

tterra

A world of research & creativity at Oregon State University • Summer 2008

Peril and Promise

Finding Hope on the Path to Adulthood

Edel

SUPPORTING OUR YOUTH

Oregon's most famous scientist started off with a bang, but it looked like he was just headed for trouble. As a teenager, Linus Pauling liked to play with chemicals and got the idea to put an explosive mix of powders on the streetcar lines near his Portland home. According to Pauling biographer Tom Hager, Linus let out a whoop as trolleys set off the charges. The company wasn't so amused and sent a representative to Pauling's home to issue a warning. That didn't stop him entirely. He would also scare his sisters by making unstable compounds that would pop when disturbed. Not satisfied to keep such a discovery to himself, Pauling took it to school, Hager notes in his book, *Force of Nature*.

His difficulties were only beginning. At 16 years old, he had raced through the math and science courses at Washington High School and was determined to finish early and head to college. So he asked for permission to complete the two required semesters of American history in one term. When the principal said "no," Linus countered by leaving school without a diploma. In short, he was a high school dropout, albeit one whose thirst for learning pushed him to study Greek in his spare time and to aim for a career in chemical engineering.

Linus' determination to follow an impulse was hardly unusual. It is echoed in the energy, creativity and compassion of students at OSU and in the young adults everywhere who keep businesses humming, serve their nation in the military and strive to make a difference in their communities. The vast majority may struggle, but with support from families, churches and youth organizations, they succeed.

Many, however, are more vulnerable. OSU sociologist Michelle Inderbitzin has documented the consequences for those who end up in juvenile detention centers, which some call a "pipeline to prison." Public health specialist Brian Flay has devoted his career to positive youth development and applies rigorous evaluation techniques to demonstrate the effectiveness of a character-building program, Positive Action. And social scientist Rick Settersten finds that institutions need to rethink their support for youth. At stake are the lives of potentially productive citizens and maybe even a Nobel Prize winner.

— Nick Houtman, Editor



In 1917, Linus Pauling, far left, was 16 and in his first year at Oregon Agricultural College (photo: Ava Helen and Linus Pauling Papers, Special Collections)



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OSU is Oregon's largest public research university with \$191 million in research expenditures in FY2007. Classified by the Carnegie Foundation for the Advancement of Teaching in its top category (very high research activity), OSU is one of only two American universities to hold the Land-, Sea-, Sun- and Space-Grant designations. OSU comprises 11 academic colleges with strengths in natural resources, earth dynamics and sustainability, life sciences, entrepreneurship and the arts and sciences.

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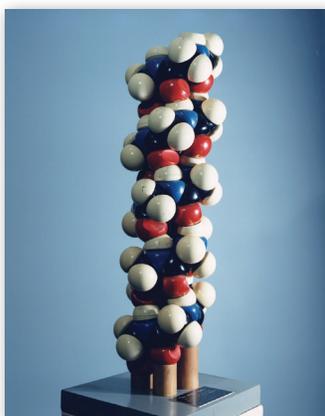
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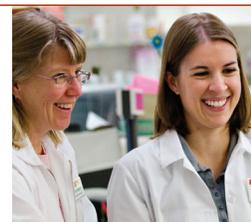
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From Risk to Relationship

Youth development focuses on the positive, but the most vulnerable still face long odds

by Nick Houtman | Illustrations by Edel Rodríguez



(Photo: ©iStockPhoto.com, Chris Schmidt)

In 1998, Michelle Inderbitzin decided to conduct a study of youth in a detention center for violent offenders. Almost every Saturday morning for 15 months, the University of Washington graduate student in sociology made the 90-minute drive from Seattle to an “end-of-the-line training school” for boys convicted of multiple property crimes, armed robberies, violent and/or sexual assaults and homicides. In the “cottage” where she worked, most of the 20 or so inmates, many of them gang members from poor urban neighborhoods, had been sentenced for robberies and “drug deals gone bad.” She was little older than the center’s residents.

Field studies in juvenile centers are rare. So Inderbitzin wanted to observe and talk with the boys, to evaluate their stories against the background of theories on delinquency and criminal justice. She hung out in a common room where residents talked, played games and watched TV, taking notes only after she left.

At first, the reception was cold. Inmates ignored her, later saying they expected her to give up and leave. The staff kept a close eye on her. Eventually one of the older youths, a 19-year-old Hispanic boy respected by the others, approached her and began to talk. He took some heat from his peers, but gradually, others followed, sharing details of their lives, their dreams, frustrations and unsettled scores that awaited them back home. Staff members also talked frankly with Inderbitzin about the futures for boys who would return to their communities as young men with criminal records.

