



# The California Tech

VOLUME CVI, NUMBER 3

PASADENA, CALIFORNIA

OCTOBER 11, 2004

## Apology: Headline in *The Tech* Led to Misperception about Article

Last week (Oct. 4, 2004) *The California Tech* published an article on its front page informing the campus community of James Boyk's non-renewal as Pianist in Residence and Lecturer in Music in Electrical Engineering. When the headline was proofed, we as *The Tech* editors believed it summarized the content of the news story; otherwise, it would definitely not have appeared as published. In retrospect, the editors recognize how easily the headline could be misperceived and wish to apologize to Mr. Boyk, who is justifiably proud of his long service to the students of Caltech.

-- The Editors

## Impoverished Nations Use WLEDs for Light

By CHRISTINE CHANG

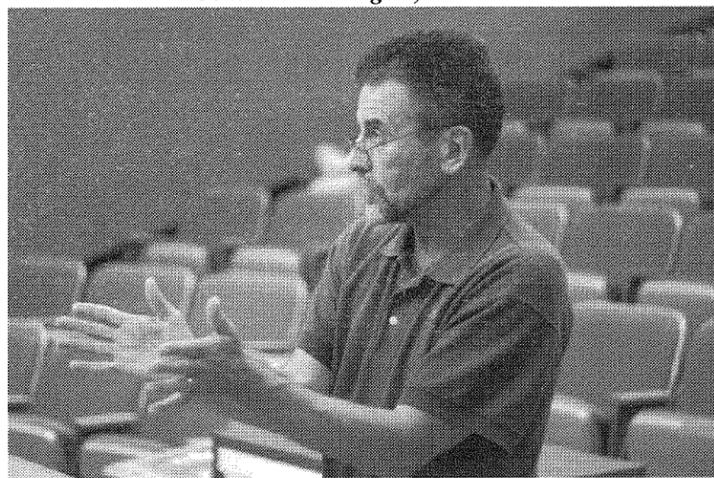
Dressed in khaki shorts and an olive green shirt, Dr. Dave Irvine-Halliday resembled a worldly traveler who had seen many rugged terrains. This image was only amplified as he unpacked a black luggage case, removing a flashlight, wires, a six-pound battery and a Reader's Digest which sported his picture on the front.

True to his appearance, Irvine-Halliday has visited various developing countries. In his talk on Thursday October 7 in Noyes 153, Irvine-Halliday spoke of his travels and his endeavor to bring light to the poor in the developing world.

Even though the vast majority of people in the United States enjoy electric-powered lights, many in the world still use kerosene lamps to brighten their homes at night. Burning kerosene not only requires that the family buy fuel each week or month, but it also pollutes the air and can lead to respiratory diseases and other health problems. Therefore, Irvine-Halliday, along with his foundation Light Up the World, wishes to replace the kerosene lamps with white light emitting diodes (WLEDs).

"The eureka moment for us was when we switched on a LED light

Continued on Page 2, Column 1



A. Green/The California Tech

Dr. Dave Irvine-Halliday explains how his group wants to provide white light emitting diodes to impoverished nations.

## Dabney Hall Refurbishing Done; Parking Structure Finish Delayed

By CHRISTOPHER KLEIN

During the summer, in the absence of most of the undergraduate population, the Caltech campus may seem more mundane and less youthful, but that doesn't mean all productive work comes to a halt. In fact, it is more convenient for Campus Planning to conduct maintenance, renovations and construction while a good deal of the population is away. This last summer was no exception. Headway was made on many projects, large and small, in their planning and execution phases.

Two large projects were the

renovation of Dabney Hall and the continued construction on the California Parking Structure.

Since it was one of the original Caltech buildings, Dabney Hall holds special historic significance. It was first designated for the Humanities; however, over the years it became a hodgepodge of development and administrative offices. Much care was taken to preserve the original feel of the building and restore it to a pure humanities facility.

"We reconstructed the building using modern techniques and modern materials and we used the original furnishings and materials

where possible," noted Arthur Elbert, Acting Vice President for Business and Finance.

This construction method has a profound effect on the overall feel of the building. The old ceramic bricks of the original staircase offset with the clean, white hallways and wood grain doors. On each floor there is an old-fashioned water fountain backed by a tile mosaic, obviously treasured remnants of the original building.

Updates to the building include air conditioning, a new roof, a new elevator and a second staircase. Of interesting note is the

Continued on Page 8, Column 4



Courtesy of pr.caltech.edu

Dr. H. David Politzer, center, sits in a mock Manhattan Project boardroom during his role in *Fat Man and Little Boy*. The Nobel committee announced Tuesday that Politzer would receive the Nobel in Physics for his discovery of asymptotic freedom.

## Physicist Wins Nobel Prize Committee Recognizes Graduate Work

By ROBERT TINDOL

PASADENA, Calif.--Hugh David Politzer has won the 2004 Nobel Prize in physics for work he began as a graduate student on how the elementary particles known as quarks are bound together to form the protons and neutrons of atomic nuclei. The announcement was made today by the Royal Swedish Academy of Sciences.

Politzer, a professor of theoretical physics at the California Institute of Technology, shares the prize with David Gross and Frank Wilczek. The key discovery celebrated by today's prize was made in 1973, when Politzer, a Harvard University graduate student at the time and two physicists working independently from Politzer at Princeton University--Gross and his graduate student Wilczek--theorized that quarks actually become bound more tightly the farther they get from each other.

This discovery has been known for 31 years as "asymptotic free-

dom," and is often described by physics professors to their students with the analogy of a rubber band increasing in tightness as it is pulled apart. Asymptotic freedom established quantum chromodynamics (QCD) as the correct theory of the strong force, one of the four fundamental forces of nature.

Caltech president David Baltimore, himself a Nobel laureate, said he was pleased that another Caltech faculty member has joined the list of the Institute's Nobel recipients. "It's wonderful that David was acknowledged for something that was so far back in his career," Baltimore said. "It shows what young people can do if they think differently."

Politzer joined the Caltech faculty as a visiting associate in 1975, the year after finishing his Harvard Ph.D. in physics and three years after publishing his work on asymptotic freedom. He earned tenure in 1976, became a full professor in 1979 and served as head of the physics department (executive officer, in Caltech par-

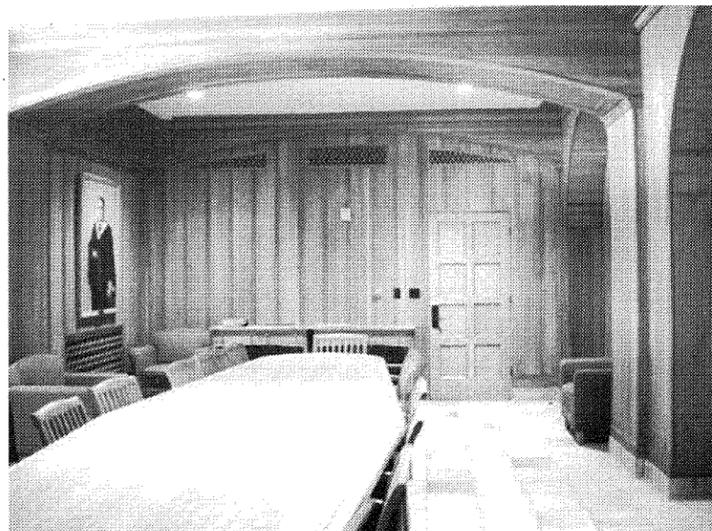
lance) from 1986 to 1988.

