The California Tech

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CIT team cools object to quantum ground state

KIMM FESENMAIER
Caltech Science Writer

PASADENA, Calif.—For the first time, researchers at the California Institute of Technology (Caltech), in collaboration with a team from the University of Vienna, have managed to cool a miniature mechanical object to its lowest possible energy state using laser light. The achievement paves the way for the development of exquisitely sensitive detectors as well as for quantum experiments once only dreamed of.

"We've taken a solid mechanical system—one made up of billions of atoms—and used optical light to put it into a state in which it behaves according to the laws of quantum mechanics. In the past, this has only been achieved with trapped single atoms or ions," says Oskar Painter, professor of applied physics and executive officer for applied physics and materials science at Caltech and the principal investigator on a paper describing the work that appears in the October 6 issue of the journal Nature.

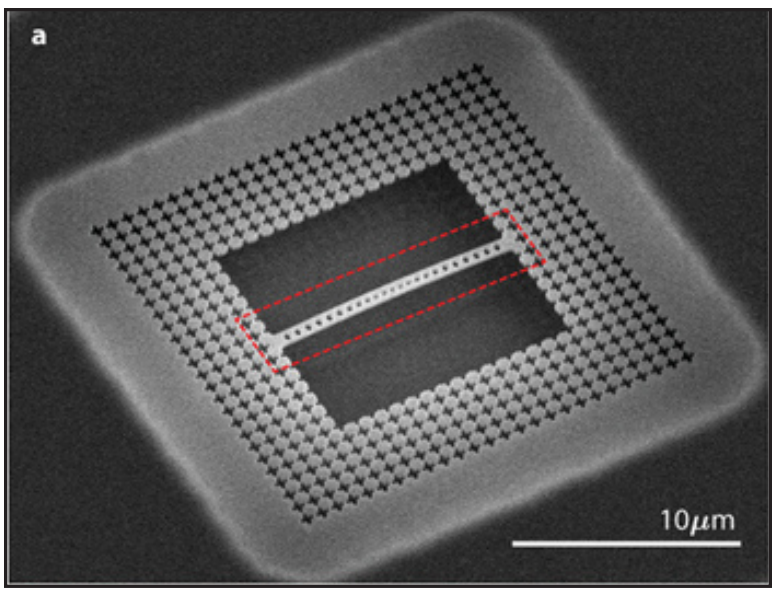
As described in the paper, Painter and his colleagues have engineered a nanoscale object—a tiny mechanical silicon beam—such that laser light of a carefully selected frequency can enter the system and, once reflected, can carry thermal energy away, cooling the system.By carefully designing each element of the beam as well as a patterned silicon shield that isolates it from the environment, Painter and colleagues were able to use the laser cooling technique to bring the system down to the quantum ground state, where mechanical vibrations are at an absolute minimum. Such a cold mechanical object could help detect very small forces or masses, whose presence would normally be masked by the noisy thermal vibrations of the sensor. "In many ways, the experiment we've done provides a starting point for the really interesting quantum-mechanical experiments one wants to do," Painter says. For example, scientists would like to show that a mechanical system could be coaxed into a quantum superposition—a bizarre quantum state in which a physical system can exist in more than one position at once. But they need a system at the quantum ground state to begin such experiments. To reach the ground state, Painter's group had to cool its mechanical beam to a temperature below 100 millikelvin (-273.15°C). That's because the beam is designed to vibrate at gigahertz frequencies (corresponding to a billion cycles per second)—a range where a large number of phonons are present at room temperature. Phonons are the most basic units of vibration just as the most basic units or packets of light are called photons. All of the phonons in a system have to be removed to cool it to the ground state.Conventional means of cryogenically cooling to such temperatures exist but require expensive and, in some cases, impractical equipment.

There's also the problem of figuring out how to measure such a cold mechanical system. To solve both problems, the Caltech team used a different cooling strategy. "What we've done is used the photons—the light field—to extract phonons from the system," says Jasper Chan, lead author of the new paper and a graduate student in Painter's group. To do so, the researchers drilled tiny holes at precise locations in their mechanical beam so that when they directed laser light of a particular frequency down the length of the beam, the holes acted as mirrors, trapping the light in a cavity and causing it to interact strongly with the mechanical vibrations of the beam.Because a shift in the frequency of the light is directly related to the thermal motion of the mechanical object, the light—when it eventually escapes from the cavity—also carries with it information about the mechanical system, such as the motion and temperature of the beam. Thus, the researchers have created an efficient optical interface to a mechanical element—or an optomechanical transducer—that can convert information from the mechanical system into photons of light. Importantly, since optical light, unlike microwaves or electrons, can be transmitted over large, kilometer-length distances without attenuation, such an optomechanical transducer could be useful for linking different quantum systems—a microwave system with an optical system, for example. While Painter's system involves an optical interface to a mechanical element, other teams have been developing systems that link a microwave interface to a mechanical element. What if those two mechanical elements were the same? "Then," says Painter, "I could imagine connecting the microwave world to the optical world via this mechanical conduit one photon at a time." The Caltech team isn't the first to cool a nanomechanical object to the quantum ground state; a group led by former Caltech postdoctoral scholar Andrew Cleland, now at the University of California, Santa Barbara, accomplished this in 2010 using more conventional refrigeration techniques, and, earlier this year, a group from the National Institute of Standards and Technology in Boulder, Colorado, cooled an object to the ground state using microwave radiation.

The new work, however, is the first in which a nanomechanical object has been put into the ground state using optical light. "This is an exciting development because there are so many established techniques for manipulating and measuring the quantum properties of systems using optics," Painter says.

The other cooling techniques used starting temperatures of approximately 20 millikelvin—more than a factor of 10,000 times cooler than room temperature. Ideally, to simplify designs, scientists would like to initiate these experiments at room temperature.

Using laser cooling, Painter and his colleagues were able to perform their experiment at a much higher temperature—only about 10 times lower than room temperature. Along with Painter and Chan, additional coauthors of the paper, "Laser cooling of a nanomechanical oscillator into its quantum ground state," include Caltech postdoctoral scholar T.P. Mayer Alegre and graduate students Amir Safavi-Naeini, Jeff Hill, and Alex Krause, along with postdoctoral scholar Simon Gröblacher and Markus Aspelmeyer of the Vienna Center for Quantum Science and Technology. The work was supported by Caltech's Kavli Nanoscience Institute; the Defense Advanced Research Projects Agency's Microsystems Technology Office through a grant from the Air Force Office of Scientific Research; the European Commission; the European Research Council; and the Austrian Science Fund.



A scanning electron microscope image of the silicon mechanical resonator used in laser cooling.

-Caltech/Painter et al.

