological and Planetary Sciences Seminar
155 Arms, Robert Sharp Lecture Hall, 4 p.m.—“The Shape and Internal Structure of 433 Eros from the NEAR Mission,” Maria Zuber, professor of geophysics and planetary science, MIT. Refreshments, 151 Arms, 3:45 p.m.

Tuesday, April 3

Chemical Physics Seminar
147 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Understanding Intermolecular Coherences in Solution NMR: How Everything Organic Chemists Understand Is Wrong,” Warren S. Warren, professor of chemistry, Princeton University.

Special Fluid Mechanics/Environmental Science and Engineering Seminar
101 Guggenheim Laboratory, Lees-Kubota Lecture Hall, 4 p.m.—“Stability and Transition of Wind-Driven Water Surfaces,” Fabrice Veron, Scripps Institution of Oceanography, UC San Diego. Information: www.galcit.caltech.edu/Seminars/Fluids/CurrentFluids/index.html.

German Film Series
Baxter Lecture Hall, 8 p.m.—*Exklusiv (Exclusive)* (1997, English subtitles). Directed by Florian Froschmayer and starring Martin Rapold, Daniel Bill, Judith Wyprachtiger, Stefan Gubser, and Beat Schlatter.

Wednesday, April 4

Astronomy Colloquium
155 Arms, Robert Sharp Lecture Hall, 4 p.m.—“A New Era of Microlensing Astrophysics: Cool Jupiters and Cool Stellar Atmospheres,” Dr. Penny D. Sackett, Kapteyn Astronomical Institute, Rijks University, Netherlands.

Thursday, April 5

Civil Engineering Seminar
206 Thomas, 4 p.m.—“Catastrophe Risk Modeling,” Weimin Dong, Risk Management Solutions, Inc. Refreshments, 210 Thomas, 3:45 p.m.

Physics Research Conference
201 E. Bridge, 4 p.m.—Topic to be announced. Dr. Hari Manoharan, assistant professor of physics, Stanford University. Refreshments, 110 East Bridge, 3:45 p.m.

Friday, April 6

Fluid Mechanics Film Series
306 Firestone, 1 p.m.—“Effects of Fluid Compressibility,” prepared by Professor Hunter Rouse, University of Iowa; and “Transonic Flight,” prepared by Shell International Petroleum Company.

Fluid Mechanics Seminar
101 Guggenheim Laboratory, Lees-Kubota Lecture Hall, 3 p.m.—“The Overlap Region of Wall-Bounded Turbulent Flows and the Log-Law Versus Power-Law Debate,” Hassan Nagib, professor of mechanical, materials, and aerospace engineering, Illinois Institute of Technology. Information: www.galcit.caltech.edu/Seminars/Fluids/CurrentFluids/index.html.

Ulric B. and Evelyn L. Bray Seminar
25 Baxter, 4 p.m.—Topic to be announced. Rachel Croson, associate professor of operations and information management, the Wharton School, University of Pennsylvania, Philadelphia. Refreshments.

Inorganic-Electrochemistry Seminar
147 Noyes, Sturdivant Lecture Hall, 4 p.m.—“Designing Transition Metal Activated Diradicals as Unimolecular Reagents,” Jeffrey M. Zaleski, assistant professor, department of chemistry, Indiana University, Bloomington.

William Bennett Munro Memorial Seminar
Judy Library, 110 Baxter, 4 p.m.—“Engineering Ethics and the Ethical Dimensions of Risk,” Charles E. Harris, associate professor, department of philosophy, Texas A&M University. Refreshments.

Watson Lectures examine molecules, photography

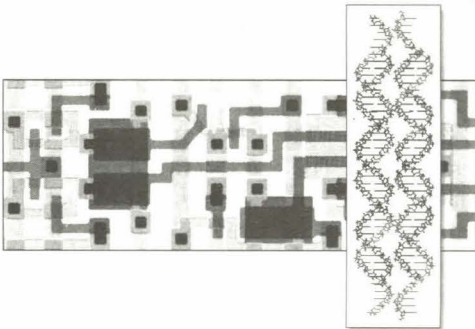
The balance of the academic year brings with it the last three installments of the season’s Earnest C. Watson Lectures. In keeping with the series’ tradition of presenting the fruits of cutting-edge research, these lectures represent the latest findings in the fields of molecular engineering and digital photography.