Now an associate professor of sociology at Oregon State University, Inderbitzin has published eight journal articles about her observations and findings. In addition, she shares her knowledge with OSU students through courses on criminal justice and deviant behavior. In 2007, she became the first university professor on the West Coast to lead a class of students and men’s prison inmates through the national Inside-Out Prison Exchange Program, which promotes understanding of the criminal justice system.

While Inderbitzin’s direct approach to one of the most troubled edges of today’s youth culture was unusual, her desire to address problems by building on the positive attributes of our children and teens is not. Colleagues at OSU are tackling some of the most pressing challenges that confront families and youth: the development of positive behaviors; the channeling of youthful energy to meet community needs; the lengthening transition to adulthood.

Initiatives span the age range from child to early adult. They focus on issues such as readiness to learn, nutrition, obesity, risky behaviors and social policies. And the newly endowed Hallie Ford Center for Healthy Children and

Families will foster new collaborations among researchers, families and professionals in education and child welfare agencies (see sidebar, Page 4).

These efforts are being noticed. “OSU has put together an extraordinary group of people who are at the cutting edge of developmental science,” says Richard M. Lerner, an international leader in youth development at Tufts University. Developmental science tends to look at youth through a “deficit lens,” but he argues that success will come from

promoting their strengths. Accordingly, OSU is combining high quality science with good practice, Lerner adds, and approaching youth as resources to be developed instead of problems to be solved. The author of more than 65 books, Lerner gave the first presentation at the Duncan and Cynthia Campbell Lecture Series on Childhood Relationships, Risk and Resilience, sponsored by the College of Health and Human Sciences in April 2007.

Positive and Universal

In 1975, a high school English teacher in Idaho identified what she thought were the common elements of effective character development for youth. “I was idealistic, like most beginning teachers, and I wanted to make a difference,” says Carol Allred, who is affiliated with the OSU Department of Public Health and owns Positive Action, Inc. (www.positiveaction.net), a national character education company in Twin Falls.

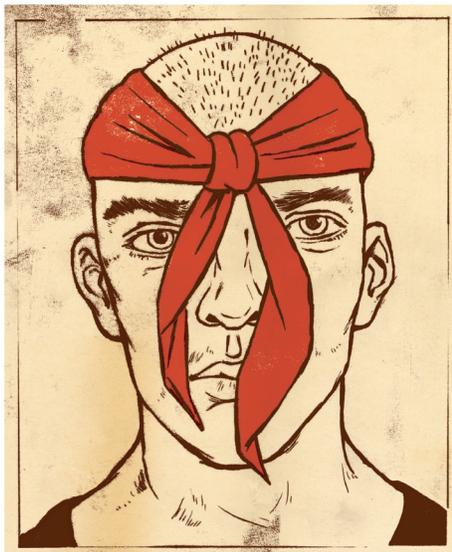
In her classes, she created lessons to teach students to build self-esteem through intentionally positive behaviors. With support from

the Idaho Youth Commission and federal agencies (Department of Justice, Centers for Disease Control), she expanded her program to the elementary grades. Five years later, when the grant money dried up, she started her company.

“In the first, year, we set a goal of getting the Positive Action program into 25 schools. At the end of that time, it was in 80,” she says. The company now counts 13,000 schools, mostly in the United States, as past and current clients.

At about the same time that Allred was launching her business, a public health researcher at the University of Illinois at Chicago was developing a theory that defines effective ways to reduce risky behavior by youth. His vision: Address the common underpinnings of smoking, drugs, violence and dropping out of school, and you reduce the incidence of all such behaviors simultaneously. Preventing problems before they develop is key, says Brian Flay, now a professor of public health at OSU.

“The broader sociocultural environment influences all of our behaviors. It’s the same with kids. And family



“Many in the detention center saw criminal activities as a way to make money and earn respect.”

— Michelle Inderbitzin, Assistant Professor
of Sociology

interactions influence kids' developmental trajectories. Bonding with your family and bonding with your school influence all of your behaviors. Not just smoking, not just drugs, not just violence. Everything," Flay explains.

Flay embarked on a series of systematic studies to determine if such prevention techniques actually worked, and he developed a program known as Aban Aya for inner-city African-American schools in Chicago to put his theory into action. After meeting Allred and learning of Positive Action, he focused his work on the Positive Action program. "I had this comprehensive theory in need of a comprehensive program and she had a comprehensive program in need of a comprehensive theory," says Flay. Their professional compatibility took a personal turn when they married in 2000.