In this issue

News briefs from around the globe

Provided by Tech *correspondent Sam Barnett*

Need to know < **100** words about the world this week – topics sorted from good to bad

by Sam Barnett – links to full stories available at barnett.caltech.edu/news

Human embryo cloned	**15** years since first cloning (Dolly) – embryo produces stem cells	[NATURE]
Unexpected rise in jobs	**103,000** jobs added in US last month – still 9.1% unemployment	[BBC]
California college aid	~ **1%** of enrolled students are illegal immigrants – now qualify too	[REUTERS]
Anti-war protests in DC	~ **200** protested museum exhibit of drones – guards use pepper spray	[AP]
Downsizing education	**24,400** public school jobs lost in September – major budget cuts	[CNN]
Cargo ship leaking oil	**3** mile oil slick threatens wildlife and coastline of New Zealand	[BBC]
Steve Jobs passes away	**317** patents revolutionized technology – world loses a visionary	[WPOST]

Food with Mannion!

Do you like eating food?
How about free food at nice restaurants?
Ever want to tell the world exactly what you think of said food?
The Tech will be beginning a new column to chronicle the foodie experiences of new writers every other week...The Catch: They'll be going head-to-head with Tom Mannion who will be reviewing the same restaurant. If you have ever thought you were more of a gourmand than our resident master chef, now's your chance to prove it!
Email us for a spot on the list at tech@caltech.edu

The California Tech

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The advertising deadline is 5 PM 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@caltech.edu*. For subscription information, please send mail to "Subscriptions."

Upcoming Event: Caltech Y Open House

Details:
- Thursday, 10/13 from 3:30 PM – 5:30 PM
- Food and music

Founded by students in 1916, the Y was organized to provide extracurricular activities planned and implemented by students as an opportunity to learn leadership skills and discover themselves. The mission of today's Y remains the same—to provide opportunities that will prepare students to become engaged, responsible citizens of the world. The Y seeks to broaden students' worldviews, raise social, ethical, and cultural awareness through teamwork, community engagement, activism, and leadership. Come and learn more about the Caltech Y located in the Tyson House to the right of the Caltech Credit Union this Thursday from 3:30 PM - 5:30 PM. There will be food, music, and students, who will be more than willing to answer any questions you have about the Y. The Y also welcomes anyone to attend its student-led Excomm meetings on Tuesdays at the Tyson House at noon, lunch provided.

Feynman teaching award nominations

NOMINATE YOUR FAVORITE PROFESSOR FOR THE FEYNMAN TEACHING PRIZE!!!

Here's your chance to nominate your favorite professor for the 2011-12 Richard P. Feynman Prize for Excellence in Teaching! You have from now until January 2, 2012 to submit your nomination package to the Provost's Office to honor a professor who demonstrates, in the broadest sense, unusual ability, creativity, and innovation in undergraduate and graduate classroom or laboratory teaching.

The Feynman Prize is made possible through the generosity of Ione and Robert E. Paradise, with additional contributions from an anonymous local couple. Nominations for the Feynman Teaching Prize are welcome from faculty, students, postdoctoral scholars, staff, and alumni.

All professorial faculty of the Institute are eligible. The prize consists of a cash award of $3,500, matched by an equivalent raise in the annual salary of the awardee. A letter of nomination and detailed supporting material, including, but not limited to, a curriculum vitae, course syllabus or description, and supporting recommendation letters
should be directed to the Feynman Prize Selection Committee, Office of the Provost, Mail Code 206-31, at the California Institute of Technology, Pasadena, California, 91125. Nomination packages are due by January 2, 2012.

Additional information including guidelines for the prize and FAQ may be found at http://provost.caltech.edu/FeynmanTeachingPrize. Further information can also be obtained from Karen Kerbs (626-395-6039; kkerbs@caltech.edu) or Stacey Scoville (626-395-6320; staceys@caltech.edu) in the Provost's Office.

News updates from Caltech Today

Caltech snags number one spot on Times Higher Education rankings

KATHY SVITIL
Caltech Science Writer

PASADENA, Calif.—The California Institute of Technology (Caltech) has been rated the world's number one university in the 2011–2012 Times Higher Education global ranking of the top 200 universities, knocking Harvard University out of the top spot for the first time in the survey's eight-year history.

Caltech was number two in the 2010–2011 ranking; Harvard and Stanford University share the second spot in the 2011–2012 survey, while the University of Oxford and Princeton University round out the top five.

"It's gratifying to be recognized for the work we do here and the impact it has—both on our students and on the global community," says Caltech president Jean-Lou Chameau.

"Today's announcement reinforces Caltech's legacy of innovation, and our unwavering dedication to giving our extraordinary people the environment and resources with which to pursue their best ideas."

Thirteen performance indicators representing research (worth 30% of a school's overall ranking score), teaching (30%), citations (30%), international outlook (which includes the total numbers of international students and faculty and the ratio of scholarly papers with international collaborators; 7.5%), and industry income (a measure of innovation; 2.5%) are included in the data.

Among the measures included are a reputation survey of 17,500 academics; institutional, industry, and faculty research income; and an analysis of 50 million scholarly papers to determine the average number of citations per scholarly paper, a measure of research impact.

"We know that innovation is the driver of the global economy, and is especially important during times of economic volatility," says Kent Kresa, chairman of the Caltech Board of Trustees. "I am pleased that Caltech is being recognized for its leadership and impact; this just confirms what many of us have known for a long time about this extraordinary place."

Times Higher Education, which compiled the listing using data supplied by Thomson Reuters, reports that this year's methodology was refined to ensure that universities with particular strength in the arts, humanities, and social sciences are placed on a more equal footing with those with a specialty in science subjects. Caltech—described in a Times Higher Education press release as "much younger, smaller, and specialised" than Harvard—was nevertheless ranked the highest based on their metrics.

According to Phil Baty, editor of the Times Higher Education World University Rankings, "With differentials so slight, a simple factor plays a decisive role in determining rank order: money."

"Harvard reported funding increases similar in proportion to other institutions, whereas Caltech reported a steep rise (16%) in research funding and an increase in total institutional income," Baty says.

Data for the Times Higher Education's World University Rankings was provided by Thomson Reuters from its Global Institutional Profiles Project, an ongoing, multistage process to collect and validate factual data about academic institutional performance across a variety of aspects and multiple disciplines.

Professor Rudy Marcus reflects on path to Nobel Prize

KIMM FESENMAIER
Caltech Science Writer

It's a good thing Rudy Marcus loves libraries. Otherwise, the Noyes Professor of Chemistry at Caltech might never have stumbled across the problem that he solved to win the 1992 Nobel Prize in Chemistry.