“Understanding the World, One Molecule at a Time” is the title of Stephen Quake’s lecture about recent advances in physics and chemistry that permit investigation into a variety of scientific problems. New techniques allow scientists to image and manipulate single molecules, opening the door to the study of the behavior of polymers and to the development of highly sensitive research tools. Quake, an associate professor of applied physics at Caltech, presents his lecture on **Wednesday, April 11.**

The push to “bridge the gap” between natural and synthetic macromolecules is the focus of “In Praise of Permissiveness: Coaxing Cells to Make Novel Macromolecules.” Biological macromolecules rely on precisely defined architectures to transmit chemical and genetic information. They are strikingly different from their synthetic cousins, which display highly complex molecular mixtures. David Tirrell, chair of the Division of Chemistry and Chemical Engineering, and Ross McCollum—William H. Corcoran Professor of Chemistry and Chemical Engineering, will detail how cells are directed, coaxed, and cajoled into making proteins with new, yet well-defined, molecular structures. The lecture takes place on **Wednesday, May 9.**

Although digital photography beats traditional film photography when it comes to convenience, it is still a poor substitute in terms of image quality. So says Carver Mead, Gordon and Betty Moore Professor of Engineering and Applied Science, emeritus, in “The Coming Revolution in Photography,” to be presented on **Wednesday, May 23.** However, recent developments in silicon image sensors have made possible the direct capture of images, an advancement that exceeds the quality of film images. Mead predicts that cameras with such technology will eventually replace film cameras in toto.

The above-mentioned Watson Lectures take place in Beckman Auditorium and begin at 8 p.m. They are open to the public and free of charge. For further information, contact the Caltech Ticket Office at 395-4652, 1 (888) 2CALTECH, or events@caltech.edu. Individuals with a disability can call 395-4688 (voice) or 395-3700 (TDD).



A quarter-century of computer science

The Division of Engineering and Applied Science will mark the 25th anniversary of computer science at Caltech with a three-day celebration on April 8, 9, and 10. The agenda includes presentations by luminaries from industry and academia in fields that the Institute has helped pioneer (these presentations are free and open to the public). Also on the schedule are social gatherings, poster sessions, and lab tours for computer science alumni, former faculty and staff, members of the Caltech community, and guests.

One of the celebration highlights will be a panel on entrepreneurship and computer science, moderated by Ben Rosen ’54, chairman emeritus of Compaq Computer Corporation and chairman of Caltech’s Board of Trustees. Among the panelists will be Lounette Dyer, PhD ’91, cofounder of Cogit Corp.; Carver Mead ’56, PhD ’60, Caltech’s Moore Professor of Engineering and Applied Science, Emeritus; and Phil Neches ’73, PhD ’83, cofounder of Teradata.

Other Caltech speakers include Mani Chandy, Ramo Professor and professor of computer science; André DeHon, assistant professor of computer science; Alain Martin, professor of computer science; Peter Schröder and Leonard Schulman, associate professors of computer science; and Erik Winfree, assistant professor of computer science and computation and neural systems. Topics covered will range from chips and VLSI, to architecture and distributed systems, to computer graphics, to new computing paradigms “beyond silicon.”

The celebration continues throughout the year with other events, including a spring CS 0.1 lecture series, and a history of Caltech computer science that will be available for purchase. For more information and a schedule of events, visit the 25th anniversary Web site at www.eas.caltech.edu/cs25/, or contact Amy Engler, coordinator, at (323) 428-9646 or amy@encom.com.

CampusEvents

Monday, March 26

Badminton

Brown Gymnasium, 9:30 a.m. to noon—Bring your own racket. Information: 355-6158.

Baby Furniture and Household Equipment Pool

234 S. Catalina, 10 a.m. to 1 p.m.—Loans of kitchen and household necessities and baby furniture are made to members of the Caltech community. Information: 584-9773.

Wednesday, March 28

Baby Furniture and Household Equipment Pool

234 S. Catalina, 10 a.m. to 1 p.m.—Loans of kitchen and household necessities and baby furniture are made to members of the Caltech community. Information: 584-9773.

Banff Festival of Mountain Films

Baxter Lecture Hall, 7:30 to 10 p.m.—The best films and videos from the 25th anniversary of the Banff Mountain Film Festival. Details: www.events.caltech.edu. Tickets: 395-4652, 1 (888) 2CALTECH, or events@caltech.edu. Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Tickets are also available through the Arcadia REI store, 447-1062.

Jazz Dance Class

Braun Athletic Center, aerobics room, 9:30 p.m.—A free jazz dance class for beginners, sponsored by the Caltech Dance Troupe. No special clothing or shoes are required. Open to all adult members of the Caltech community. Information: 395-2508 or troupe@caltech.edu.