A native of New York City, Politzer earned his bachelor's degree from the University of Michigan in 1969. The paper that inaugurated his Nobel Prize-winning work, titled "Reliable Perturbative Results for Strong Interactions?" appeared in the journal *Physical Review Letters* in 1973 and was Politzer's first published article.

Politzer's initial foray into the public limelight came in 1989, when he was recruited to play physicist Robert Serber in the movie *Fat Man and Little Boy*, which recounted the story of the Manhattan Project and starred Paul Newman as the hard-driving project leader Gen. Leslie Groves. The director of the film, Roland Joffe, had been recruiting career physicists to play some of the roles and he settled on Politzer, whose academic specialty was quite similar to that of the man he would play.

Politzer, who did not even own a television, later told a reporter

Continued on Page 8, Column 1



K. Peng/The California Tech

The Treasure Room in Dabney is one of example of the fine workmanship used in the renovation of the humanities hall.

# Group Uses Light to Spread Literacy in Poor Countries

Continued from Page 1, Column 2

for the first time and realized a child could read by it," he said.

The many villages which Light Up the World has aided includes Mubarak, Pakistan and Andra Pradesh, India. In the village of Mubarak, as in most of the other villages which have been helped, children could not study and do school work after sundown because any light they had was too dim. Families often spent twelve dollars on kerosene per month and they were only able to light the lamp for a couple of hours each night. However, the WLEDs provided to them emits enough light for the children to study and allows them to perform productive tasks long after sundown.

At Andra Pradesh, Irvine-Halliday reached out to the Untouchables. Cursed by belonging to the lowest tier in the caste system, these people often live in rural, poor conditions.

Sri Lanka also benefitted from this foundation's work. For them, the WLEDs provides a night light which helps them prevent deadly snake bites from snakes sneaking into their rooms at night.

"The beautiful thing about the product is its simplicity," said Irvine-Halliday.

Originally, Irvine-Halliday attempted to design efficient LED lamps using colored lights, but found that these were generally too dim. Once WLEDs became more widespread, however, he was able to create effective lamps. The first design consisted of

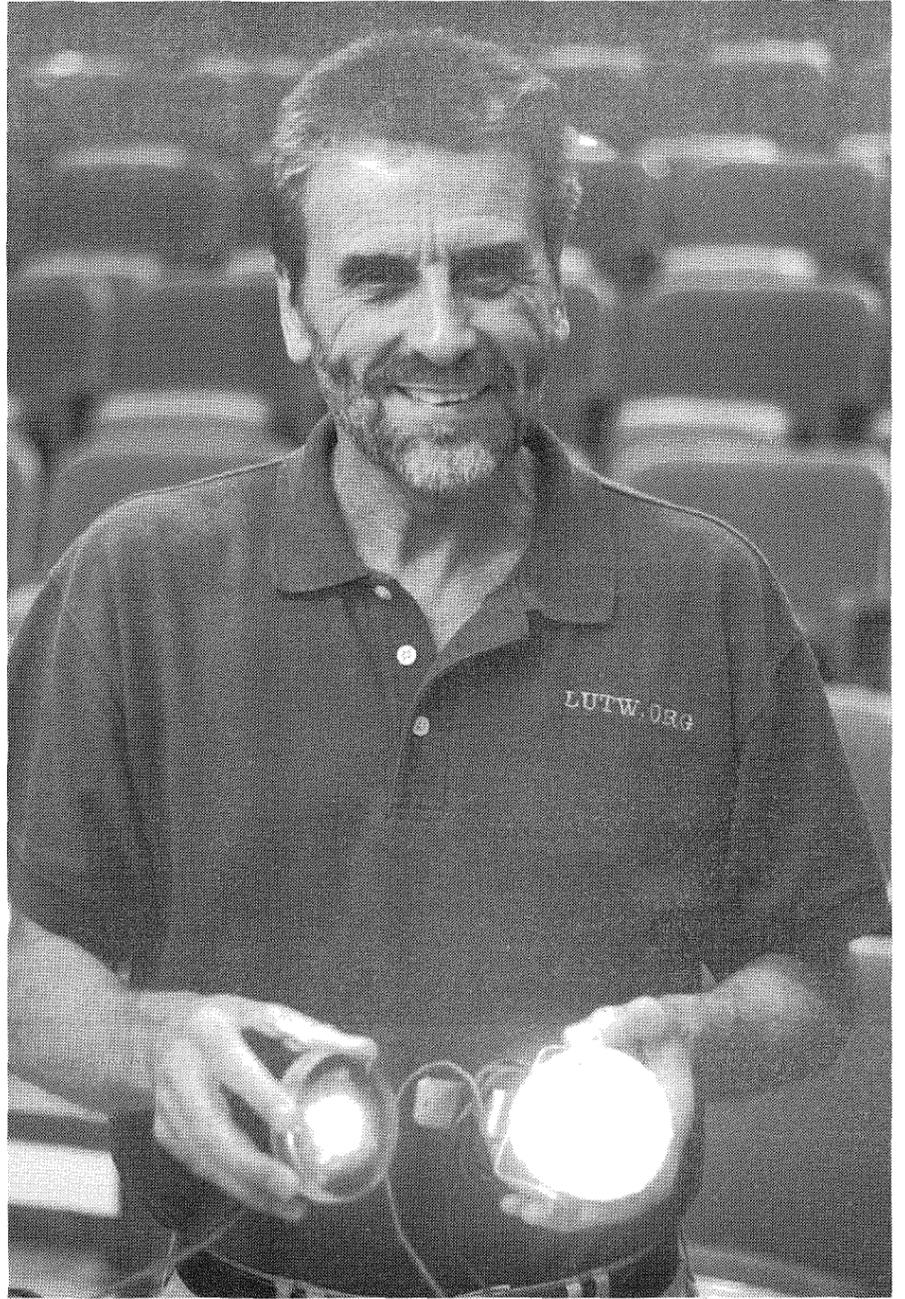
nine small LEDs which consumed about one watt of power. However, as WLEDs became cheaper, he was able to create a second lamp using a larger LED which, though also using one watt of power, is brighter and can be dimmed.

"As my colleague says, 'The darker it gets, the better our lights are,'" said Irvine-Halliday.

The WLED lamps can either be powered by a battery or solar power panels. Using turbines or a pedal generator, electricity can be produced to recharge the batteries for future use.

Irvine-Halliday is a Professor of Electrical Engineering at the University of Calgary. While taking a sabbatical in Nepal, he realized the necessity of bringing rural villagers a clean, safe and bright source of light. Light of the World's first mission was in Nepal, where Irvine-Halliday had first encountered the idea of providing clean sources of light to the poor. Since then, the demand for the services of Light of the World has increased and now they are sometimes contacted by prominent world leaders who ask for their aid. Furthermore, they have won multiple awards including the Rolex Award for Enterprise.

The talk was co-sponsored by the Graduate Student Council, with additional funding provided by Institute Housing and Campus Life.



A. Green/The California Tech

Dr. Irvine-Halliday demonstrates one of his WLED lamps, which use only one watt of power and can last over ten years. They are easily recharged by solar power.