These days, researchers can read all the leading journals online, but when Marcus was a young associate professor at the Polytechnic Institute of Brooklyn, he spent hours in the library, leafing through the chemical literature. One day in 1955, he happened across a symposium issue of the Journal of Physical Chemistry in which chemist Bill Libby laid out a theory to explain some of the puzzling observations chemists had made in the lab—namely, why some chemical reactions that involve a simple transfer of an electron happen quickly, while others take much longer to transpire.

Marcus was intrigued by Libby's explanation, which was that electrons are so light compared to the nuclei of reactants that they should be able to jump from one reactant to another before the nuclei have a chance to change. "I thought, 'That's fantastic!'" Marcus recalled recently. "Libby was taking the Franck-Condon principle—something that was devised in the 1920s for a totally different application, for interpreting the spectra of molecules—and applying it to the rate of chemical reactions." But after thinking about Libby's theory for a while, he says, "Something didn't seem quite right." That uneasy feeling launched a month-long flurry of work that yielded a different explanation—an equation and the beginnings of the Marcus theory of electron transfer that many years later won Marcus his trip to Stockholm.

Marcus realized that Libby's explanation didn't feel right because it violated the law of conservation of energy—if an electron were transferred without the nuclei changing, the system would end up with far more energy after the transfer than before. To get away from that violation, the Marcus theory says that the molecular structure of some of the nuclei of the reactant and solvent molecules have to change positions before an electron can transfer, and then adjust again afterward. Therefore, an energy barrier has to be overcome in order for an electron-transfer reaction to proceed. And since that barrier varies depending on the structure of the molecules involved, it makes sense that some reactions take longer than others. Marcus worked out a mathematical model to describe such electron-transfer reactions and to calculate the expected values for their energy barriers.

- features.caltech.edu

"It took one month from start to finish to produce that equation," Marcus says. "For the record, it was the fastest thing I've ever done before or since."

In addition to being completely engrossed by the problem, in many ways Marcus was prepared to attack it. Early on, as both a graduate student at McGill University, in Montreal, and as a postdoctoral fellow at the National Research Council, he had worked in the lab, measuring rates of chemical reactions. But equally critical to his success was the fact that by the time he was pondering Libby's article, Marcus had developed the ability to approach problems from a theoretical standpoint.

He hadn't always had that ability. When Marcus was in school, there were no theoretical chemists in Canada. He had taken a course in theoretical chemistry at McGill, but the professor didn't teach where the theories came from or how they were developed. So Marcus says, "It never occurred to some of us to go into theoretical chemistry." But he had always been very interested in mathematics. In fact, Marcus says he probably took more math courses at McGill than any other chemistry student at the time. So after grad school, sometime during his postdoctoral fellowship, he says, "I became very dissatisfied because I wasn't using the kind of math that I enjoyed so much." It occurred to him that theoretical chemistry might provide the blend of chemistry and mathematics he was looking for.

So he and a friend at the Research Council, Walter Trost, formed a two-man seminar. They took turns describing theoretical papers to each other and then tried to apply the findings to their own experimental work. As simple as it may sound, that preparation encouraged Marcus to take a rather bold step—to apply for a postdoctoral position in theoretical chemistry in the United States. Though Marcus had no formal training on the theoretical side, one professor, Oscar Rice from the University of North Carolina, invited the eager young chemist to join his group.

As it turned out, Marcus's decision to head to Chapel Hill was a good one for more than one reason. Within a couple weeks of his arrival, Marcus met the love of his life, Laura Hearne, a graduate student in sociology and cultural anthropology, whom he married six months later and who passed away in 2003. He was also able to nurture and develop his knowledge of theoretical chemistry. After a few months of sitting in on lectures and reading every theoretical paper he could get his hands on, and after some gentle prodding by Rice, Marcus started working on a theoretical problem that dealt with what are called unimolecular reactions.

"I gradually put together the bits of a theory," Marcus says. The theory predicts how long a molecule that has acquired a lot of energy will survive in such a state before breaking up or becoming stabilized, by colliding with another molecule, for example. "Before I realized it—after being there for six months—I had developed a theory of unimolecular reactions that is still used today." That theory is referred to in textbooks as the RRKM theory—the "M" stands for Marcus.

So by the time he joined the faculty at the Polytechnic Institute of Brooklyn in 1951, Marcus had proven his theoretical chops. But sensing that there wouldn't be enough experimental results in the area of unimolecular reactions to continue on that path, he needed a new problem to focus on. Eventually, it was a student's question about electrolytes that got Marcus interested in electrostatics. He published two papers in the field before coming across Bill Libby's symposium paper in the library.

"One often hears something along the lines of, 'Discoveries come to those with a prepared mind,'" Marcus says. "Here, my preparation was that I had published something about treating electrostatic interactions. I combined that background with elements of the work I had read about that were going on in physics at the time . . . It was really a matter of putting a bunch of little ideas together."

Marcus may downplay his accomplishment, but in the Nobel award-ceremony speech, Lennart Eberson of the Royal Swedish Academy of Sciences addressed Marcus, saying, "Your theory is a unifying factor in chemistry, promoting understanding of electron-transfer reactions of biochemical, photochemical, inorganic, and organic nature and thereby contributing to science as a whole."

Marcus received his Nobel medal 19 years ago for work he started more than 35 years before that. He says that the honor changed his life in some ways—more invitations and requests came his way—but that his interest in and enthusiasm for solving problems has never waned. Today, Marcus is 88 years old and still actively working on problems in theoretical chemistry while advising postdocs and grad students.

He's also planning a return to his beloved ski slopes this winter after a couple of seasons off. In his speech at the Nobel Banquet in 1992, Marcus drew comparisons between the sport of skiing and doing theoretical work in science, offering insight into the rush he gets from both.

He described "the challenge and sense of excitement when the slope is a little more difficult than one feels comfortable with."

Caltech Couture: One student's take on fashion

ALEX LANGERFELD
Staff Writer

Senior Ernest Lee demonstrates that "swag" can be perceived even in black-and-white.

- Fred Zhao

Rotation is finally over! Frosh have settled in, upperclassmen are finally getting back to their usual routines, and the normal Caltech year has begun! To celebrate such an occasion, Caltech had the End of Rotation Party in the Page House courtyard (where else for such a party?). Personally, I'd say it was a great success which definitely lived up to the hype that has been building up for over a week. This is the first party of each year (even before Page Interhouse) that is not under Rotation Rules, and it sets the mood for the rest of the parties. That said, I see many good parties coming our way.

