Serendipity, on Purpose

This article is adapted from a story that was originally published online at caltech.edu.

Caltech surprised chemist and neurobiologist Linda Hsieh-Wilson when she arrived as a new professor in 2009. The unusually interactive campus felt like a community, even a family. “Here, it is easy to find people with common interests or learn about other people’s research,” says Hsieh-Wilson, who is now Caltech’s Arthur and Marian Hansen Memorial Professor of Chemistry. “That has helped my students and our research, allowing us to venture into new areas of science.”

For instance, Hsieh-Wilson recently created antibodies that one day could help patients recover from brain or spine injuries—an invention that started with a serendipitous conversation years ago.

About a decade ago, Hsieh-Wilson and her team noticed something curious when they were studying carbohydrates. A sugar molecule they were examining might play a role in the way vision develops in the brain. But as organic chemists, they didn’t have experience with the specialized biological research techniques they needed to follow the hunch.

Then, in a lucky break, one of Hsieh-Wilson’s graduate students struck up a conversation with Caltech biologist Jost Vielmetter, who leads a center in Caltech’s Beckman Institute. That institute’s philanthropic funding and mission give its scientists freedom to assist scholars across campus. So Vielmetter took time to teach Hsieh-Wilson’s group techniques they needed to trace cellular connections between the eyes and brain.

Using those techniques, Hsieh-Wilson and her team discovered that the sugar molecule they were investigating helps vision develop. They found that the sugar molecule is needed for the eyes to develop vision deep in the brain. More broadly, they found, it helps wire neurons in the brain during so-called “critical periods” of development, when neural circuits can be sculpted by experience. During critical periods, infants’ and toddlers’ brains are more malleable so that children learn fast during those early years. But later in life, the sugar reverses that process, helping neurons fully rewiring themselves after they are injured.

The antibodies that Hsieh-Wilson and her students are refining now—with the aim of helping people recover from brain or spine injuries—block the sugar molecule. That will help regenerate more neurons. In 2012, Hsieh-Wilson and her team used these antibodies to regenerate optic nerves in mice.

ROBERT PERKINS
Caltech Media Relations

The goal is to teach autonomous systems to think independently and react accordingly, preparing them for the rigors of the world outside of the lab,” says CAST Director Mory Gharib, Hans W. Liepmann Professor of Aeronautics and Bioinspired Engineering.

The facility will be a living experiment. While engineers construct and test drones, robots within CAST itself will learn to help run the facility—all while being observed by 46 cameras that provide complete coverage of the space. That research will be guided in part by scientists and other stakeholders who will benefit tremendously from autonomous systems. For example, by collaborating with seismologists and first responders, engineers could develop a swarm of flying drone that automatically deploys during an earthquake, rapidly scan damaged areas, and relay information about what they find. There are likely to be injured people in need of medical attention.

“The CAST team will also work on the next generation of drones and robots to explore the solar system,” says CAST steering committee member Woody Fischer, Professor of Geobiology.

“The current state-of-the-art in autonomous systems is very promising on two divergent fronts,” Gharib says. “The bodies, or machines and sensors, have been made smaller and more sophisticated and capable. Meanwhile, the algorithms that collect and interpret behavior are increasingly fine-tuned. We plan to bring these two together through a series of ‘moonshot’ challenges that we will undertake in the coming years.”

Like their ambitious namesake that challenged Americans to send a human to the moon in the 1960s, CAST’s moonshot goals will require advances in engineering to transform dreams into reality. “It is possible,” says CAST’s Eric D. Craw, a three-story-tall, wholly enclosed aerodrome—the tallest of its kind—in which to test flying drones. To simulate the ever-shifting environmental conditions that drones face in the real world, the walls of CAST are capable of generating wind speeds of up to 44 mph, with a side wall of 324 fans to create a crosswind. The wall is capable of creating a nearly infinite variety of wind conditions for drones to learn to react to—everything from a light gust to a stormy vortex. It can also be tilted 90 degrees to simulate vertical take-offs and landings.

“The CAST team will also work on establishing through the generous support of Raytheon Company as well as the support of corporations such as AeroVironment, industry partnerships will help fund CAST and the development of the next generations of autonomous systems within CAST,” Gharib says.

Corporations and industry members will play a key part in the development of CAST technologies and systems to think independently and react accordingly. “It’s a huge challenge, but at CAST, we can and will build it.”

“People who used to turn away from studying carbohydrates are pursuing investigations now because they have the tools,” she says. “Hsieh-Wilson credits her philanthropic support for helping her make these contributions, which already have changed how science is done and what we know about sensory development.