Friday, March 30

Caltech Y trip to Nelder Grove

Through April 1. For information and to sign up, contact Rosilynn Tilley at rtilley@caltech.edu. Visit our event Web page at www.y.caltech.edu/.

Badminton

Brown Gymnasium, 9:30 a.m. to noon—Bring your own racket. Information: 355-6158.

Saturday, March 31

Men's and Women's Track and Field

UC Riverside Classic, at UC Riverside, 11 a.m.

Ballet Dance Class

Braun Athletic Center, aerobics room, 1 to 4 p.m.—A free ballet class, sponsored by the Caltech Dance Troupe. Beginners: 1 to 2 p.m. Intermediate: 2 to 3 p.m. Advanced: 3 to 4 p.m. No special clothing or shoes are required for the beginners' class. Open to all adult members of the Caltech community. Information: 395-2508 or troupe@caltech.edu.

Monday, April 2

Badminton

Brown Gymnasium, 9:30 a.m. to noon—Bring your own racket. Information: 355-6158.

Baby Furniture and Household Equipment Pool

234 S. Catalina, 10 a.m. to 1 p.m.—Loans of kitchen and household necessities and baby furniture are made to members of the Caltech community. Information: 584-9773.

Ballroom Dance Club

Winnett lounge, 7:30 to 9:30 p.m.—American tango for beginners. Five weekly lessons taught by a professional instructor. No partner or experience is required. \$4 per class for Caltech undergraduates, \$6 for others. Refreshments. Information: 791-3103 or www.its.caltech.edu/~ballroom/index.html.

Ballroom Mini Dance Party

Winnett lounge, 9 to 11 p.m.—Open dancing; make requests or bring your own music. No admission charge and no partner needed. Refreshments. Information: 791-3103 or www.its.caltech.edu/~ballroom/index.html.

Wednesday, April 4

Baby Furniture and Household Equipment Pool

234 S. Catalina, 10 a.m. to 1 p.m.—Loans of kitchen and household necessities and baby furniture are made to members of the Caltech community. Closed Fridays. Information: 584-9773.

Ballroom Dance Club

Winnett lounge, 7:30 to 9:30 p.m.—East Coast swing for beginners. Five weekly classes. No partner or experience is required. Free for Caltech freshmen, \$1 per class for others. Refreshments. Information: 791-3103 or www.its.caltech.edu/~ballroom/index.html.

Jazz Dance Class

Braun Athletic Center, aerobics room, 9:30 p.m.—A free jazz dance class for beginners, sponsored by the Caltech Dance Troupe. No special clothing or shoes are required. Open to all adult members of the Caltech community. Information: 395-2508 or troupe@caltech.edu.

Friday, April 6

Badminton

Brown Gymnasium, 9:30 a.m. to noon—Bring your own racket. Information: 355-6158.

Caltech Environmental Task Force

Chandler Dining Hall, noon—Members of the Caltech community and interested public are welcome to discuss campus, community, and global environmental concerns. Look for the CETF sign on an outside table between Chandler and the Red Door.

Baseball

vs. Occidental College, 3 p.m.

Men's and Women's Track and Field

SCIAC four-way meet, at Claremont-Mudd-Scripps, 4 p.m.

All-Mozart Concert

Dabney Lounge, 8 p.m.—The Caltech Chamber Singers and Caltech Chamber Orchestra present the 15th annual Mozart concert. Works to be performed are Piano Concerto No. 23 in A Major, K. 488, and *Requiem*. Admission is free. Information: 395-4652, 1 (888) 2CALTECH, or events@caltech.edu. Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at www.events.caltech.edu.

Armchair Adventure Series

Beckman Auditorium, 8 p.m.—*Bavaria and the Black Forest*, narrated by Fran Reidelberger. Tickets and information: 395-4652, 1(888) 2CALTECH, or events@caltech.edu. Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at www.events.caltech.edu.

Saturday, April 7

Baseball

at Occidental College, doubleheader, 11 a.m.

Ballet Dance Class

Braun Athletic Center, aerobics room, 1 to 4 p.m.—A free ballet class, sponsored by the Caltech Dance Troupe. Beginners: 1 to 2 p.m. Intermediate: 2 to 3 p.m. Advanced: 3 to 4 p.m. No special clothing or shoes are required for the beginners' class. Open to all adult members of the Caltech community. Information: 395-2508 or troupe@caltech.edu.

Jeffrey Scot Banks Memorial Service

Dabney Lounge, 3 to 5 p.m.—A memorial service for Jeffrey Banks, Caltech professor of political science.