With grants from the National Institutes of Health and the U.S. Department of Education, Flay has compared the rate of risky behaviors in schools that have adopted Positive Action with those that have not. He and teams of independent collaborators have focused on a range of school settings, from the inner-city neighborhoods of Chicago to urban and rural communities in the Southeast, Utah and Hawaii. Using data from school report cards, student surveys, teacher interviews and other sources, they have shown that Positive Action improves academic performance and reduces negative behaviors in elementary, middle and high schools.

For example, in a large southeastern school district, scores on the Florida Reading Test improved by 40 percent, and out-

of-school suspensions declined by 29.6 percent in elementary schools that used the Positive Action program. In middle schools, the larger the number of students who had experienced Positive Action in earlier grades, the lower the rate of documented "problem behaviors," as much as 75 percent less. Results from randomized trials in Chicago and Hawaii replicate these and other results.

Positive Action is the only character development program certified by the Department of Education's What Works Clearinghouse (<http://ies.ed.gov/ncee/wwc/>) to effectively change both behaviors and academic performance.

"Design the right kind of program and you can change multiple factors that end up influencing multiple outcomes," says Flay. "We reduce violence and substance abuse as measured by kids' reports, as measured by teachers' reports and by school-level data like disciplinary referrals and academic standardized test scores. It's a rich combination of data that is consistently showing effects."

The Positive Action philosophy is disarmingly simple, adds Allred. Student success stems from "feeling good about who you are, what you're doing and how you treat others." Other youth programs promote similar benefits, she says. Through the company's educational kits for schools, families and communities, "we're raising that to a conscious level. We empower kids by helping them to understand that thoughts and actions lead to feelings.

Our philosophy is intuitive and universal."

The Most Vulnerable

As parents know, children's needs change from one stage of development to another, and the stakes rise as teens approach adulthood. All too quickly an itch for the



"Bonding with your family and bonding with your school influence . . . everything."

— Brian Flay, Professor of Public Health

Hallie Ford spent a lifetime advocating for youth and families



Her work will continue to inspire research in the new Hallie Ford Center for Healthy Children and Families at OSU. Prompted by an \$8 million gift from her estate, the OSU College of Health and Human Sciences will build on existing strengths of the faculty and anticipate the needs and challenges of children and families. Targeted research areas include: obesity prevention, early childhood development,

vulnerable children and families, and risky and protective behaviors for youth. The goal is, according to Professor Rick Settersten, interim co-director with Associate Dean Jeff McCubbin, "to serve as a catalyst for innovative research that will matter in the everyday lives of children and families."

Plans call for construction of a new facility after OSU raises an additional \$2 million, as required by Hallie Ford's gift.

More information about the center is on the Web at www.hhs.oregonstate.edu/halliefordcenter

4-H builds skills for community action

Get it all out on the table. When Oregon 4-H brings teens and adults together to plan a community project, that's one of the first steps. So the adults huddle and list the challenges and benefits of working with teens, and the teens do the same thing about working with adults.

"They don't hold back," says Mary Arnold, associate professor in Extension and youth development specialist at Oregon State. "They're pretty hard on each other. The adults say things like 'you never have enough time, you're overcommitted, you're unrealistic.'" A complaint on the teen side: Adults are too quick to dismiss a new idea.

"But then it gets to the good stuff," says Arnold, "and the adults start saying things to the teens like 'you're creative; you have energy; you have ideas I'd never think of; you're fun; I believe in you.'"

Arnold and Elissa Wells, assistant professor of 4-H youth development in Coos County, coordinate a program known as Building Skills for Youth Community Action. Their primary goals are connecting youth with their communities and empowering them with social science methods.

At the heart of the program are groups of teens and adults working together to identify community needs and create projects to address them. In Myrtle Point, groups planned a series of family nights with games, potluck dinners and bowling parties. In Newport, they interviewed potential employers to share job information with their peers. At Nestucca High School in Cloverdale, teens raised money to renovate the high-school bleachers. In Eugene, Lane County youth created a beautification project to help prepare the city for the U.S. Olympic Team track and field trials.

"We're teaching the kids research skills, how to evaluate a problem or a need in the community," says Arnold. "We're giving them critical inquiry skills to ask their own questions and decide what's important."

Begun on the Oregon coast in 2007, the program has spurred youth and adult teams in the Willamette Valley and Eastern Oregon. A small grant program helps to support each project.

In each community, Arnold and Wells begin by training the participants, using a curriculum that they developed with support from the 4-H Youth Development Foundation at OSU. Training sessions are intense and typically run from Friday night through noon on Sunday.