“The advantage of private support is that it allows you to pursue new ideas, perhaps riskier ideas,” she says. “You can be fearless in your approach. You don’t have to map everything out and know all the answers in advance. That type of intellectual freedom is important to the advancement of research.”

“Anybody who doubts that a breakthrough of science is serendipitous discovery, and trusting your instinct.”

Men’s Basketball Has New Look But Same Core Message

The California Tech
The Astronomer's Dream

What would 17th Century astronomer Johannes Kepler have seen if he had today's advanced technology? The Astronomer's Dream is a journey through a computer graphic visualization of space, based on data obtained by NASA satellites.

The California Tech

NOVEMBER 18, 2017 • 4 PM

$10 (GENERAL ADMISSION)

Recommended for all ages

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SCIENCE SATURDAYS

Announcements

The Astronomer's Dream

Sign up at the Caltech Y (payment due at sign up)

Sign-up starting Thursday, Oct 19 at the Caltech Y at 10 AM

Astronomer's Dream - A Journey through the Cosmos

The Astronomer's Dream is an event that will provide an opportunity for attendees to transport themselves through a computer-generated visualization of space, using data obtained by NASA satellites.

The event will take place at Caltechlive!, located at 1500 E 13th Street, Pasadena, CA 91125, on November 18, 2017, at 4 PM. Admission is $10, and the event is recommended for all ages.

To sign up, visit the Caltech Y's website and complete the payment process. The event is available to anyone with an interest in astronomy or space exploration.
Laser-Imaging Technology Brought into Focus

**EMILY VELASCO**
Caltech Media Relations

This article is adapted from a story that was originally published online at caltech.edu.

Caltech engineers have improved a technique for taking three-dimensional (3-D) microscopic images of tissue, allowing them to see inside living creatures with greater precision than before.

The technique, called 3-D photoacoustic microscopy (PAM), bombards tissue with a laser beam. As the energy in the laser light is absorbed, it causes the tissue to vibrate ultrasonically. Those vibrations are picked up by sensors and used to assemble an image of the tissue’s internal structures in a process similar to ultrasound imaging.

The technique was invented by Lihong Wang, Caltech’s Iren Professor of Medical Engineering and Electrical Engineering, and his team in the Caltech Optical Imaging Laboratory, part of the Andrew and Peggy Chering Department of Medical Engineering in the Division of Engineering and Applied Science.

One constraint of the technology to this point has been its limited depth of field—the range at which objects are in focus. This phenomenon would be familiar to anyone who has used a camera. When the camera is focused on a nearby object, objects in the background will be blurry. When the camera is focused on something in the distance, nearby objects are blurry.

While such blurring can add an artsy flair on Instagram, it is not desirable in 3-D medical imaging, so Wang and his team set out to tweak their technology to minimize the effect. In a paper published in the October 3 issue of Nature Communications, they describe a modified form of the technology they’re calling spatially invariant resolution photoacoustic microscopy, or SIR-PAM.

SIR-PAM builds on previous PAM technology by pre-processing the laser beam with a specialized optical chip found in certain types of TVs and projectors. The chip splits the beam in two, and each of those beams bombards the object to be imaged from a different angle.

When the beams cross inside the object, they create precise interference patterns that provide acoustic signatures needed to construct a clear 3-D image of internal structures throughout the scanned area.

These modifications give SIR-PAM a depth of field 32 times larger than what PAM could achieve while also improving its resolution to as small as 90 nanometers (1/1000th the width of a human hair).

“This gives us the ability to look through opaque materials and see what’s inside,” Wang says. “It’s like an extension of the human eye, like Superman’s X-ray vision.”

“Photoacoustics is unique,” he says. “It can be scaled to image everything from structures inside a cell all the way up to an entire organism, affording an unprecedented opportunity for omniscale biological research with consistent imaging contrast.”

The paper is titled “Motionless volumetric photoacoustic microscopy with spatially invariant resolution.” Wang’s other co-authors are Caltech researchers Jiamiao Yang, Yuecheng Shen, and Pengfei Hai, Lei Gong, Xiao Xu, and Yuta Suzuki, researchers from Wang’s former lab at Washington University in St. Louis.

Funding for the research was provided by the National Institutes of Health.

Laser-Imaging Technology Brought into Focus

**Molecular Biologist Recognized for Discovering the Biology of the Ubiquitin System**

**LORI DADOSE**
Caltech Media Relations

This article is adapted from a story that was originally published online at caltech.edu.