## SURF Seminar Day

Saturday, October 16, 2004

Come hear the presentations by the 2004 SURF students, support your friends, and find out more about SURF! The presentation schedule may be seen at [www.surf.caltech.edu](http://www.surf.caltech.edu)

10:00-11:45 AM Student presentations in various classrooms

1:00-4:00 PM Student presentations in various classrooms

4:00 PM Poster Session and Reception

5:00 PM Announcement of the semi-finalists for the Doris S. Perpall SURF speaking competition

For more information, contact the Student-Faculty Programs Office ([sfp@caltech.edu](mailto:sfp@caltech.edu)).

# Princeton University



## Bendheim Center for Finance

### Master in Finance

This degree, designed to be completed in a minimum of two semesters, prepares for a wide range of careers in the financial industry, including financial engineering, risk management and quantitative trading, quantitative asset management and financial forecasting.

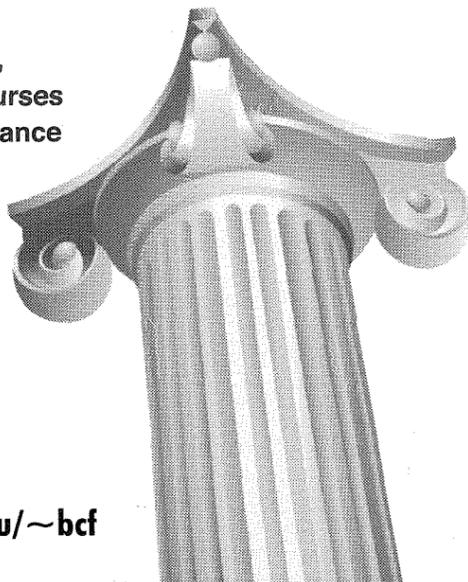
#### PRINCETON'S MASTER IN FINANCE PROVIDES:

A rigorous **core curriculum**,  
a wide range of **elective courses**  
and extensive **career assistance**

Applications for enrollment in September 2005 are due by January 2, 2005 (December 2, 2004 for candidates residing outside of North America).

For detailed information see:

<http://www.princeton.edu/~bcf>



## World Famous KROQ Concert Series

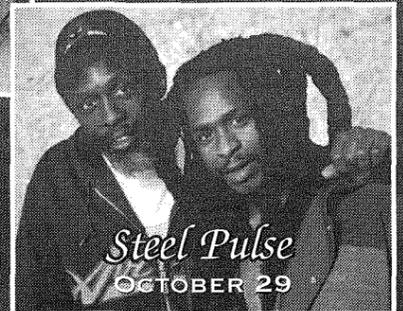
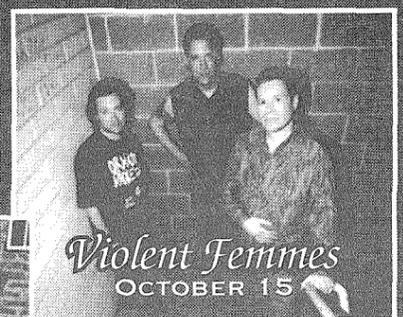
AT SANTA ANITA PARK

FREE\* Concerts After the Races  
First race 2:30 PM

Come for the Races,



Stay for the Music!



SANTA ANITA PARK

Just east of Pasadena in Arcadia. Use the I-10 or 210 Freeway.

For Information, Call (626) 574-RACE  
[www.sironas.com](http://www.sironas.com)

\*Concerts are free to racing patrons. General Admission is \$5.

*MARS ROVER**CALTECH CAMPUS*

# Show Your Pride!

Get the Credit You Deserve for Being Part of the World's Foremost Scientific Community!

Join the growing number of members enjoying the added value of a CEFCU VISA card while showing their pride in the extended Caltech family.

Choose from two striking new designs!

#### **Already Have a CEFCU VISA?**

You can switch to one of the new designs right now! Just:

- Call us at 800/592-3328, ext. 400, or
- E-mail us at [visa@cefcu.org](mailto:visa@cefcu.org), or
- Fax us at 818/952-4384

You'll receive your new card in 7-10 business days at NO CHARGE!

#### **Don't Yet Have a CEFCU VISA?**

What are you waiting for? There's no annual fee... no cash advance fees... a low rate...and no better time than now to apply! So choose your favorite design and call 800/592-3328, ext. 400, or come in to our Campus branch for an application.



**CAMPUS OFFICE:** 515 S. Wilson Ave. • M/S 100-63 • (626) 395-6300 • [www.cefcu.org](http://www.cefcu.org)

**NOT YET A MEMBER?** All it takes to join is a \$5 deposit in our high-yield, federally insured savings account, and a 25¢ membership fee. Just visit our on-campus branch.

**NCUA:** Your savings federally insured to \$100,000 by the National Credit Union Administration, a U.S. Government agency. CEFCU is an Equal Opportunity Lender.

# Popping the Bubble with the Caltech UnBubbled Project:

## A Message from the Editors Welcome to UnBubbled

"Do not answer a fool according to his folly, or you will be like him yourself. Answer a fool according to his folly, or he will be wise in his own eyes."

During this heated election campaign, I sometimes wonder whether anyone - media, candidates, or the voters - remembers this age-old adage. There are serious issues at stake in this election. Issues profound enough to make their way into future history texts. Issues that are not amenable to the thirty second sound bites. Issues that have nothing to do with what two guys did during the Vietnam War. And, issues that deserve the detailed and substantiated treatment that scientists and engineers strive for in their line of work.

Hoping not to perpetuate the usual follies of passionate political debate, I'd like to introduce the first publication of the Caltech UnBubbled Project. Our mission is to solicit, refine, and publish - in an open and non-partisan manner - political essays written by Caltech community members. The intent is to raise awareness and dialog at our Institute by bringing our analytical traditions to the political discussion.

The hotly debated 2004 election provides an excellent backdrop for this community dialog. However, our objective is not to engage in candidate or party bashing. That's what the general media is for. Rather, we hope to

draw on Techers' understanding of policies, philosophies, and possible repercussions to frame today's political questions.

Caltech is a deep well to draw from.

Today we bring you the voices of three prominent Caltech faculty members - President Baltimore, and Professors Goodstein and Kennedy. We have asked them to initiate our discussion because of their experience in and passion about specific issues.

But, this is no lecture hall or text book. The issues raised have no definitely correct solution. It is fair game to challenge their assertions and conclusions, and we hope you will.

We also recognized that the opinions we bring to you reflect a "sampling bias" that favors the most logistically accessible perspectives here on campus. It was not our intention to come down on any particular side of the political spectrum. If you feel that we did not meet our goals of non-partisanship and objectivity, a sure-fire solution is for you to write a response!

Anyone in the Caltech community, of any political persuasion, is invited to contribute, in response to questions already touched upon or on topics of your own choosing. Please enjoy reading and thinking about the "Issues at Stake in National Politics"

-- The Caltech UnBubbled Project Editors

## What Happens When Ideologues Govern

By PROF. MARY KENNEDY

In the interest of full disclosure, I'm a Democrat, now more than ever, and I'm worried about my country. Senator Joseph Biden (Democrat, Delaware) said recently, referring to the present administration during an interview with Aaron Brown on CNN, "They're not bad people, they're ideologues." I agree with him. My dictionary defines "ideologue" as "one who advocates or supports a particular ideology, especially a zealous or doctrinaire supporter of an ideology." That is what Joe Biden meant. The Bush administration adheres to its ideology with a tenacity that has cost this country dearly.