Arnold and Wells want to help teens develop new connections and a sense of belonging. So they are particularly pleased when they see a participant overcome a challenge. That happened at a recent training session in Newport when a girl was reluctant to take an active role in a practice session. She lacked the confidence to stand in front of the group. Nevertheless, with help, she took her turn, and at a subsequent public meeting in Newport, she was one of the leaders, recording public discussion about the group's project.

"Afterward she came out with a huge smile, the biggest smile in the world," says Arnold. "She asked us, 'Can you believe it was me doing this?' We just had tears in our eyes."

More than 127,000 Oregon youth participated in 4-H in 2007, pursuing projects in science and engineering as well as agriculture, forestry, wildlife and community development.

For more information about Oregon 4-H, see oregon.4h.oregonstate.edu

Relationships and critical-thinking skills are at the heart of a 4-H program coordinated by Extension Associate Professor Mary Arnold, center. Amanda Smith, left, and Madara Matson-Bell of Lane County 4-H participate in a project that helped to prepare the city for the Olympic track and field trials in June. (Photo: Lynn Ketchum)



Researcher Profiles

Brian Flay is a professor in the Department of Public Health, where he studies health promotion, smoking and drug abuse prevention and youth development. His research focuses on documenting the impact of Positive Action, a national character education program for youth. He has received funding support from the National Cancer Institute, the U.S. Department of Education, the Robert Wood Johnson Foundation, the Centers for Disease Control and the National Institute on Drug Abuse.



Michelle Inderbitzin is an associate professor in the Department of Sociology. Her research interests include criminology, deviant behavior, juvenile justice, prison culture and prisoner re-entry. She is conducting a study with men incarcerated in Oregon prisons and a project with Christopher Uggen at the University of Minnesota on

felon disenfranchisement. She has received support from the L.L. Stewart Faculty Development Award and the College of Liberal Arts at OSU.

A professor in the Department of Human Development and Family Sciences, **Richard Settersten** focuses on transitions over the life course. He is a member of the MacArthur Network on Transitions to Adulthood and Public Policy and has received grant support from the John D. and Catherine T. MacArthur Foundation, the Spencer Foundation and the National Institute on Aging. With Associate Dean Jeff McCubbin, he is interim co-director of the Hallie Ford Center for Healthy Children and Families.



latest Harry Potter book becomes a request for the car keys. For young adults looking for the key to a career, the global economy poses challenges their parents did not face: fewer manufacturing jobs, a more diverse work force and a more technically demanding labor market. In response to these and other factors, many youth disengage from social institutions after high school (see sidebar, Page 7).

That concerns Rick Settersten, whose analyses of the transition to adulthood show that, as economic forces grind against personal aspirations and social programs, the support networks for young adults fray. For example, he says, the trade unions that used to protect and support young men from working-class and disadvantaged backgrounds have all but disappeared, along with the pockets of the economy that used to absorb them. So, too, have the loyalty of corporations and the certainty of benefits for the middle class. The “common, collective set of commitments” that emerged from the New Deal is unraveling.

The net result: “You fend for yourself. You’re responsible for your own welfare. You make your own choices and live with the consequences. The rub is that old assumptions about life don’t hold anymore; life is full of new and unforeseen risks. Governments and markets don’t absorb them. Individuals and their families do,” says Settersten.

A professor in human development and family sciences at OSU, Settersten is also a member of the MacArthur Research Network on Transitions to Adulthood and Public Policy. He and colleagues at the University of Pennsylvania, Harvard, Princeton and other universities have analyzed national and international datasets (the U.S. Census, public attitude surveys and youth development studies) to reveal how income, gender, race and other factors affect the ability of youth to become independent, to establish sound personal relationships and to launch productive careers — in short, to become responsible adults.

“It is simply not possible for most young people to achieve economic and psychological autonomy as early as they once did. Most kids from families with some resources and connections fare pretty well. They just need more support to get there, and they’ll get there late,” says Settersten.

The most vulnerable are those young adults whose fates have been tied to public programs and policies. “Whether they’ve come from fragile families, or they’ve been tied to the juvenile justice system or special education, they are abruptly cut off from support when they reach 18 or 21. If middle-class kids are getting so much support to make it through the 20s, what is the plight of kids who don’t have those types and levels of supports?” Settersten asks.

To increase the chances of success for these youth, Settersten and his colleagues suggest that educational institutions, workplaces, social services and policies must be organized in more coordinated, rather than piecemeal, ways. In their 2005 book, *On the Frontier of Adulthood*, they propose a policy agenda built on greater flexibility and communication among community colleges and universities, employers and the military. They also point to opportunities for public service and mentoring as critical in facilitating the skills and capacities of young people.