This year's End of Rotation Party struck a delicate balance between a sophisticated classy set-up and a super happy college kid party ensemble. The elaborate color-themed crepe paper and balloons, paired with a projector and a midnight surprise of colorful confetti fluttering through the air let the wild party-goers know that this party was carefully thought-out and that the coordinators had a specific mood of elegance in mind. The partiers themselves brought various moods to the party.

As much as the classy decorations were a surprise for such a party as this one, the general social patterns that I observed were very predictable.

I've observed that when put together, our undergraduate campus tends to divide more or less by House. (There are exceptions, the most noticeable one being Caltech sports teams.) If a party is registered to start at say, 9:00pm, then exactly at 9:01pm a certain group comes in and surveys the food and snacks. Some of that group's members proceed to slightly move to the music which is still being frantically set up. This isn't the most dressed-up group or the most down-to-earth group but this is certainly one of the most dedicated groups that never comes late and never misses an event.

After this group leaves, there is usually a dead waiting period while everyone else warms up for the party.

By this time, the music is playing and the bar is open, which lets people know that the party is ready to begin. Occasionally, a few energetic people jump into the courtyard to take advantage of the abundance of free dance space that will soon be crowded by excited Techers.

This certainly the case at the aforementioned party, as a couple people randomly broke into dance while others observed from the perimeter. This is also a time when scouts from farther away locations scope out the scene to tell their comrades what to expect and whether or not the party is ready.

Usually, if posters say that a party starts at 9pm, the party really starts around 11pm (which is exactly what happened).

Before I realized it, the Page courtyard was packed, the line to the bar was impassable, and as a true indicator for a party in Page House, water pong was in full swing in the lounge.

Those who were playing pong were mostly Pageboys and Frosh, if I remember correctly, but plenty of others stood around the table socializing.

New swarms of partiers entered the courtyard every minute. Groups made their way through the dance floor to the lounge, losing numbers as pairs got caught up in dancing.

This party was not advertised as a dance party, but I was surprised by the amount of it that took place.

I may have a skewed view here because I was on the dance floor a lot myself with a great partner and friends. As usual, circles formed, into which people occasionally jumped to show off their moves. There were also the couples enjoying themselves and the groups of friends all dancing together.

There were also plenty of non-dancers who were filling the floor, fortunately mostly around the perimeter.

And no party would be a Caltech party without several sophisticated and deep conversations taking place (Frosh, some of you were talking about your problem sets!).

This happens a lot.

People come to the dance floor and don't dance. As long as this isn't an official dance party, I don't see much wrong with this. But hey, don't be shy!

It's a party! Bust a move. Invite a girl to dance with you instead of trying to woo her with descriptions of your new computer's features.

There will be time for that later. Steal the spotlight.

The truth is, most people here know just as much about dancing as you do, so there is certainly no reason to be shy!

The people burning the floor are doing so because they are enjoying themselves.

All in all, the party went well. Frosh seemed to have thoroughly enjoyed themselves.

As an upperclassman, I can vouch for the efforts that my peers and I have made to ensure the pleasure of the Frosh.

When the more prominent House groups begin to leave, one knows that the party is ending so when I could no longer find my Fleming friends scattered about, or the Lloydies and Rudds enjoying themselves outside, or others leading intellectual conversations in corners, I knew that the rest of the party would be mostly the hosting Pageboys enjoying the aftermath (all except the confetti that had to be cleaned up).

So, I bid the party part of the night farewell and very happily capped off a long day.

Class of 2015, I hope you feel welcome here!

How the Tech's new website came to fruition

YANG HU
Website Manager

Don't know where to pick up an issue? Too lazy to pick up an issue? Want to save paper?

Read the Tech online at tech.caltech.edu!

It is no surprise that most of us spend a lot of time on the Internet. Many activities such as shopping and socializing have been digitized for our convenience on the web. Newspapers, as well, have well-made online editions.

Until the start of the fall term, the Tech had but an unadorned and unrevised website.

It was a file cabinet of past scanned issues dating all the way back to the 1940s. The website was simple and did its job, but it didn't measure up to other student-published newspapers from other universities of similar caliber.

The current editors realized this problem and solicited the student body for help to build a new website over the past school year.With the same opinion, Dai Wei and I undertook this challenge to build a website befitting the institution's image of excellence while making it friendly to both users and the editors, who can publish comments and articles with ease.

The beauty of the framework I chose to use is that the website is in the hands of the reporters themselves. Using a system similar to Wikipedia, the new Tech website allows news articles to be published in real time right after they are written, meaning you can actually get to read the Tech earlier, before the completed newspaper goes to the print shop.You may have realized that the Tech sometimes reports events a week or two after they have occurred, so "news" reads more like a review or flashback than actual news.

We can now circumvent this potential problem by using the ease of publishing on the Internet to our advantage.

Another feature of the new website is its large space.

With paper issues, we are limited by how much paper and ink we want to pay for, but with the website, it's all free.

This allows us to showcase pictures.

In fact, if you have interesting photos of the week that you would like to submit to the Tech, please do so at tech@caltech.edu, so we can post them on our website!

Some other features we hope to include in the website in the future include video interviews as well as music to accompany music reviews. We hope somewhere down the line that the Tech's website can be used as a central news portal to all types of Caltech news. For now, we would like you to point your browser to tech.caltech.edu.

We hope that you would bookmark and take a look because the sole purpose of the website is for your convenience.

Of course we would also like to expand our readership.

Share it with your parents and off campus friends, who may be curious about what happens on the Caltech campus.

Professor of the Month: Brian Stoltz

SANDHYA CHANDRASEKARAN AND PUSHPA NEPPALA
News Editor
Contributing Writer

Professor Brian Stoltz joined the Chemistry department at Caltech during the summer of 2000. He began teaching Ch41, the organic chemistry series in 2003, and has been teaching Ch41c since. He has also taught both Ch41a and Ch41b. Stoltz' passion and approachability has made the experience both enjoyable and exciting for all of his students.

Stoltz considers his class to be traditionally structured. He explains, "We go through chapters based on the functional groups of the organic compounds, but it's mostly me at the chalkboard, writing notes, occasionally putting up an overhead or two. There are also quizzes and problem sets, usually problems out of the book, but we make all the past quizzes available to students online. And, not surprisingly, there is a midterm and a final. I used class activities two years ago in Ch41a and also used them last year also in Ch41b and Ch41c. They allow you, in one class period, to discover for yourselves the topics and also take them further than you would ever be able to cover in class. They provide a discussion-oriented, rather than lecture-oriented, component to the class."

Regarding his affinity for teaching, Stoltz traces evidence back to his school days, "I've always loved teaching. I remember thinking about how my elementary school teachers would teach something, and how I would have explained it differently."

But he also notes that his love for the subject matter, organic chemistry, translates to his teaching.