Sunday, April 8

All-Mozart Concert

Dabney Lounge, 3 p.m.—The Caltech Chamber Singers and Caltech Chamber Orchestra present the 15th annual Mozart concert. Works to be performed are Piano Concerto No. 23 in A Major, K. 488, and *Requiem*. Admission is free. Information: 395-4652, 1 (888) 2CALTECH, or events@caltech.edu. Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at www.events.caltech.edu.

Coleman Chamber Concert

Beckman Auditorium, 3:30 p.m.—The New York Woodwind Quintet will perform works by Villa-Lobos, Roseman, Fine, and Beethoven. Tickets and information: 395-4652, 1 (888) 2CALTECH, or events@caltech.edu. Individuals with a disability: 395-4688 (voice) or 395-3700 (TDD). Visit Public Events at www.events.caltech.edu.



The Caltech Chamber Singers will present their 15th annual Mozart concert, accompanied by the Caltech Chamber Orchestra, on Friday, April 6, and Sunday, April 8.

Dinosaurs, from page 1

To address the questions, Mukhopadhyay and his colleagues measured the amount of cosmic dust in the sediments of an ancient seabed that is now exposed on land about 100 miles north of Rome. In particular, they focused on a two-centimeter-thick clay deposit that previously had been dated to about 65 million years ago. The base of this clay deposit corresponds to the date of the extinction event.

The clay deposit lies above a layer of limestone sediments, which are essentially the skeletons of microscopic sea life that settled at the bottom of the ancient sea. The limestone deposit also contains a certain percentage of clay particles, which result from erosion on the continents. Finally, mixed in with the sediments is extraterrestrial dust that landed in Earth's oceans and then settled out. This dust carries a high concentration of helium-3 (³He), a rare isotope of helium that is depleted on Earth but highly enriched in cosmic matter.

The lower limestone layer abruptly ends at roughly 65 million years, since the organisms in the ocean were suddenly wiped out by the impact event. Thus, the layer immediately above the limestone contains nothing but the clay deposits and extraterrestrial dust that continued to settle at the bottom of the ancient sea. Immediately above the two-centimeter clay deposit is another layer of limestone deposits from microorganisms of the sea that eventually rebounded after the catastrophe.

In this study, the researchers measured the amount of ³He in the sediments to learn about the K-T extinction. They reasoned that a gigantic impact would not change the amount of ³He in the clay deposit. This is because large impacting bodies are mostly vaporized upon impact and release all their helium into the atmosphere. Because helium is a light element, it is not bound to Earth and tends to drift away into space. Therefore, even if a huge amount were brought to Earth by a large impact, the ³He would soon disappear and not show up in the sedimentary layers.

In contrast, ³He brought to Earth by extraterrestrial dust tends to stay trapped in the dust and not be lost to space, says Kenneth Farley, Caltech professor of geochemistry and coauthor of the paper. So ³He found in the limestone and the clay deposits came from space in the form of dust.

Based on the ³He record obtained from the limestones, the researchers eliminated the possibility that a string of comets had caused the K-T extinctions. Comets are inherently dusty, so a string of them hitting Earth would have brought along a huge amount of new dust, thereby increasing the amount of ³He in the lower limestone deposit.

But the Italian sediment showed a steady concentration of ³He until the time of the impact, eliminating the possibility of a comet swarm. In fact, the researchers found no evidence for periodic comet showers, which have been suggested as the cause of mass extinction events on Earth.

Mukhopadhyay and his colleagues reason that because the "rain-rate" of the extraterrestrial dust from space did not change across the K-T boundary, the ³He concentration in the clay is proportional to the total depositional time of the clay. "It's been difficult to measure the time it took for this two-centimeter clay layer to be deposited," says Farley.

The researchers conclude that the two-centimeter clay layer was deposited in approximately 10,000 years. Then, very quickly, the tiny creatures that create limestone deposits reemerged and again began leaving their corpses on the ocean bed. The implication, Farley says, is that life can get started again very quickly. Thus, the study answers two major questions about the event that led to the extinction of the dinosaurs, says Mukhopadhyay.

In addition to Mukhopadhyay and Farley, the paper is also authored by Alessandro Montanari of the Geological Observatory in Apiro, Italy.

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Varshavsky, from page 1

organs in the body, and in the regulation of general metabolism.

Conversely, malfunctions of the ubiquitin system often allow the cell's mechanisms to run amok. These malfunctions thus play major roles in many human diseases, including cancer, bacterial and viral infections, and neurodegenerative syndromes like Parkinson's and Alzheimer's diseases. Varshavsky's work on the ubiquitin system was instrumental for the current efforts to devise new classes of drugs to attack such diseases.