Every politician has an ideology of some kind, so what do I mean? First, I'll offer some principles that I think both major parties, and most Americans, can agree with. A system of government in which a nation chooses its leaders by voting is a good thing. Dictatorships are not good governments. Freedom of expression is essential for a democratic government to function properly. Some version of a "free market" is the best economic model because it works to distribute goods roughly according to demand for them. These are American principles that I don't dispute.

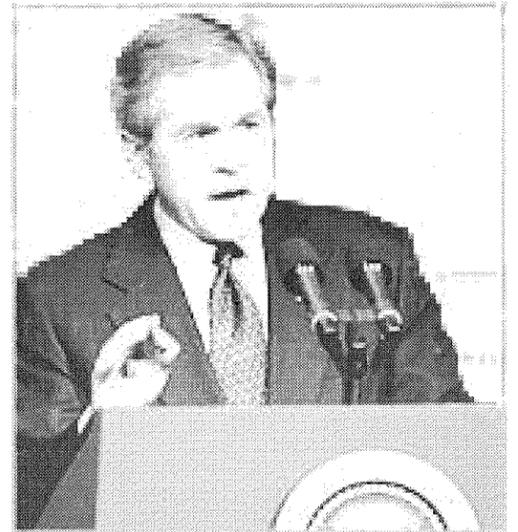
These principles lead to a few current specific beliefs that I also think both major parties would agree on: Saddam Hussein was a brutal dictator whom the world is better off without. Terrorism is a serious threat to world peace. Free world trade, subject to some regulation, will ultimately bring more prosperity for everyone.

However, the specific ideology that the Bush administration

adheres to includes the following beliefs. Foreign policy: Middle East nations, including Iraq, will be better off with democratic governments similar to our own. American military might can prevail in Iraq and the Iraqi people will hail us as liberators. Iraq is an important front of the war on terrorism. The United States does not need to work with, or cooperate with, the United Nations or our European

Allies, who advocate diplomacy and containment over military action whenever possible. Economic Policy: Tax cuts are good, especially for the most wealthy; they will stimulate the economy and bring prosperity. A corollary is the belief that the wealthy are the principle creative force in the economy.

What most worries me about the Bush ideology is that Bush acts on it with the zeal of an ideologue. This administration has been very slow to respond to the feedback of reality, that form of feedback engineers and scientists call "ground truth." In some situations, it isn't responding at all. It is well known that the Bush administration came to believe that Saddam Hussein harbored a significant cache of weapons of mass destruction. They asserted this conclusion so confidently that most others Americans believed it too. In retrospect, the fact that UN weapons inspectors were far more skeptical about the existence of such weapons caches should have been a clear warning. Instead the administration dismissed the inspectors and our allies as weak. Believing that the vast majority of Iraqis would be overjoyed to see Saddam Hussein removed and would welcome us as liberators, the administration headed into war without the means to control the chaotic situation that arose in the power vacuum left after Hussein's fall. They had been warned about the complicated tribal and religious rivalries within Iraq, about the large numbers of guns available everywhere, and about the weakness of the Iraqi economy. I read the warnings myself reported in the New York Times! Yet the first looting was dismissed by Rumsfeld as a few criminals, and the press was castigated for reporting it. Until a few weeks ago, Vice-president Cheney still asserted that weapons of mass destruction would be found. As the insurgency grows to the brink of civil war, Secretary of State Powell tells us that our Army will quell the centers of rebellion in time for elections in January. The United States is left without the trust and confidence of the UN or our European allies



courtesy of www.usembassy.org/uk

whose help we desperately need. I can't blame the rest of the world for distrusting us. We need to elect a president who is not so blinded by ideology that his administration can start to adapt realistically to the disastrous situation in Iraq and convince our allies that it is in their interests to work with us again.

Here at home, the Bush administration has insisted on continuing large tax cuts, even for the very wealthy, despite the monumental cost of the Iraq war (One billion per week, according to Reuters.) George Bush seems to agree with Steven Moore, president of the "Club for Growth," that "The only reason God put Republicans on this earth is to cut our taxes." Many Republicans, including two who worked in the Nixon administration, are among the most vocal opponents of this strategy. Peter G. Peterson, Chairman of the Federal Reserve Bank of New York from 2000 to 2004 and Secretary of Commerce under Richard Nixon, states that the present unfunded liabilities of the Federal Government (including Social Security obligations) total 45 trillion dollars; they will total ~ 74 trillion in ten years with the current tax structure. In contrast, the net worth of the United States is 42 trillion dollars. He says flatly that this level of debt is unsustainable and leaves us vulnerable to foreign debt holders. The heavy price of current tax cuts will eventually be paid, most likely by our children. Kevin Phillips who worked as an economic adviser to the Nixon administration has written extensively about the dangerous concentration of capital in only a few hands that is fostered by the Bush administration's tax policies. The administration never speaks about any of this. It doesn't fit with their tax-cutting ideology.

My message is that, whether you are Republican or Democrat, it would be wise in the next few months to consider the decision-making style of the present administration and whether its policies can and will be sensitive to feedback from reality and adapt accordingly.

### got vote?

Visit <http://caltechvotes.caltech.edu>

-- Voter registration forms and deadlines for all states

-- Request an absentee ballot

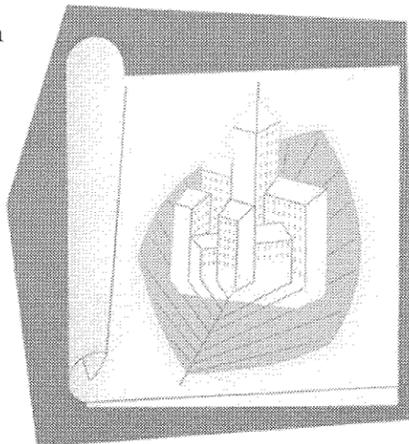
-- Fill out our survey for a chance to win a \$25 Caltech Bookstore gift certificate

California voter registration deadline is October 18

## COLUMBIA UNIVERSITY SCHOOL OF INTERNATIONAL AND PUBLIC AFFAIRS THE EARTH INSTITUTE AT COLUMBIA UNIVERSITY

### Earn your MPA in Environmental Science and Policy

The Master of Public Administration Program in Environmental Science and Policy combines Columbia University's hands-on approach to teaching public policy and administration with pioneering thinking about the environment. This twelve-month program takes place at Columbia University's New York campuses.



For more information, please call

212-854-3142, e-mail: [lar46@columbia.edu](mailto:lar46@columbia.edu),

or visit our Web site.

**Application deadline for early decision: November 1**

[www.columbia.edu/cu/mpaenvironment](http://www.columbia.edu/cu/mpaenvironment)

Contribute to the Student Health Advisory Council

Fall term meeting: Monday, Oct. 18, 2004, 7-8pm  
Health Educator's office, (SAC, Rm. 64)

RSVP: ext. 2961 or  
email [jcurtis@studaff.caltech.edu](mailto:jcurtis@studaff.caltech.edu)

All students and ideas welcomed!