Alexander Varshavsky, Caltech’s Thomas Hunt Morgan Professor of Biology, has received the 2017 Heinrich Wieland Prize from the Rochehinger Ingelheim Foundation. The prize, named after the late Nobel Laureate Heinrich Wieland, honors “outstanding research on biologically active molecules and systems in the fields of chemistry, biochemistry, and physiology as well as their clinical importance.”

Varshavsky was recognized for his work on the biology of the ubiquitin system, a large set of molecular pathways that have in common a small protein called ubiquitin. A major function of the ubiquitin system is the regulated degradation of cellular proteins. The ubiquitin system targets for selective destruction not only misfolded or otherwise abnormal proteins, but also normal proteins that have evolved to be short-lived, depending on specific physiological conditions. The destruction of such proteins underlies a multitude of biological processes, including cell growth and division, cell differentiation, gene expression, and DNA replication. Malfunctions of the ubiquitin system cause numerous human diseases, including neurodegeneration, diabetes, cancer, and immune deficiencies.

Varshavsky studied chemistry at the Moscow State University in Russia and received his PhD in biochemistry from the Moscow’s Institute of Molecular Biology in 1973. In 1977, he took a faculty position at the Massachusetts Institute of Technology, where he began his research into the ubiquitin system, at the time a nascent area of study. In 1992, he moved his laboratory to Caltech. Varshavsky is a member of the American Academy of Arts and Sciences and the National Academy of Sciences. He has received a number of major awards, including the Canada Guerinier International Award, the Albert Lasker Basic Medical Research Award, the Max Planck Award, the Albany Medical Center Prize in Medicine and Biomedical Research, and the Breakthrough Prize in Life Sciences.

The Heinrich Wieland prize of 100,000 euros (approximately $118,000) was awarded on October 18 in Munich, Germany, at a scientific symposium in Varshavsky’s honor.
Procrastination workshop

A 1-hour workshop offered 2 times this term:

Friday, October 13th, 4:00 - 5:00
Friday, November 3rd, 4:00 - 5:00

326 Sherman Fairchild Library

- Learn tools for coping with procrastination and work avoidance.
- Learn practical, behavioral strategies for responding differently to old habits.
- Respond differently to unhelpful thoughts like “I can just get up early and do this tomorrow.”
- Optional text-based reminder system to keep the lessons fresh in the week after the workshop is over!

More information: counseling.caltech.edu

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Emotional Awareness

Get better at knowing what you’re feeling, and see how your thoughts and feelings affect each other. October 9th and 16th

Open-Mindedness

Learn how to be more flexible in the way you see the world! October 23rd and 30th

Face The Fear

Learn how to hang in there with difficult situations and emotions without having to avoid them. November 6th and 13th

Just show up!
Mondays 4:00 - 5:00
326 Sherman Fairchild Library

Join the Meditation Mob!

Tuesdays, 12:00 - 12:50

Want to learn more about mindfulness meditation? It’s a great way to improve your attention and to become more grounded in the present moment.

There’s no religious component. We use secular, evidence-based meditation techniques.

We meet in the study room on the 9th floor of Millikan Library. All students are welcome, from total beginners to experienced meditators.

Mailing list and MP3 archive: counseling.caltech.edu/students/meditation
Men’s Basketball’s Core Message Remains the Same  

Bret Johnson (Carlsbad, Calif. / Santa Fe Christian) played similar minutes to Li and was utilized as a bench scoring option. Sophomore Roshan Bal (Saratoga, Calif. / The Rivers School) and Calvin Huh (Fort Lee, N.J. / Bergen Tech) both saw minutes in bunches last year and all are expected to get in there and get lots of reps. Going against some of the top guards of the SCIAC, another guard, sophomore Gokul Srinivasaragavan (San Ramon, Calif. / Pinewood School) meanwhile will be tasked with playing a similar role to Johnson last year while giving the Beavers some energy and scoring off the bench.

“Mike is going to be counted on to be a leader and extension of our coaching staff out on the floor,” Eslinger said. “He is a highly aggressive defender and want him to be able to play make for everybody else. Bret is a really hard worker and we need him to be able to score for us and defend at a high level, which he can do. Roshan can really shoot it as well so hopefully he’ll get a real shot this year to showcase that part of his game.”

A big key for the uncharacteristically small Beavers (only three players exceed 6-foot-4) will be finding a combination in the front court that is going to pay dividends. Behind Kawashima is a youthful team not light on sophomores. Second-year players make up half of the Beavers lineup and all six of them will be expected to fall into featured roles, particularly in the scoring department. The bulk of Caltech’s scoring last season came from a group of four players, all of whom averaged at least 10 points of game.