Varshavsky is a member of the National Academy of Sciences, the American Academy of Arts and Sciences, and the American Academy of Microbiology. His other honors include the 1998 Merit Award from the National Institutes of Health; the 1998 Novartis-Drew Award in Biomedical Science; the 1999 Gairdner International Award from Canada's Gairdner Foundation; the 2000 Sloan Prize from the General Motors Cancer Research Foundation; the 2000 Albert Lasker Award in Basic Medical Research from the Lasker Foundation; and the 2001 Merck Award from the American Society for Biochemistry and Molecular Biology.

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Mirror, from page 1

Almost immediately after it was commissioned, the Hale Telescope was responsible for revolutionizing the cosmological distance scale, and in later years was used to better describe the evolution of stars and to establish the optical basis of quasars. It was the first telescope to be used to study infrared sources—still a major emphasis of Palomar research and an active area in space- and ground-based research programs—and currently is used to study galactic structure and gamma-ray bursts.

But as Thicksten points out, the telescope's usefulness ultimately depends on an extremely thin surface of aluminum weighing less than an ounce.

After about four hours of washing, gently removing the aluminum with acid, rewashing, rubbing with potassium hydroxide, again washing with distilled water, and finally patting the glass down with 200-proof ethyl alcohol until it's literally squeaky clean, the crew is ready to seal the mirror in a giant "bell jar," or vacuum chamber, for the actual aluminizing process to begin.

Also involved is Palomar's chief engineer (and a Caltech alum), Hal Petrie '68. A 13-year employee of the observatory, Petrie has been working with Thicksten on improving the aluminizing process. Too much aluminum, he explains, and the mirror surface takes on a wavy pattern of haze that the researchers can't live with. Too little, and the reflectivity suffers. In fact, way too little and the mirror becomes transparent, allowing the 114 honeycombed cells inside the disk to become visible.

"It's really remarkable how much difference a new coating of aluminum makes," says Petrie. "Aluminum gets corroded easily, and even though we take the mirror down every six months to wash it, we can't restore it completely through washing."

Thicksten and his crew have become so adept at mirror-cleaning that they've scheduled an April conference at Palomar to discuss issues shared by about 40 other observatory technicians from around the world.

After the crew has finished preparing the mirror surface, the bell jar is lowered into place and all the air pumped out. Then, colleagues Bruce Baker and Steve Einer fire off 350 tungsten filaments coated with pure aluminum in the roof of the bell jar one by one. This process, dating to the original design of the telescope in the 1930s, acts something like a perfume atomizer to deposit an extremely smooth coating over the entire surface.

A vacuum-pump malfunction slows down progress for a time, but four days after the 28-ton mirror and metal holding cell were originally unbolted from the back of the Hale, the crew does a final inspection of the new aluminum surface. Thicksten and Petrie determine with a portable reflectometer (a special laser gadget) that the new surface is reflecting in the

visible wavelengths at about 90 percent. This is about the best that can be hoped for with an aluminum mirror surface, so the giant mirror is bolted back into place and the Hale Telescope declared hale and ready for use once again.

Thicksten, a relieved man to say the least, isn't yet sure if he and his crew will do anything to celebrate their success. Because the observatory is in a remote part of rural northeastern San Diego County, the venues are somewhat limited, he says. "Sometimes we'll maybe have ice cream. It's not as if we're downtown where we can go to the local bistro!"

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Party like it's 2001

Visitors to the Athenaeum on Saturday night, March 3, might have sensed an alien invasion, with silver- and red-caped creatures mingling amid 3-D Martian landscapes, vapors, and strobe lights. But no, these beings turned out to be Caltech professors, enjoying the atmosphere of "2001: A Spaced-Out Faculty Odyssey." Dreamt up by Paul Patterson, professor of biology and executive officer for neurobiology, and coordinated by Cheryl Gause, the gala was presented by the Officers of the Faculty—Kim Border, professor of economics and executive officer for the humanities; Paul Patterson; and Ward Whaling, professor of physics, emeritus—with approval from Provost Steve Koonin.

Faculty members mingled, enjoyed such edibles as mini asteroid potatoes, stellar sushi, and a bright orange drink called the Pathfinder, and danced till all hours. All in all, the gathering proved what Caltech students have known all along: their professors are totally spaced out. Special thanks to Marisu Jimenez, catering director; Jorge Alvarado, banquet service manager (and videographer); and the Athenaeum staff for helping to make the event a cosmic success.



The dawn of humankind, or just a new faculty member? Professor of Biology Paul Patterson and his wife, Carolyn Patterson, just monkeying around.

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