# Intelligent Debate on the Issues at Stake in National Politics

## A Scientific Approach to Dealing with the Issues

By PRESIDENT DAVID BALTIMORE

Many Caltech students may feel that the greater outside world is far away and irrelevant to their immediate lives. However, at this election time, there are critical issues at stake and it is a good time for all who are over 18 to think about their choices and take the time to get a ballot and vote. The issues are not distant, they stare us in the face. We are a beleaguered country with few friends and sworn enemies. But we are a rich and powerful country with an extraordinary history of democracy. This election is about choosing how we approach our challenges: it is about how we extricate ourselves from the difficult position we have created in Iraq, it is about how we distribute income and how we do our science. It may be about whether you as a citizen are called to serve your country abroad. No matter what your chosen area of study, the results of this election will be important to your future.

Voting is most critical for those who come from one of the many swing states where a few votes could be the margin of victory. You should be especially diligent in getting your absentee ballot and filling it out.

All of us at Caltech are devoted to the principle that we must use a scientific approach to dealing with issues. So one way to judge the present election is by how the candidates incorporate scientific judgments into their administrations. If we listen to their rhetoric, both candidates are committed to science. But grave doubts have been raised about the policies of the Bush administration. [Here and elsewhere below I quote excerpts from an editorial I wrote in the 24 September, 2004 issue of *Science* magazine.] In various ways, the scientific community in the United States—and in other nations as well—has expressed concern about the way in which decisions about scientific issues have been subjected to political tests by the Bush administration. For example, the Union of Concerned Scientists (UCS), in a statement that I signed along with many others, said in pertinent part: "When scientific knowledge has been found to be in conflict with its political goals, the administration has often manipulated the process through which science enters into its decisions."

U.S. policy with respect to HIV/AIDS is a case in point. The

virus is spreading at an alarming rate, devastating Africa and now making horrifying inroads into the teeming continent of Asia. Initially, the Bush administration gave scant recognition to the protective value of condom use. Complaints led to modification of the statements on Web sites. But there is still little recognition of the need to encourage widespread use of condoms.

Climate change has had a similar history. Repeated administration statements questioned the science behind the position of the Intergovernmental Panel on Climate Change (IPCC) that the global warming seen in the past 100 years is associated with human activity. Now, at last, comes a statement from an interagency administration committee, signed by cabinet secretaries, confirming the IPCC position. In the policy domain, however, we still have a long-range research program aimed toward a "hydrogen economy," but no commitment to current mitigation of this growing crisis.

As for stem cells, the arbitrary decision to restrict federally supported research to the few cell lines available before the president's statement in 2001 still holds. After sustained criticism from the scientific community, the administration has conceded that the research is valuable. It has made funding available for research but nevertheless maintains the cell line restriction. And it supports legislation that would criminalize research involving nuclear transfer from somatic donor cells—work focused on making stem cell research more valuable, both therapeutically and experimentally.

As a scientist, I find the policies of the present administration questionable and I am heartened by statements from Senator Kerry that he would respect scientific results and conclusions and would act on them. However, I recognize that this election has many other issues at stake and I encourage everyone to consider multiple criteria when choosing a candidate and to not be a one-issue voter.

I want to thank the students who have catalyzed this discussion and helped thereby to raise the consciousness of the community about the importance of participation in this election.

## An Issue Unspoken: Fossil Fuel Depletion

By PROF. DAVID GOODSTEIN

If Earth had no greenhouse effect, it would be a frozen ice-ball, far too cold for advanced life. If it had a 100% greenhouse effect, it might well be like its near-twin Venus, whose runaway greenhouse effect gives it a surface temperature hotter than molten lead. Instead we live on a planet-wide garden of Eden, delicately balanced between those extremes. Our atmosphere is transparent to the white-hot radiation from the Sun, but it is nearly opaque to the much cooler radiation with which Earth tries to send its received energy back out into space. The result is a balmy average temperature of 57degF. In those benign conditions, we evolved, climbed down from the trees, and started drilling oil wells.

Over the past 150 years, we have evolved a civilization firmly anchored in the mathematically impossible promise of an endless supply of cheap oil. Now there is good reason to believe that sometime in the next decade or two, the world's oil fields will start to be depleted faster than new ones can be developed. When that happens, a gap will begin to grow between the supply of fuel and the need for it. If we lived in an orderly, rational world, it might be possible for some other fossil fuel to fill in the gap. But anyone who was alive in 1973 knows that we don't live in such a world, especially when it comes to a shortage of our precious gasoline. In 1973, a temporary, artificial shortage immediately caused mile-long lines at gas stations and panic and despair for the future of our way of life. The experiment was repeated in 1979 with the same result. When world-wide oil supplies reach their natural peak, the shortages that follow will be neither temporary nor artificial.

Back in the 1950's, the United States was the world's leading producer of oil. Much of our industrial and military might grew out of our giant oil industry, and most petroleum geologists expected that to go on forever. There was one exception, however. His name was M. King Hubbert, and he worked for Shell Oil in Houston. In 1956, against the wishes of his employer, he made public his prediction that U.S. oil production would peak around 1970 and decline forever after that. His prediction was widely derided at the time, but to the amazement of his colleagues, he had it right.

To make his prediction, Hubbert began with the historic record of oil discovery (not production) in the U.S. Oil discovery had already peaked in the 1930's and was declining. Let  $Q$  be all the oil that's been discovered, and  $Q_0$  be all the oil nature ever made for us. When you first start exploring for oil, it's easily found and the amount you find grows exponentially with time, obeying the differential equation for positive exponential growth,

After a while, however, it gets harder to find because there's less of it to find. That can be modeled by multiplying the right hand side by the

**"To tell the voters that they're going to have to give up their precious SUV's would amount to political suicide."**

amount of oil not yet found, giving

This is called the Logistics Equation. It's wasn't familiar to geologists at the time, but it had been used by population biologists since the nineteenth century. If you solve the differential equation and plot

versus time, you get a classic bell-shaped curve, much like a Gaussian or a Lorentzian. I think the reason Hubbert chose the less familiar Logistic curve is that if you divide both sides by

increase,  $Q/Q_0$  versus  $Q$  (not  $t$ ), you get a straight line with a negative slope that intercepts the horizontal axis when  $Q = Q_0/2$ . That makes it easy to extrapolate the historical record of oil discovery to find  $Q_0$ , the area under the bell-shaped curve. Then Hubbert assumed there would be a second later Logistic curve for production (you can't produce the oil until after you've discovered it) with the same total area,  $Q_0$ , all the oil that ever was. So he fitted the historic data for rising production to a Logistic Curve with the right area under it, and the result was his stunningly accurate prediction of where the peak-Hubbert's peak-would occur for the lower 48 United States.

The same kind of data that Hubbert had for the U.S. now exists for the whole world. For

example, just as U.S. discovery peaked around 1930, world discovery peaked around 1960. Data for world-wide discovery scatter pretty badly in the early going on the extrapolation plot, but after about 1982, they settle down to a fairly convincing straight line, extrapolating to a world  $Q_0$  of about two trillion barrels. Unlike the U.S. data Hubbert worked with, these data are highly suspect for a variety of reasons, so one must be skeptical of them. But if the two trillion barrel estimate is close to correct, Hubbert's peak for world oil production should come in this decade. Indeed, what we read in the newspapers every day now suggests that the world-wide production and distribution system is stretched to the breaking point, certainly a symptom one would expect if the peak has been reached. But it may be a false alarm. Time will tell.

It is technically possible to make a substitute fuel out of coal or natural gas, or any of the many other hydrocarbons in the earth, and as the price of oil skyrockets (along with the price of all petrochemicals and everything that has to be transported), more fuel at this higher price will be grudgingly extracted from oil sands, tar sands, depleted oil fields and other sources. So, ignoring the effects of runaway inflation, possible armed conflict and the like, it might be possible to muddle on for a while.