Heroes

Michelle Inderbitzin's study revealed how difficult it can be to develop solutions for youth who put themselves at greater risk by making serious mistakes. Despite having been caught and imprisoned, many in the detention center saw criminal activities as a way to make money and earn respect. Some told her outright that they would return to those activities after they were released.

Amid such grim observations, she saw signs of hope: examples of creative writing and music, awarding of high-school equivalency certificates, discussions about education and career options. It was the staff members, though, who were the day-to-day heroes.

"It took me a while to figure out that the staff were really raising these kids. They called them their 'sons.' It was a little bit of a joke. To each other, they would say, 'Oh, your son needs you.' But there was a reality there," says Inderbitzin.

One picture that she can't forget is that of a staff member teaching a boy how to shave at a bathroom mirror. "The kid was going through puberty and had to shave for the first time. It was an extraordinary moment," she says.

The staff were mostly male, including ex-military officers and former college athletes, some with families of their own. They attempted to help their boys by bringing in community college applications and information about financial aid. They counseled them on personal relationships, job prospects and how to discuss a criminal record in an inter-

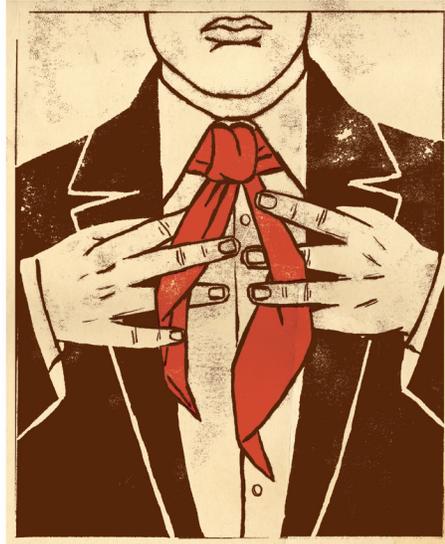
view. Although cautioned against it, some even followed up after their "sons" were released, listening to stories of frustration in dead-end jobs and encouraging them to be patient and stay clean.

The net result, Inderbitzin has written, was that the staff helped their "sons" to revise their expectations of cashing in on the American Dream. Sociologists have theorized

that youth with few legal options for advancement seek wealth and status by any means available, including criminal activity. For the staff, the often-unrealized hope was that their boys would accept less wealth and status in exchange for the relative safety of conforming to social norms.

For Inderbitzin, hope appeared in the boys who showed leadership potential through their intelligence and communication skills. One boy in particular stood out: a "born leader, funny, smart, able to communicate well with the different groups in the center." Inderbitzin communicated with him briefly after his release but then lost contact and heard that he was back in prison on a gun-possession charge. "What a horrible waste," she says.

Nevertheless, like many of the detention center staff that she interviewed, she retains an unshakable belief in the potential for youth to overcome even these difficult barriers. "I just don't understand giving up on them when they're 16, 17 or 18 at the time of their offense. It doesn't seem like good logic to say 'we're done.'" **terra**



"You fend for yourself. You're responsible for your own welfare. You make your own choices and live with the consequences."

— Richard Settersten, Professor of Human Development and Family Sciences

OREGON'S YOUNG ADULTS AT A GLANCE

After high school, most young people get a job, enlist in the military or go to college. They are connected to social institutions. Others are at loose ends. Here's a breakdown based on the 2000 Census.

Total number of 18- to 24-year-olds in Oregon: 327,884

Connected (in school, employment or the military): 269,849 (82.3%)

Disconnected: 58,035 (17.7%)

Receiving public assistance: 8,852 (3%)

Among those who are connected

Employed: 132,226 (49%)

Employed and in school: 74,161 (26%)

Unemployed and in school: 56,668 (21%)

Living with parents: 36% of young men, 30% of young women

Married with children: 9% of young men, 20% of young women

Married, no children: 16% of young men, 24% of young women

Unmarried with children: 2% of young men, 8% of young women

Without a high school diploma (21- to 24-year-olds): 60,330

Sources: 2000 Census; S. Jekielek and B. Brown, "The transition to adulthood: Characteristics of young adults ages 18-24 in America," 2005, Annie E. Casey Foundation

One to

As students explore opportunities, mentors provide personal support

by Gary Dulude | Photos by Jim Folts

Most students come to college as works in progress, their interests only partially identified, their potential still to be realized. And as they explore and develop that potential, many students find something equally important: a mentor.