With time and experience, Stoltz has been able to revamp his class to better suit the needs of the people that matter the most to him – his students, "The course hasn't changed a whole lot, although I can say the first year I taught the course, I went faster than I have ever gone since… But I think the reason that it slowed down is because now I explain things a lot better, and after all those years of asking similar questions on tests, I know where students have trouble, so I think I have become better at helping them."

Stoltz has successfully incentivized his students to attend and participate in class by centering the course on key information, connections, and applications from his lectures. He comments, "Although the course nominally follows the book, it is very clear to students who take the class that the quizzes and exams are fundamentally based on my notes; so the easiest way to figure out what is important for the quizzes is to show up for class. In-class activities and quizzes serve a similar purpose. We also cover concepts that go beyond the textbook, such as more modern-day examples Students seem to really appreciate that. They don't feel like they're just being spoon-fed the book verbatim or slightly dumbed down; I they've enjoyed hearing about things that chemists do in the real world."

However, even a skilled professor such as Stoltz faces some challenges while teaching. He admits, "Especially at a place like Caltech, where students are universally smart but may have very different background and interest levels certain topics, it is difficult to keep the content stimulating to both organic chemistry aficionados and students taking the course simply to fulfill a requirement. Every year I start the class by saying, 'For many of you, this is it – this is the last chemistry class you will ever take, but for others, this really is the beginning.' So really, I'm trying to sway those who think this is their last time ever into not quitting after the course ends."

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>
> **- Brian Stoltz**

Stoltz is not only a widely loved professor, but he is also the PI of a rigorous organic chemistry lab. When asked how he manages to balance both his research and his courses, Stoltz has some insightful remarks, "I honestly don't know how you can do one without the other. I have always struggled with seeing people who do exceedingly great research but are lousy teachers – I don't know how that works. I've always looked at them as being almost the same thing. I teach graduate students with the goal of giving them a basic knowledge of the subject matter that they stays with them even after the class ends. In some ways, with the undergraduates, I feel like as a service to organic chemistry. More broadly speaking, if I can sway a few people into loving organic chemistry, or convince a few people who were excited about chemistry to focus on organic chemistry, I view it as a good thing."

He continues, "I think there are people that view teaching as an additional burdensome responsibility, because, to be honest, when tenure evaluations come around, it is not really at the top of the list at a research-oriented institution such as Caltech. I feel like that is a bit discouraging to hear. But if the professor genuinely likes teaching and is determined to provide for his students in the best way that he or she can, the professor ends up doing an 'okay' job."

In Stoltz' case, 'okay' is a definite understatement. As one student describes, "Professor Stoltz genuinely cares about the well being of his students. In addition to being a great teacher, he always takes our opinions into account, ensuring that we are happy and well adjusted. He was the first professor I have had at Caltech who actually addressed our TQFRs and made the necessary changes. He has made a rather difficult class far more enjoyable, which has led to a better learning environment for all students."

The ARC's "Professor of the Month" program shows our appreciation for the amazing professors at this school all year around.

Students may nominate professors that they feel deserve recognition, and the ARC will use these nominations to choose a Professor of the Month. The deserving professor will then receive a small gift from the ARC along with being featured in the campus newspaper.

Professors can be nominated online at http://www.ugcs.caltech.edu/~arc/POM.php.

New club makes volunteering for engineers easy

SARAH WRIGHT
Contributing Writer

As your Facebook news feed (and President Chameau) informed you this past week, we have been ranked the number one university in the world. I think it's truly amazing how many exceptional and talented people are here together in one place. Even as undergrads, we are learning so much from our classes and research—and not just knowledge in our specific field.

We are learning to problem solve, learning to think about things in different ways than we have before (even though sometimes it may feel like we are getting so much thrown at us that we can't possibly be learning anything at all), and learning to manage our time (yes, procrastinators, we are handling this kind of workload better than most people would). So why not use all the skills we are learning and help, in a very real way, a group of people who may have never had the chance to acquire the abilities we have?

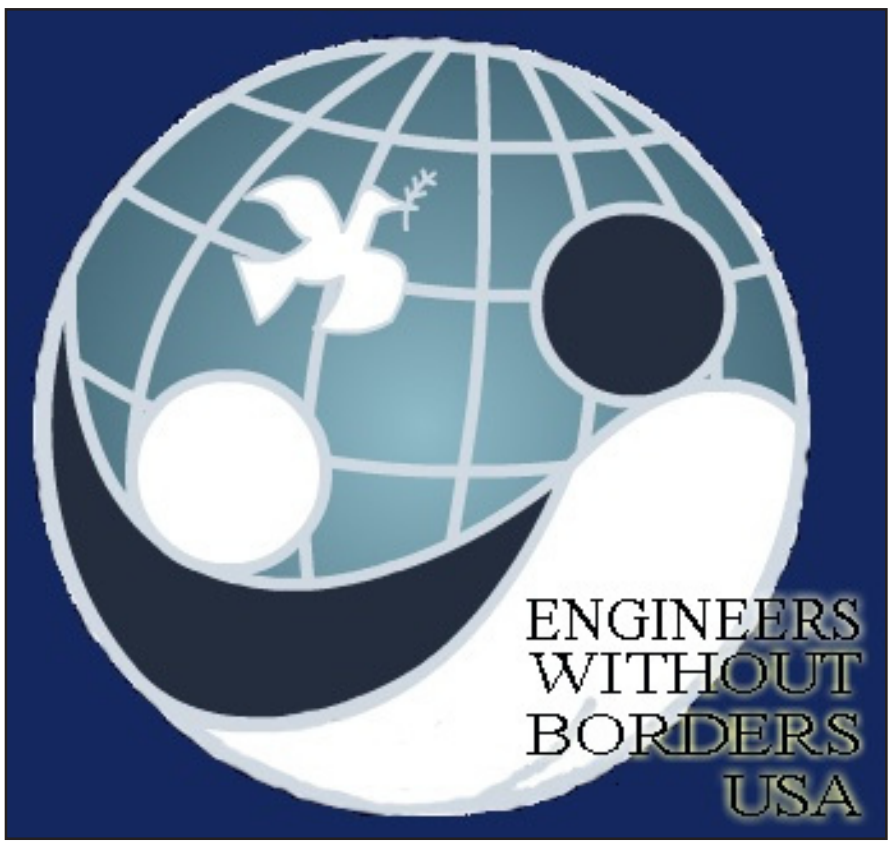
It's this thought that brings me to a new club on campus: Engineers Without Borders (EWB). There are student chapters of Engineers Without Borders on more than 180 university campuses across the country, as well as dozens of professional chapters, including one in Los Angeles. As a whole, the national organization is over 12,000 members strong and supports 350 projects in over 45 developing countries.