How long? We are told that there is enough coal in the ground to last for hundreds of years or more, but that estimate is surely flawed. For one thing, if we use coal as a substitute for oil it will have to be mined many times faster than we are doing now. In addition, as the world's population continues to increase, the poorer peoples of the world want to live more like the richer ones, using far more energy. And finally, coal supplies, like those of any mineral resource, will peak and begin to decline long before the last ton is dug out of the ground. It's a pretty good bet that the peak will happen before the end of this century.

And, if we let all that happen, the increased greenhouse effect produced by burning all those fossil fuels may well destroy the delicate balance that makes it possible for us to live on this planet Earth.

During this presidential election year, neither political party will say a word about this, the most important issue of the age we live in. To tell the voters that they're going to have to give up their precious SUV's would amount to political suicide. But a courageous candidate could say that, in order to end our dependence on a nasty and unstable part of the world, and in order to protect our climate for future generations, he or she would challenge our scientists and engineers to enable us to kick the fossil fuel habit. Beyond fossil fuels there is only sunlight and nuclear energy. Finding ways to run a civilization as complex as ours on those resources alone would be exceedingly difficult, but not entirely impossible. The scientific principles on which the new technologies would have to be based are well known. We are very good at solving technical problems when we put our minds to it. The task to be accomplished is enormous, but we could do it. What's lacking now is leadership.

### Infosys®

POWERED BY INTELLECT  
DRIVEN BY VALUES

www.infosys.com

"Settle for a traditional work experience out of college OR...  
...join Infosys' inaugural class of US educated hires in India"

Employment opportunities available in:

- Software Engineering
- Quality
- Test Engineering
- Marketing

Internship opportunities also available

Infosys (NASDAQ: INFY) is a world leader in consulting and information technology services. Infosys offers complete end-to-end business solutions and strategic sourcing designed to increase its clients' competitiveness.

Info session : 20th October  
Room : Brennen Conference Room  
Time : 3.30 p.m. - 5.00 p.m.  
First round interview : 29th October  
For further details please contact:  
Joshua Bornstein  
Email: joshua\_bornstein@infosys.com

# BE AT THE RIGHT PLACE AT THE RIGHT TIME.

FOR PLACE AND TIME, SEE BELOW.

Is Goldman Sachs truly the "right place"? Well, if you're eager to join a dynamic culture of motivated, well-rounded people – and to work alongside the world's best companies – the answer is yes. Is this really the "right time"? In this period of global transformation, companies, investors, governments and institutions from around the globe are seeking our unique brand of support. To be part of it, stop by our upcoming campus visit. After all, why leave your future to chance?

**Firmwide Information Session**

Thursday, October 14th, 2004

Time: 5:00 pm – 6:30 pm

Location: Dabney Lounge

Interested applicants should apply by e-mailing their resume and cover letter to: [quantrecruiting@gs.com](mailto:quantrecruiting@gs.com)

## Unhappy with Classes? Join a SFC Committee!

By MENG-MENG FU

It's not uncommon here at Caltech to hear students complain about classes. Whether the class is too long, the sets are too hard, or the TA's are never around, everyone has opinions on academics at Caltech. Every two years, however, there is an opportunity for students to voice their opinions at the Student Faculty Conference (SFC). The SFC provides a forum for student representatives and faculty to discuss issues that are important.

This year, the SFC will take place during third term. Classes will be cancelled for one day only so that students and faculty can attend the SFC presentations. It is a day-long conference during which different committees present their findings and recommendations. Many SFC recommendations have been incorporated into our current academic system. For example, computer science became an option. More anthropology and psychology classes are being offered. Specific recommendations within different majors have been brought to light and have been acted upon.

If you've read this far and you're still interested, you should definitely consider signing up to serve on one of the SFC committees. This year, the committees will be:

1. Core Curriculum
2. Workload, Student Morale, and Student-Faculty Interactions
3. Honor Code
4. Humanities and Social Science (HSS)
5. Physics, Astrophysics, and Applied Physics
6. Biology
7. Mechanical and Aerospace Engineering
8. Electrical Engineering/ECE, and Computer Science
9. Chemistry and Chemical Engineering
10. Geology and Planetary Science (GPS)

11. Mathematics and Applied Computational Mathematics (ACM)

12. Environmental Science Engineering (ESE), Computational Neuroscience (CNS), Structural Engineering (Civil Engineering), and Material Science.

Students who are already on ARC (Academic and Research Committee)-appointed committees or academic committees (such as BUSAC), are strongly encouraged to apply. On the other hand, no experience is needed, only ideas and opinions. Each committee also has a student chairperson, who will be responsible for overseeing the progress of the committee.

Sign-ups are posted now in front of SAC 33 and will be up until midnight Friday (October 15). Interviews will be held Sunday (October 17) starting at 8 p.m. So in conclusion, if you have opinions about academics: speak out and sign up!

## Caltech Sports Weekly Roundup

By MIKE RUPP

### Athlete of the Week:

#### Men's Water Polo's Dan Oliver

The 6-2 Sophomore from Sacramento, CA was named Caltech Athlete of the Week after a tremendous weekend that saw him named to the All-Tournament team of the Caltech Classic.

Oliver followed up his performance during the three match tournament with another strong performance on Sunday against Cal Maritime.

Over the course of the four matches, Oliver scored eight goals, twelve steals, ten assists, and 26 errors drawn.

### Men's Water Polo

The Caltech Men's Water Polo team finished fifth at the Caltech Classic this past weekend. The team went 2-3 for the week, led by Sophomore Daniel Oliver's Athlete of the Week winning performance. Senior Tom Jurczak had 14 goals, 7 steals, and 4 assists. Sophomore Jason Lee had 9 goals and 2 steals. Senior Logan Linderman had 7 goals and 5 assists.

Men's Water Polo lost the first two matches of the Caltech Classic, suffering a heartbreaking 10-12 loss to Saint Mary's, followed by a 9-16 loss to Chapman. The

team rebounded, however, in their third match of the Classic, beating Cal Maritime in a high-scoring overtime thriller, 14-13.

Occidental College, who Caltech defeated earlier this season in a stunning upset, won the tournament, defeating Cal Maritime, Cal Lutheran and Chapman. The Championship game against Chapman went into overtime before Oxy pulled out a 10-9 victory.

On Sunday, Caltech eeked past Cal Maritime once again, 9-8.

### Women's Volleyball

The Women's Volleyball team suffered three more Division III losses this past week, including two losses to SCIAC opponents, dropping their record to 5-7, with an 0-4 record in conference matches.

Senior Middle Blocker Delia Davies lead the team over the course of the week, with 15 kills and 3 blocks, both team highs. Davies also lead the team in kill percentage for the week. Sophomore Outside Hitter Rebecca Streit was second on the team in kills (11) but lead the squad in service aces and digs. Freshman Setter Sarah Stidham had 31 assists for the week.

The team plays its next match

this Tuesday at home against Whittier College. Game time is set for 7:30 PM.

### Men's Soccer

The Men's Soccer team lost 8-0 to Claremont Mudd-Scripps, but played tough against the Bulldogs of Redlands, holding the top team in the SCIAC to three goals.