OSU offers an “opportunity-rich environment” for mentoring; at the same time, it’s an informal and organic process, says Larry Roper, vice provost for student affairs. Inspiration can come from a faculty or staff member who sees promise in a student, or a student may find it in a teacher or researcher.



“I’ve learned more from her than she’s learned from me,” Bell says. “The rewards far exceed the effort.”

THE MENTOR Chris Bell, associate dean, College of Engineering

THE STUDENT Eunice Naswali, senior in electrical engineering from Kampala, Uganda

MAKING A DIFFERENCE Bell was only an “incidental mentor,” he says. With his wife and grown children, he had volunteered through Crossroads International, a community volunteer organization in the Office of International Programs, to serve as a “friendship family” when Naswali came to the United States in 2004. Although his specialty is in a different discipline, civil engineering, Bell encouraged her early on to pursue an internship in the Multiple Engineering Cooperative Program (MECOP). More than 100 companies in Oregon and Washington offers students opportunities through MECOP.

Naswali has completed her first internship at Mentor Graphics in Wilsonville, and she is working in her second at Vestas Americas in Portland this summer. Vestas is one of the world’s largest wind-energy companies, and Naswali hopes the experience will help her in a future career back in Uganda, tackling the country’s problems with power generation and distribution to remote areas.

One

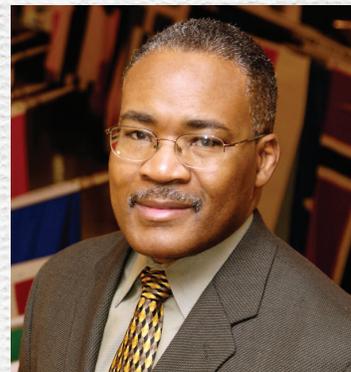
Regardless of how they begin, mentoring relationships are characterized by intensity and openness. Mentors may offer specific advice or simply listen without judgment. Other times, they may have to tell students what they don't want to hear.

"Good mentors seem to know what voice is appropriate at what time to get students' attention and help them along the way," Roper says.

Roper's own experience being mentored in college, by a Russian literature professor and his track coach, remains

influential more than 30 years later. The relationships taught him about balance and gave him confidence.

"They helped me uncover my best possible self, always looking for the possibilities in my life that weren't clear to me," Roper says. "In the places where my ability didn't match the potential, they helped me develop the competence I needed." **Terra**



Larry Roper, vice provost for student affairs (photo: Dennis Wolverton)



THE MENTOR Peter Bottomley, professor in microbiology, College of Science

THE STUDENT Shawn Starkenburg, Ph.D. '07, Rapid City, South Dakota

MAKING A DIFFERENCE As a Ph.D. student and then as a post-doctoral researcher, Starkenburg worked in Bottomley's lab for almost five years to understand how bacteria process nitrogen in fertilizers and wastewater. He helped to map the genome of a type of bacteria that plays a crucial role in the nitrogen cycle. Although Starkenburg had worked in labs before coming to OSU, Bottomley helped him to hone his writing skills and "to take ownership and creatively approach the research," Starkenburg says.

For his part, Bottomley sees mentoring as a learning process with different levels of management and input. "It's very difficult to have one model that you follow with all students," he says. "You have to see students individually, giving them opportunities to recognize their own strengths."

A participant in OSU's Subsurface Biosphere Initiative, Starkenburg received a National Science Foundation fellowship to study the genomics of nitrification. He is now working at Invitrogen in Eugene, Oregon.

"You have to see students individually, giving them opportunities to recognize their own strengths."

THE MENTOR Greg Thompson, department head, agricultural education and general agriculture, College of Agricultural Sciences