The mission of EWB-USA is to support "community-driven development programs worldwide by collaborating with local partners to design and implement sustainable engineering projects, while creating transformative experiences and responsible leaders."

Projects are community-driven, meaning they coincide with what the community, not outsiders, believes to be a point of need. Once the national organization has paired a project with a chapter, the works begins.

The Caltech chapter would brainstorm, research, design, and prototype, and eventually transition to fundraising and implementation. There also the possibility of international travel, as throughout the project there will be assessment and implementation trips planned.

Caltech would be a great place to start a student chapter of Engineers Without Borders—we have hardworking students, impressive resources in our faculty, and well-equipped facilities on campus. Furthermore, the LA Professionals chapter has provided mentors for several other student chapters in the area, including UCLA and USC, and would be able to match us with a professional engineer who has specific expertise related to our project. We can apply to be a chapter on January 1st, 2012, and if accepted could start on a project soon after.



- congostory.org

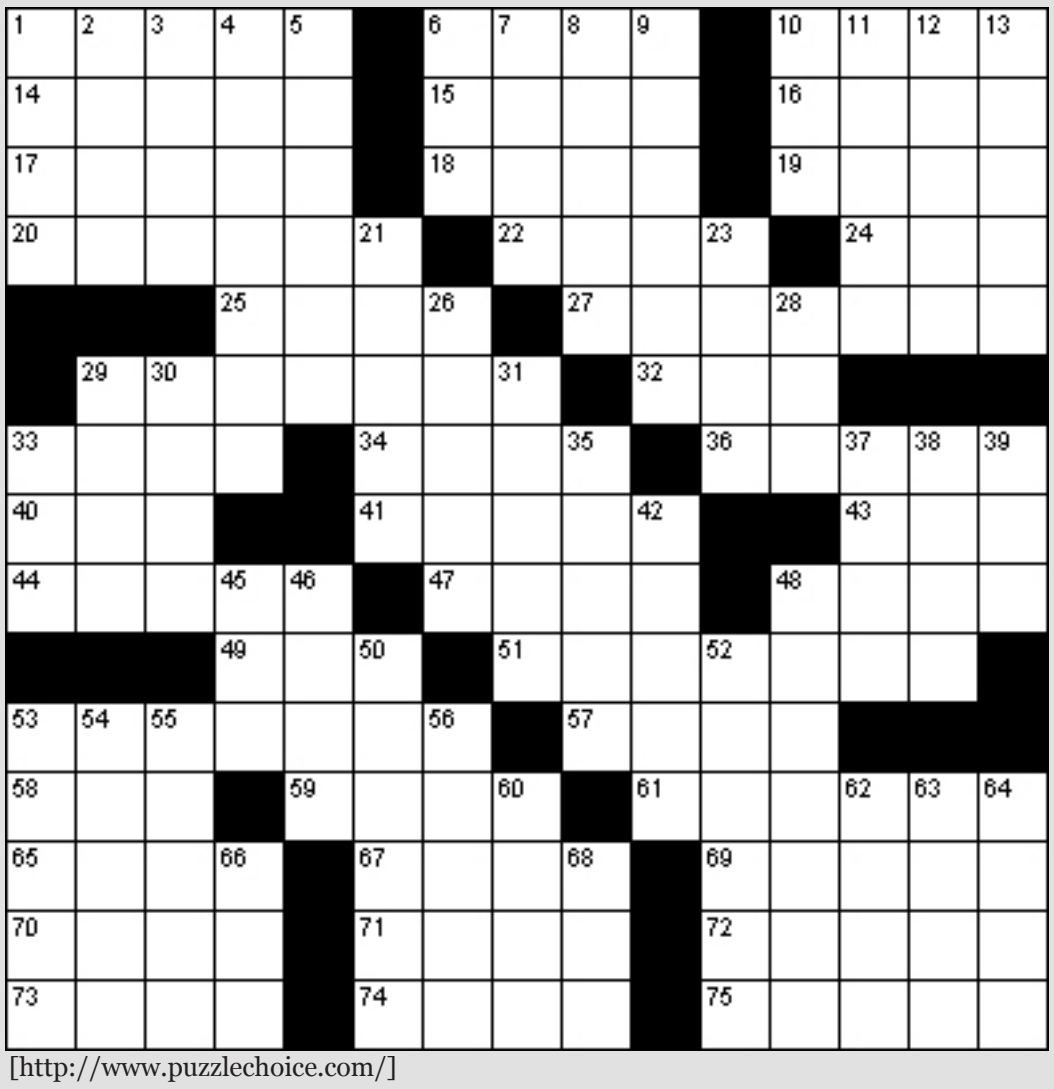
Now, if you are thinking to yourself, "I don't have the kind of experience that they need; I'm not a MechE," think again. EWB needs chemical engineers, geophysicists, biologists, businessmen, and mathematicians alike. EWB needs creative thinkers to help envision, design, fundraise, and implement the project.

Engineers Without Borders is a collaborative effort that includes students of varied disciplines, faculty members, EWB-USA, professional advisors, the community where the project will be implemented, and nearby NGOs, among others.

If you think you are interested, there will be an information session on Monday, October 24th at 7:30pm in a location TBA. If you are unsure if you will be able to attend but still want to express your interest in the club, you can shoot me an e-mail at swright@caltech.edu and I'll put you on the mailing list.

In the meantime you can check out http://www.ewb-usa.org/, or the website of the USC chapter http://viterbistudents.usc.edu/ewb/.

Today's Puzzle: Crossword



[http://www.puzzlechoice.com/]

Across

1. Strip of leather
6. Fibbed
10. Golf stroke
14. Not restrained
15. Having the means to do something
16. Succulent plant
17. Broadcasting live
18. Female opera star
19. Stringed instrument
20. Court game
22. Withered
24. Operated
25. Scintilla
27. London cathedral
29. Lead an orchestra
32. Belonging to him
33. Remuneration
34. Average
36. Coarse cotton fabric
40. Make a mistake
41. Ostler
43. Misfire
44. Type of tree
47. Music symbol
48. Sheep pen
49. Paddle
51. Unforseen difficulty
53. Tool
57. Vascular plant
58. Rotating disc
59. Possessed knowledge
61. Rationality
65. Gem
67. Profound
69. Rock
70. Small island
71. Always
72. Approximately in or at
73. Encounter
74. Make anew
75. Composition for eight instruments