Freshman Goalkeeper Elliot Pallett had four saves against Claremont and had five more against Redlands. In doing so, last week's Athlete of the Week continues to impress his coaches and teammates, and has brought stability to the most important position on the field for Caltech.

The team plays its next match on the road at Occidental College.

### Cross-Country

Both the Men's and Women's Cross-Country teams continued their best seasons in years. The teams fared well at the UC Riverside Invitational this past weekend, with Freshmen David Rosen and Matt Kiesz leading the pack for the Men. For the Women, Senior Kamalah Chang and Andrea Vasconcellos set the pace. The team next runs at the SCIAC Multi-duals, Friday, October 15.

Men's Soccer loses to Claremont Mudd-Scripps; hangs tough against Redlands

No one knows what the future will bring.

Except those  
creating it.

Visit our Career Fair Booth on Wednesday, October 13.

Opportunities are available in the following areas:

Computer Science  
Computer Engineering  
Electrical Engineering

Mechanical Engineering  
Math  
Physics

Systems Engineering  
Aeronautical Engineering  
Optics

Check out our website at [rayjobs.com/campus](http://rayjobs.com/campus) for further information, including our **Campus Recruiting Events**.

Start your job search by clicking **Find a Job**.

The power of applied intelligence.  
[rayjobs.com/campus](http://rayjobs.com/campus)

One of the most admired defense and aerospace systems suppliers through world-class people and technology. Our focus is developing great talent.

© 2004 Raytheon Company. All rights reserved. Raytheon is an equal opportunity and affirmative action employer and welcomes a wide diversity of applicants. U.S. Citizenship and security clearance may be required.

**Raytheon**

Customer Success Is Our Mission

### TUTORS WANTED

Home Tutoring for all subjects K-12  
Flexible hours. Car needed.  
Long term position. Part-time.  
\$18.50-20/ hr  
To apply:  
[www.thetutorsclub.com/jobs](http://www.thetutorsclub.com/jobs)

Business Plans  
Financial Models  
MBA, 20 years experience  
Email [jkennedy@ant91.com](mailto:jkennedy@ant91.com)  
Or call 310 641 3511 x14

If you have a master  
or doctor degree, you  
should go to:

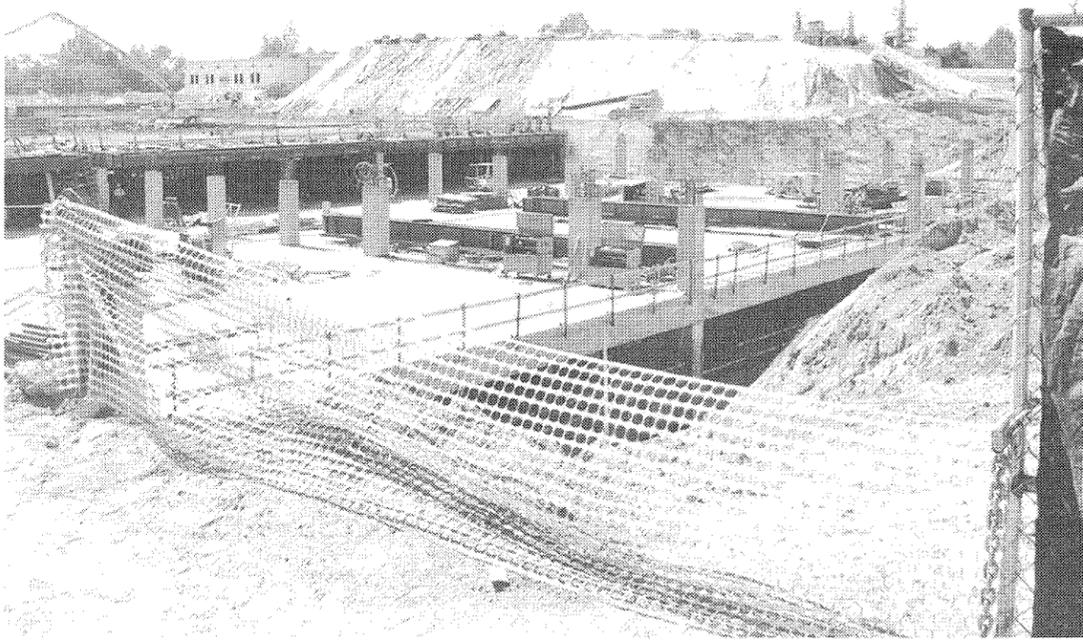
[www.MyFirstClaim.com](http://www.MyFirstClaim.com)

### DEANS OFFICE TUTORS

Dean of Students Office needs tutors in all areas--help is especially needed with the main Institute requirements e.g., MA1, MA2, PH1, PH2, CH1, etc.

The pay is \$10.00 - \$13.00 an hour. A strong understanding of the subject matter, patience, and the ability to communicate well are the qualities needed as a tutor.

If you are an upperclassman and would like to be a Deans' tutor please stop by the Deans' Office to see Sandra Estes located in room 210 of the Center for Student Services Building to complete an application.



K. Peng/The California Tech

The parking structure should be completed by January, after a strike during the summer halted work for over a month.

## Politzer's "Asymptotic Freedom" Paved Way for Quantum Theory

Continued from Page 1, Column 5

from Caltech's internal publication *On Campus* that he had been reluctant to take the part, but had relented after Joffe convinced him that the "role would not require too much in the way of time or talent." During his two weeks on the set, Politzer warmed up to the project and began discussing nuclear defense policy with Paul Newman, with whom he shared a memorable dinner of spaghetti and salad--the latter dressed with "Newman's Own," of course.

Politzer's prize brings to 31 the total number of prizes won by 30 Caltech faculty and alumni through the years (Linus Pauling won awards in both chemistry and peace).

The following information was written by Caltech's MacArthur Professor of Theoretical Physics John Preskill, a colleague of Politzer's. Preskill prepared the text upon learning that Politzer had won the Nobel Prize and sent it from England:

Of the four fundamental forces--the others besides the strong nuclear force are electromagnetism, the weak nuclear force (responsible for the decay of radioactive nuclei) and gravitation--the strong force was by far the most poorly understood in the early 1970s. It had been suggested in 1964 by Caltech physicist Murray Gell-Mann that protons and neutrons

contain more elementary objects, which he called quarks.

Yet isolated quarks are never seen, indicating that the quarks are permanently bound together by powerful nuclear forces. Meanwhile, studies of high-energy collisions between electrons and protons performed at the Stanford Linear Accelerator Center (SLAC) had probed the internal structure of the proton and Caltech's Richard Feynman had suggested in 1969 that the results of these experiments could be explained if quarks inside a proton are nearly free, not subject to any force. Feynman's suggestion, together with the observation that quarks are unable to escape from nuclear particles, posed a deep puzzle: how could nuclear forces be both strong enough to account for the permanent confinement of quarks and weak enough to account for the SLAC experiments?

The discovery of asymptotic freedom provided a highly satisfying resolution of this puzzle. The calculations of Gross, Wilczek and Politzer showed that in quantum chromodynamics (QCD), quarks are held together strongly when separated by a distance comparable to the size of a proton, explaining quark confinement. Yet for the smaller separations explored in the high-energy SLAC experiments, the attraction is weaker, supporting Feynman's proposal.