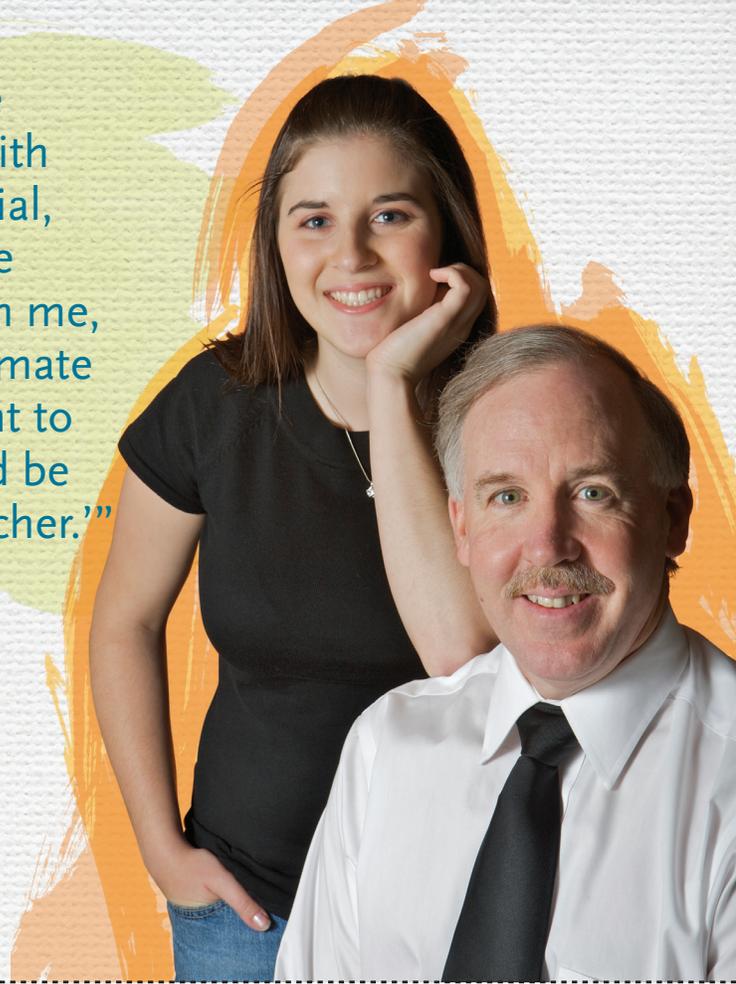
THE STUDENT Bibiana Gomes, senior in general agriculture from Sandy, Oregon

MAKING A DIFFERENCE As a high school student, Gomes showed beef cattle at the county fair and was president of her local FFA (Future Farmers of America) Chapter. Family and friends advised her to go into education, but she spent her first two years at OSU on a different career path.

Still, she couldn't stay away from agriculture. She joined the collegiate FFA chapter, for which Thompson is the adviser. "I'm passionate about teaching," says Thompson, "and when I see students with real potential, I encourage them. From me, it's the ultimate compliment to hear, 'you'd be a great teacher.'"

Gomes completed her degree last spring and will start an agricultural education master's program at OSU this fall. Thompson is impressed with how hard she works and her natural ability as a "kid magnet," he says. "She will be a great teacher."

"When I see students with real potential, I encourage them. From me, it's the ultimate compliment to hear, 'you'd be a great teacher.'"



THE MENTOR Ann Zweber, senior instructor, College of Pharmacy

THE STUDENT Channa George, second-year pharmacy student from Ten Sleep, Wyoming

MAKING A DIFFERENCE Take your prescription to the Bi-Mart pharmacy on 9th Street in Corvallis, and you might find Zweber and George working side by side. Zweber works in the pharmacy part time to "maintain my practice and credibility with students," she says. George is completing an internship as part of the pharmacy program.

George says working with Zweber gives her a role model for how to care for patients, "how she talks to them, listens to them and helps them." The internship experience also shows how pharmacists are becoming more involved with patients and more responsible for the outcomes of medications.

"Ann gives me a lot of confidence. She makes me feel I can do whatever I want to do," George says. "I want to be like her when I'm a pharmacist."

"Ann gives me a lot of confidence. She makes me feel I can do whatever I want to do," George says. "I want to be like her when I'm a pharmacist."

Devoted to Nano

The submicroscopic search for a better battery

Undergrad Anna Putnam is squirming. The interviewer has touched a raw nerve in the chemical engineering major. “You’re digging deeply into my life,” she says, shifting in her chair. Her confession comes with reluctance: “My first term at OSU, I struggled in math.” Pressed, she admits the worst: “I got a C in vector calculus.”

For the University Honors College student who had breezed through Advanced Placement calculus and chemistry at Oregon’s Clackamas High School, a grade of “average” was a jarring wake-up call. “Before I got to the university,” the 2005 senior class valedictorian explains, “I never had to study very hard.”

In the three years since that rude awakening, nothing less than an A has darkened Putnam’s grade report. She has gone on to collect scholarships like most students collect songs on their iPods. The American Engineering Association Scholarship from Intel and OSU’s Presidential Scholarship are among them.