With none of those players returning, the Beavers will look to sophomore guard Alec Andrews (Folsom, Calif. / Folsom), who averaged 7.9 points per game over last year’s 25-game schedule. Andrews also finished the season as the SCIAC’s second-leading assists leader (3.3 per game) and finished second on the team in minutes. He is able to contribute in a number of different ways, and that led to him being leaned on heavily by Eslinger and his coaching staff in year one.

“Alec started every game last year for us,” Eslinger said. “We want him to have expanded his game and be more dynamic.”

The remaining trio of guards contributed in bunches last year and all are expected to take on expanded roles this year. Sophomore point guard Michael Li (Bryn Mawr, Pa. / Radnor) came off the bench to work in with Andrews acting as more of a freelance shooting guard and played meaningful minutes against some of the top guards of the SCIAC. Another guard, sophomore Hollywood, a scrappy guard/forward who can score in spots but will likely be tasked with taking on the opposition’s top scorer and creating offense on the counter attack. Kawashima missed a handful of games last year with a minor injury but recovered to play a key role for the Beavers ahead the following season. That will be not the case for Head Coach Dr. Oliver Eslinger and the Caltech men’s basketball team in the 2017-18 season. In fact, the youthful bunch which includes just one senior and no juniors are eager to continue to build on the foundation that Eslinger has helped foster as he enters his 10th season with the team.

The Beavers finished the prior season fifth in the SCIAC, just four games out of the coveted fourth-place position. Led by newly minted member of Al-Sadd Sports Club and seventh all-time leading rebounder Nassir Al-Rayes ’17 in addition to departed seniors Ricky Galliani ’17 and David LeBaron ’17, the Beavers turned a corner when the SCIAC portion of the schedule hit. They picked up key wins over Pomona-Pitzer Colleges on Senior Night, no less, Occidental College and nearly upset then-Division III West Region No. 4 Claremont-Mudd-Scripps Colleges in Braun Gymnasium on Feb. 2. While the senior trio certainly left their mark as four-year contributors to the team, as Eslinger puts it, “there is no rebuild, only build.”

“We’ve never stopped building,” Eslinger said. “Togetherness fuels the philosophy of group dynamics, staying together, being there for each other, trusting each other and motivating others and yourself to pick up the slack when needed and be conducive to the success that comes our way. I think this is the tightest group we have had in terms of working together and believing in each other. They’re energetic with each other, really talkative and engaging with one another like we will need them to.”

The presence of just one senior means Eslinger will be working with the youngest group he has ever fielded in his 10 years with the program. The lone senior is David Kawashima (Studio City, Calif. / North down the stretch. His best game came in the team’s third Occidental meeting: a 12- and-12 double-double. Caltech will need him to be an asset on and off the court as the team’s lone upperclassman presence.

“David has been a great leader so far,” Eslinger said. “He cares about this team a lot and has it in a lot of work in the of season too, so we are expecting big things from him.”

Behind Kawashima is a youthful team not light on sophomores. Second-year players make up half of the Beavers lineup and all six of them will be expected to fall into featured roles, particularly in the scoring department. The bulk of Caltech’s scoring last season came from a group of four players, all of whom averaged at least 10 points of game.

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Vice Provost, Chief Diversity Officer, and Professor of English Cindy Weinstein holds regular office hours as an opportunity for undergraduate students, graduate students, and postdocs to meet for discussions pertaining to the Council on Undergraduate Education; Caltech accreditation; the Staff and Faculty Consultation Center; Student-Faculty Programs; the Center for Teaching, Learning and Outreach; the Caltech Diversity Center; and the Caltech Libraries.

There are four 15-minute appointments available per office hour. Sign up in the Office of the Vice Provost, Parsons-Gates room 104, ext. 6339 or by sending an email to dlewis@caltech.edu. We look forward to hearing from you!

Student Office Hours for Fall Term 2017:
11/7/17 Tuesday 9:00-10:00 a.m.
11/16/17 Thursday 11:00 A.M.-12:00 P.M.
11/21/17 Tuesday 10:00-11:00 A.M.
11/27/17 Monday 10:00-11:00 A.M.

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ASCIT Minutes
Meetings are every week in SAC 13

ASCIT Board of Directors Meeting
Minutes for November 3, 2017. Taken by Dana He.