Down

1. Coin aperture
2. Tincture
3. Type of horse
4. Vacuous
5. Full stop
6. Man or boy
7. Wading bird
8. Fairies
9. Severe shortage
10. Friend
11. Ayer's Rock
12. Sum
13. Between 12 and 20
21. Bitten by an insect
23. Long poem
26. Fruit of the oak
28. Type of tree
29. Aid
30. Fiend
31. Group of soldiers
33. Entanglement
35. Theme
37. Object of worship
38. Void
39. Peculiar
42. Measuring instrument
45. Swindle
46. Whorl
48. Rabid
50. Pesent formally
52. Wall painting
53. Curtain fabric
54. Temporary inactivity
55. Stroll
56. Pass a rope through
60. Remove unwanted plants
62. Variety
63. One time
64. Orderly
66. Up to the present time
68. Athlete who plays for pay

Answers to last week's crossword from puzzlechoice.com

P	L	O	D	■	D	R	A	B	■	■	S	H	O	P
R	O	V	E	■	Y	O	D	E	L	■	W	A	G	E
I	D	E	S	■	E	M	O	T	E	■	A	U	R	A
M	E	R	I	T	■	P	R	E	A	M	B	L	E	■
■	■	■	G	U	M	■	E	L	S	E	■	■	■	■
■	C	A	N	N	E	S	■	■	H	A	R	D	E	N
P	U	T	■	A	T	L	A	S	■	N	A	I	R	A
O	B	O	E	■	E	A	G	L	E	■	W	A	R	M
L	I	N	E	R	■	M	O	U	L	T	■	R	O	E
O	C	E	L	O	T	■	■	M	A	R	T	Y	R	■
■	■	■	■	A	R	U	M	■	N	E	W	■	■	■
■	P	E	N	D	U	L	U	M	■	K	E	B	A	B
H	O	P	E	■	S	T	R	A	P	■	L	O	N	E
A	R	I	A	■	T	R	A	I	L	■	V	O	T	E
S	E	C	T	■	■	A	L	L	Y	■	E	M	I	R

[http://www.puzzlechoice.com/]

Genie claims he set SAC fire

MARY NGUYEN
Satirist/Contributing Writer

Student Activities Center - A genie has claimed responsibility for the fire in the Student Activities Center during SURF. On August 14th at 3:30am, a fire was reported in a mechanical room in the SAC underneath the South Hovse undergraduate dorms.

Despite the fact that the majority of summer and Caltech students ignored the thirty minute siren, no one was harmed in the incident.

"After three false alarms in one weekend, I learned to sleep through it," said one summer student. "I didn't know about a fire under my room until I did my laundry."

"There was actually a fire?" asked an incredulous Caltech undergrad. "I always joke about what would happen if an alarm was actually right for once, but wow."

An investigation determined that an open bottle of acetone caused the mechanical room fire, but not how the bottle got to that location or who owned the bottle. As a result, blame fell on the house closest to the fire: Blacker.

Blacker objected, saying that they did not store anything flammable close to the fire. However, a confession from a genie on Friday revealed further evidence that Blacker may not have caused the fire.

The genie, aptly named Jinn, reported that a bitter Caltech dropout had found his lamp in Saudi Arabia and used one of her wishes to place an acetone bottle in the most fire-prone location in the SAC.

The dropout explained the false fire alarms had interrupted her sleep to the point where she could no longer concentrate and dropped out.

She wanted to get back at the university by causing an actual fire so that the at least one instance of the South Hovse fire alarm would be real.

Jinn also stressed that the dropout seemed delirious from the extreme desert heat, but he was bound to grant three wishes.

This incident, he heavily insisted, was not because he used to reside in a laundry detergent bottle in the South Hoves and despised the false alarms as much as the students living there.

Taking this new revelation into account, the administration concluded Blacker caused the fire.

Beavers Break Nine Year Losing Spell with Dramatic Victory

from gocaltech.com

PASADENA, Calif. – Nearly nine years to the day since their last win, the Caltech men's water polo team posted a 10-9 win over Connecticut College on Thursday afternoon at the Braun Pool.

The win gave the Beavers their first win since Oct. 5, 2002 when Caltech beat the Master's College 12-9.

"It feels amazing to end the losing streak. This whole season we've had glimpses of how good we can be, and we finally put it all together for an entire game. Now we want to carry this momentum into the remainder of our season," junior Jack Blackwood said.

"The fact that the win came in such an exciting and hard-fought game is just icing on the cake and will hopefully give us the confidence to finish close games in the future."

In a game were neither team held a lead larger than two goals, the nip and tuck contest started with Connecticut holding a 2-1 lead after the first period.

Caltech tied the score with a Jerome Skelly goal less than two minutes into the second frame.

After Connecticut retook lead with 3:59 left until intermission, back-to-back goals by Dan Sexton and Adam Khan nudged the Beavers in front for the first time.

However, the visitors responded with two unanswered goals in taking a 5-4 edge after two periods.

Connecticut nudged in front 6-4 with their only goal of the third period.

Sexton added his second goal of the day to get the Beavers within 6-5 after three stanzas.

In a wild fourth period, Caltech tied it up at 6-6 on Blackwood's second goal of the afternoon with 3:42 left in the contest.

Connecticut retook the lead with a Sam Burns goal with 2:11 remaining.

The Beavers forced the action and put the game into extra time when Tommy Kwong scored with 15 seconds left in the regulation.

Connecticut scored two goals in the first of two overtime periods but Blackwood found the back of the net on a beautiful no look goal with 29 seconds left in the first extra frame.

Skelly tied the game at 9-9 with his second goal of the contest with 1:05 left in the final overtime period.

Sexton buried a five meter penalty shot to seal the win with 23 seconds left in the game.

Blackwood and Sexton both tallied hat tricks in the victory to pace the Beavers offense.

The two squads met again on October 8, this time ending in a Connecticut win during the annual Convergence Tournament. Nonetheless, the Beavers have and will continue to work hard to add to their win on Thursday,

The Caltech men's water polo team celebrates its victory over Connecticut College on Thursday.

-gocaltech.com

Beavers fall to Occidental

from gocaltech.com

LOS ANGELES, Calif. – Looking to avenge an earlier loss to Occidental, the Caltech men's soccer squad came up short as the Tigers posted a 1-0 win on Saturday, October 8, at Lower Field.

Less than a month ago, the Tigers knocked off the Beavers 4-0 at Caltech's North Field.

The game's only goal came in the 57th minute when James Kornfield headed home a corner kick off the foot of Doug Pentland.

In the final minutes of the games the Beavers had a chance to score the neutralizing goal. Marec Serlin put Caltech's only corner kick of the afternoon in front of the net but a shot by Mikhail Sushkov went wide in the 87th minute

Although the home squad posted a 7-1 edge in shots on goal, Wesley Swank kept the Beavers in the game by recording six saves on the afternoon.