Before this development, many physicists had anticipated that understanding the strong nuclear force would require revolutionary new concepts. But surprisingly, QCD has a remarkable mathematical similarity to quantum electrodynamics (QED), the theory that successfully explains electromagnetic phenomena. In QED the force between two electrically charged particles is mediated by the exchange of a photon (a particle of light) between the two particles; in QCD, the quarks carry a different kind of charge, called "color," and the force between two colored particles is mediated by the exchange of a "gluon" between the particles.

The crucial difference between the two theories is that while the photons of QED carry no charge of their own, the gluons of QCD are themselves colored particles. A quark is surrounded by a sea of "virtual" gluons that arise due

to quantum fluctuations and the color of the virtual gluons enhances the quark's own color. A probe coming closer and closer to the quark is influenced less and less by the virtual gluons, so that the effective color charge of the quark seems to weaken; this is asymptotic freedom.

Gross, Wilczek and Politzer used pencil and paper to perform their breakthrough calculation. In 1973, the methods they needed were newly developed and fraught with subtleties. Today, the calculation is routinely assigned to physics graduate students as a homework exercise.

QCD predicts that the strength of the force between quarks changes with distance in a particular calculable way that has been well confirmed in experiments studying high-energy collisions of elementary particles. The theory makes other detailed predictions, such as the masses of various strongly interacting nuclear particles, which can be extracted only through large-scale numerical computations performed using supercomputers; these too are in satisfying agreement with experiment.

Because QCD, the theory of the strong nuclear force, turned out to be so similar to QED and to the theory of the weak nuclear force, it became possible after the discovery of asymptotic freedom to conceive of unified theories that incorporate all three forces into a common framework. Such theories have been proposed, but still await experimental confirmation. A further challenge, being pursued by many physicists today, is to achieve an even broader unification theory that encompasses the gravitational force as well.

## Strike Delays Progress On Parking Structure

Continued from Page 1, Column 3

special accommodations made for the furnishing of the 30 or so faculty offices that now occupy the building on the second and third floors. Tradesmen and carpenters on campus made much of the furniture, especially the bookcases.

The Dabney Lounge Bench resides in the first floor hallway of the structure to mark the 2004 restoration. The back of the bench is composed of a carved relief depicting Master Architect Bertram Grosvenor Goodhue's 1917 plan for the Caltech campus. The bench is dedicated to Goodhue's grandchildren, Nicholas Goodhue and Jill Goodhue Hoeksma, who contributed to the restoration project.

Adjacent to the Dabney Lounge Bench is the tastefully furnished conference room. It is in recognition of the Ahmanson Foundation for supporting the 2004 restoration.

The price tag for the Dabney Hall renovation was 7.6 million dollars.

The large hole in the ground where the old baseball and soccer fields were is going to be the California Parking Structure. It is currently surrounded by temporary wire fencing and guarded by an impressive dirt hill to the west. The estimated completion of the structure is in mid January. To hit that mark, construction work continued, albeit irregularly, through the summer.

Dr. Elbert explained that the reason for the new parking structure is to keep in line with city requirements.

"The master plan called for a new astrophysics building south of California Boulevard, right next to Keith Spalding. In order for us to be able to build a new

building there, the city said that we had to accommodate additional parking."

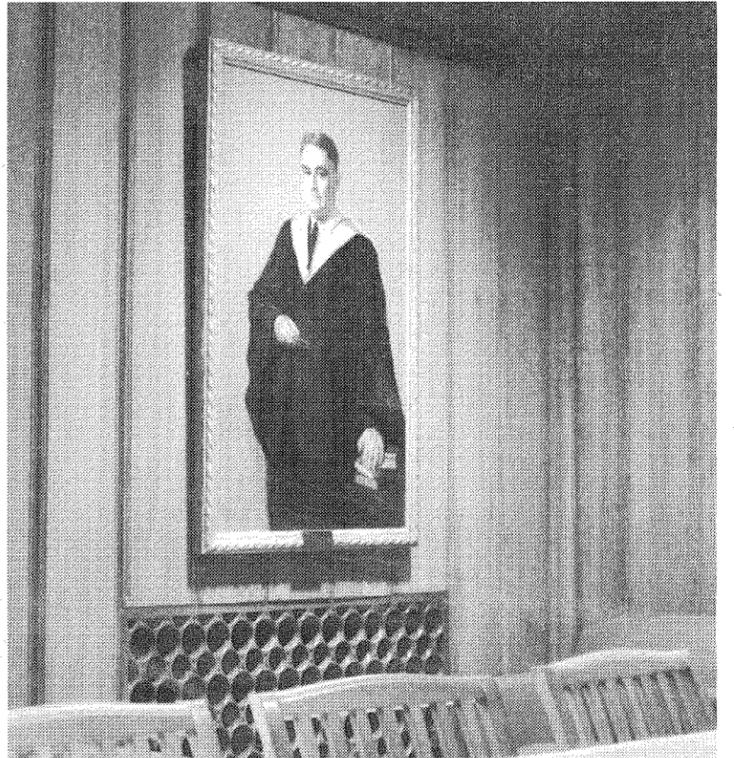
During the summer there was a strike at the construction site. It was ruled illegal and the workers were forced to resume work, but only after delaying the progress by a month.

Work also took place at the old convent of the St. Luke Medical Center, purchased recently by the Institute. The convent, once reconstruction is finished in February, will serve as the planning facilities for the Thirty Meter Telescope (TMT) project.

The TMT project is a joint effort by Caltech, University of California (UC), the Association of Universities for Research in Astronomy (AURA) and the Association of Canadian Universities for Research in Astronomy (ACURA). Faculty and members of these organizations will meet and work in the old convent to plan and prepare for the construction of a telescope larger than any other in existence.

"Over the summer we tore out all the asbestos and did all the demolition work to prepare the way the faculty members needed it," said Elbert.

Besides these large-scale, long-term projects, "a host of little things" were also accomplished. A new air handling unit was installed in Braun near the mouse cages and new water pipes were laid from the Thomas Laboratory, past the undergraduate dorms and to the Athenaeum. In addition, an architect was selected for the renovation of the south houses and program and design work was done.



K. Peng/The California Tech

A lot of the old artwork in Dabney Hall has been saved and reused in the renovated building.

### The California Tech

Caltech 40-58, Pasadena, CA 91125  
 editorial desk: (626) 395-6153  
 advertising desk: (626) 395-6154  
 editorial e-mail: [tech@tech.caltech.edu](mailto:tech@tech.caltech.edu)

VOLUME CVI, NUMBER 1

Tammy Yee Wing Ma Vi Tuong Tran  
 Managing Editor Business Manager

Matthew H Walker Robert Morell  
 News Director Circulation

The *Tech* is published weekly except during vacation and examination periods by the Associated Students of the California Institute of Technology, Inc. The opinions expressed herein are strictly those of the authors and advertisers.

Letters and submissions are welcome: e-mail submissions to [tech@tech.caltech.edu](mailto:tech@tech.caltech.edu) as plain-text attachments, including the author's name, by Friday of the week before publication. Sorry the *Tech* does not accept anonymous contributions. The editors reserve the right to edit and abridge all submissions for any reason. All written work remains property of its author.

The advertising deadline is five p.m. Friday; all advertising should be submitted electronically or as camera-ready art, but the *Tech* can also do simple typesetting and arrangement. All advertising inquiries should be directed to the business manager at [business@tech.caltech.edu](mailto:business@tech.caltech.edu). For subscription information, please send mail to "Subscriptions."

### The California Tech

Caltech 40-58  
 Pasadena, CA 91125