Officers Present: Sakthi Vetrivel, Kavya Sreedhar, Sarah Crucilla, Alice Zhai, Dana He
Guests: Kelly Woo, Chris Dosen
Call to Order: 10:13 AM

President’s Report (Sakthi):
- Received bylaw amendment proposal to change ASCIT voting system to matched pairs.
- Marsh Fund and faculty board meeting coming up soon.
- ASCIT movie night is tonight.
- ASCIT retreat planning in progress.
- Club funding meeting on Sunday, November 5th from 11:00 AM – 5:00 PM.

Officer’s Reports:
V.P. of Academic Affairs (Kavya):
- Student-faculty lunches will be during week 10.
- Software seminar will be during week 9. Thinking of teaching git.
- Creating a committee to look into curriculum revisions. This includes splitting Math 3 different parts to be more option-specific and adding CS 1 to core.
- Will discuss TGQR and option-advising improvements during ARC retreat.
- Looking into how the change in unit requirements impacted students.
- Drop day is next Friday.

V.P. of Non-Academic Affairs (Rachael):
- Not in attendance.

Director of Operations (Sara):
- Not in attendance.

Treasurer (Sarah):
- Proposal for $800 for Lloyd-Ricketts joint-house broomball event approved.
- COUCH just released article about core values. There will be a couple more articles about Bechtel house options. Seems like themed housing and quiet housing are relatively popular. Decision to be made in February.
- Got financial statement from last year; had $55,000 left over. However, there are still a lot of clubs that requested reimbursement last year that haven’t received it yet because of the lack of a point person. Needs to figure out how to transfer leftovers from last year to this year’s budget.

Social Director (Alice):
- ASCIT movie night (Thor) is tonight.
- Haunted maze went well.
- Looking into ASCIT formal venues.
- Midnight donuts will be in the next couple weeks.

Secretary (Dana):
- Nothing to report.

If anyone has any questions or concerns about a section of the minutes please email the appropriate officer. We are happy to answer any questions.

Meeting Adjourned: 10:56 AM

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Crossword

Across
1. Jump lightly (11)
4. Cut (9)
8. Consternation (8)
13. Manage (9)
14. Motor vehicle (7)
15. Musical form (9)
16. Kitchen appliance (9)
17. Cook slowly in liquid (9)
18. Braid (11)
19. Left-hand page (8)
21. Aura (9)
23. Part of the Roman calendar (9)
24. Epoch (11)
25. Particle (11)
27. Writing block (11)
29. Celestial body (11)
30. Young animal (11)
31. Gear wheel tooth (11)
32. Young whale (11)
33. Translucent mineral (11)
34. Segment of DNA (11)
35. The highest point (11)
36. Brag or gloat (11)
37. Moose (11)
38. Simian (11)
39. Decapod (11)
40. Any high mountain (11)
41. Scale drawing (11)
42. Cleaning implement (11)
43. Cut of meat (11)
45. Smother or suppress (11)
46. Female sheep (11)
47. Female sheep (11)
48. Single (11)
49. Basketball target (11)
50. Tennis serve that must be replayed (11)
51. Female sheep (11)
52. Fairy (11)
53. Couch (11)
54. Display (11)
55. Writer (11)
56. Rise as vapor (11)
57. Ululation (11)
58. Toward the stern (11)
59. Glaringly vivid or graphic (11)
60. Young animal (11)
61. Matured (11)
62. Male offspring (11)
63. Musical composition, intended as an exercise (11)
64. Hotel for travelers (11)
65. Liberate (11)
66. Relatively low in volume (11)
67. Flowerless plant (11)
68. Ship’s company (11)
69. Ocellus (11)
70. Garment of ancient Rome (11)
71. Tenacious (11)
72. Very small (11)

Down
1. Levitate (11)
2. Drama set to music (11)
3. Writing implements (11)
4. Fuel (11)
5. Writer (11)
6. Ripe as vapor (11)
7. Uplift (11)
8. Toward the stern (11)
9. Glaringly vivid or graphic (11)
10. Matured (11)
11. Artifice (11)
12. Military dining room (11)
13. Small inlet (11)
14. Cereal (11)
15. Medical treatment (11)
16. Musical composition (11)
17. Tackiness (11)
18. Worthless or oversimplified ideas (11)
19. Decapod (11)
20. Any high mountain (11)
21. Aura (11)
22. Musical form (11)
23. Left-hand page (11)
24. Epoch (11)
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Answers to current crossword (pg 7)

This picture represents a common phrase, title, or person.
Think you know the answer? Take a guess at mondaypunday.com/103