The Beavers will play their fourth straight road contest on Monday at SOKA before returning home on Wednesday against Whittier at 4:00 p.m.

Weekly Scoreboard

October 8, 2011

Men's Water Polo
vs. Fresno Pacific L, 23-7 Final

Men's Soccer
at Occidental
L, 1-0 Final

Men's Water Polo
vs. Penn St.-Behrend
L, 12-9 Final - OT

October 7, 2011

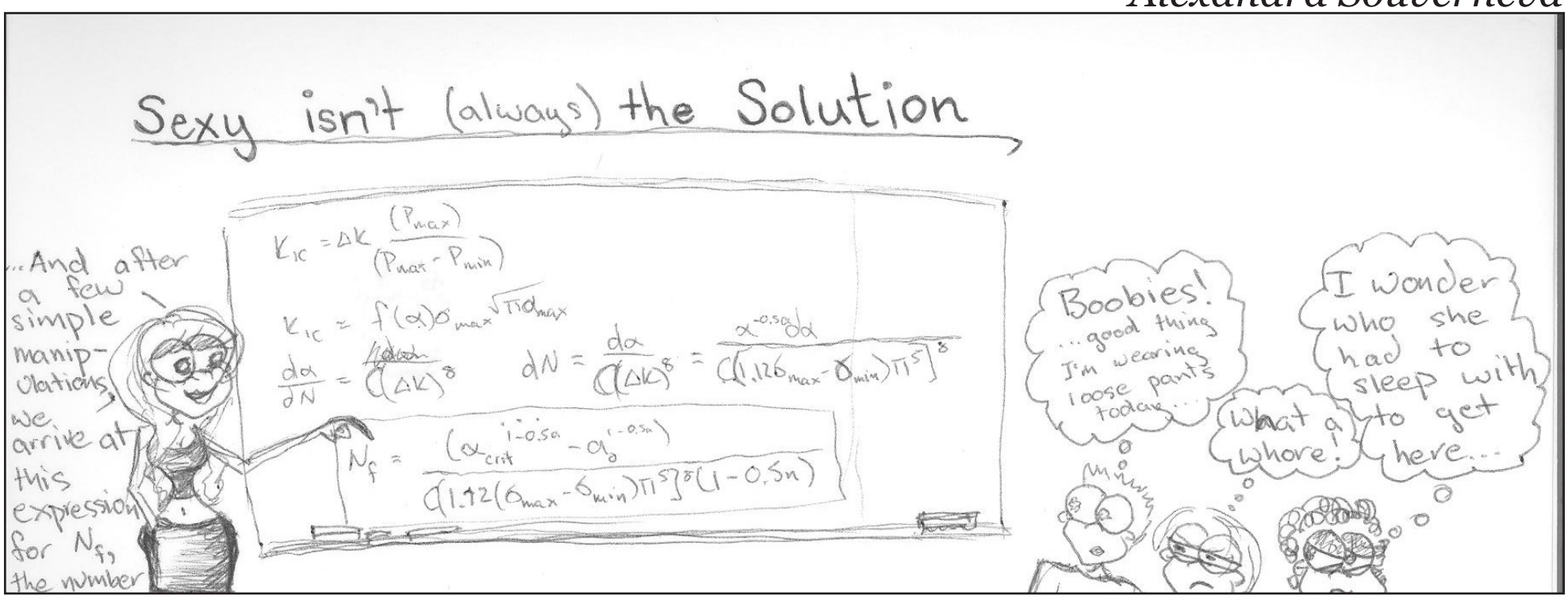
Women's Volleyball
vs. Redlands
L, 3-0 Final

Men's Water Polo
vs. Vanguard
L, 16-10 Final

APPLES AND ORANGES

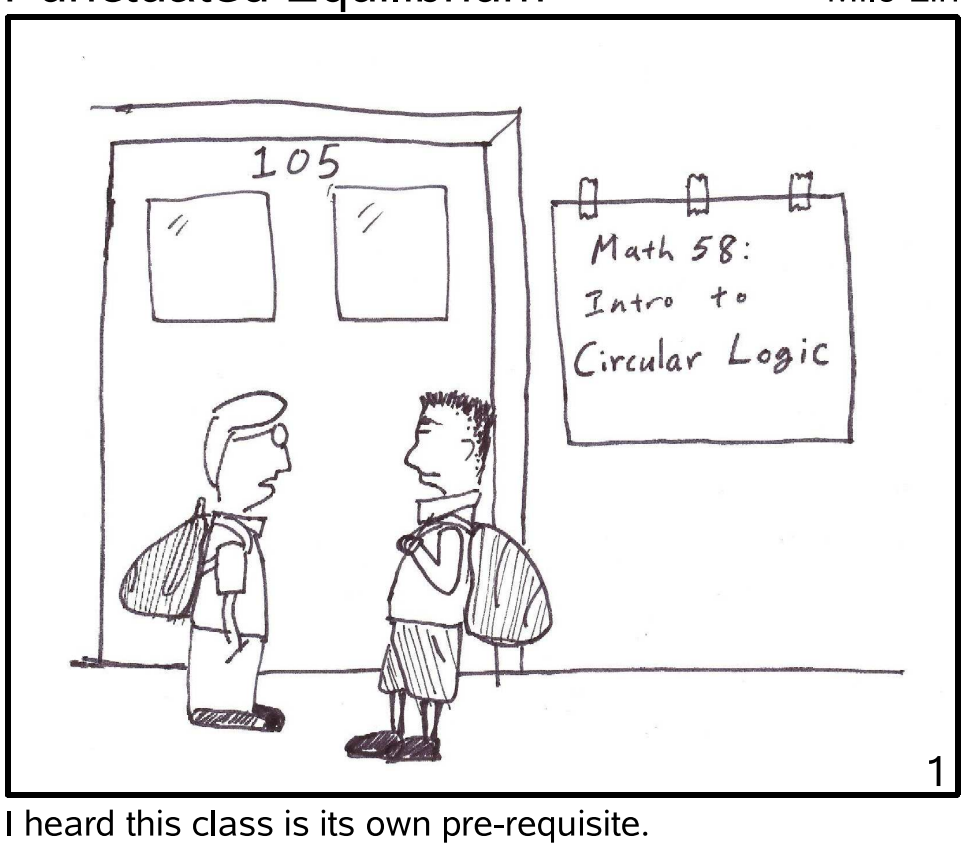
BY REBECCA LAWLER

Alexandra Souverneva



Punctuated Equilibrium

Milo Lin



I heard this class is its own pre-requisite.

The California Tech
Caltech 40-58
Pasadena, CA 91125