Now, Putnam has advanced from the front of the class to the front edge of innovation, where chemical engineering meets nanoscience and “drop-on-demand” printing technologies. As a research assistant for Professor Chih-hung “Alex” Chang, Putnam is fabricating a “nanostructured” electrode for a new generation of lithium ion battery. An initiative of ONAMI (Oregon Nanoscience and Microtechnologies Institute) in collaboration with Pacific Northwest National Labs (PNNL), the project’s ultimate goal is a revolutionary new battery: smaller, lighter, faster, tougher. The U.S. Army — eager to equip soldiers with more compact, lightweight, durable gear — is funding the research. And Hewlett-Packard, a leader in ink-jet design for novel applications in labs and factories, has donated a research-grade thermal printer to the effort.

The jumbled micro- and nano-materials lab in Graf Hall is Putnam’s base camp 20 hours a week. As comfortable with ultrasonicators (for breaking up particles)

and vacuum furnaces (for superheating chemicals) as other people are with video players and microwave ovens, she has found a way to synthesize lithium iron phosphate, a compound with superior properties to the nickel cobalt or lithium cobalt used in most batteries today. Now, aided by the advanced electron microscopy capability at Portland State University (for viewing nanostructures) and the HP thermal printer (for creating imperceptibly thin layers of nano-materials called “thin films”), Putnam is taking the next step toward better batteries.

With financial backing from the OSU Research Office’s Undergraduate Research Innovation Scholarship Creativity grant, she will spend the summer of 2008 making nanoporous thin-film electrodes in various shapes and thicknesses on the HP printer.

Professor Chang describes Putnam as “devoted to the field of nanotechnology.” It was, in fact, one of Chang’s ONAMI colleagues, Jun Jiao of PSU, who serendipitously led Putnam to nanoscience. During Anna’s last summer in high school, she heard about Saturday Academy’s Apprenticeship in Science and Engineering from a friend. The Portland-based program aims to pull more girls and minorities into the sciences. Putnam didn’t know it then, but her career plans were about to morph. Her summer studying the conductivity of carbon nanotubes in Jiao’s lab “changed my life,” she reports. When the internship started, she wanted to be a K-12 teacher. When it ended, she was set on becoming an engineer.

Although prestigious private college Harvey Mudd dangled a hefty scholarship, the small California college’s status as one of the nation’s premier engineering

In OSU’s micro- and nano-materials lab, Anna Putnam puts a printed layer of lithium iron phosphate precursor into a tube furnace, where it decomposes and forms nanosize gas bubbles. The result is a nanoporous material that is suitable for an electrode in small, lightweight batteries. (Photo: Karl Maasdam)



schools couldn’t compete with the broad diversity of students and opportunities available through Oregon State. One of those opportunities came along the summer after her freshman year, when she studied nanotreatments for breast cancer in the lab of PSU chemist and ONAMI researcher Scott Reed.

“I designed my own experiments making porphyrins and gold nanoparticles and quenching them together,” she explains matter-of-factly.

A star in the College of Engineering’s K-12 outreach and mentoring program, Putnam wows high school girls with her “real and vibrant” personality, showing them that it’s “OK to love math and chemistry, and that it doesn’t make you a ‘geek!’” says her first-year adviser Professor Willie “Skip” Rochefort, who actively recruited Putnam to OSU.

As for that hated C in vector calculus, that intolerable stain on Putnam’s near-perfect GPA, soon it will be only a painful memory. She is retaking the class. When she applies for graduate work at MIT or Berkeley, she intends that nothing average will blot her resume, or her prospects.

—LEE SHERMAN



No Barriers

Access to mass transit opens the world to people with disabilities

By Lee Sherman

OSU engineer Katharine Hunter-Zaworski designs mass-transit equipment that makes travel not only more accessible but also more dignified. (Photo: Jan Sonnemair)

At night when she dreams, Marlene Massey hikes the Cascades on sturdy legs. But when she gets up in the morning, a four-inch curb can stop her cold. That's because the 50-year-old Corvallis woman is in a wheelchair after losing a big chunk of her cerebellum to brain surgery 12 years ago. The damage to her coordination, balance and muscle control was massive. Massey now treks up mountain trails only in the gentle forgetfulness of REM sleep. In the harsh light of day, she risks jamming the tires of her Breezy 600 in cracked sidewalks en route to the bus stop.

"I used to backpack in the Mt. Jefferson Wilderness," she reminisces, her speech slow and effortful. "Now, it's a challenge just to cross the street."

Making it easier for people like Massey to get around is the mission of OSU's National Center for Accessible Transportation, funded by the U.S. Department of Education. Under the leadership of engineer Katharine Hunter-Zaworski, experts in biomechanics, ergonomics and mechanical engineering design equipment for mass transit systems — everything from bus lifts to boarding ramps and jetliner lavatories (see sidebar, Page 14). Basically, it's hardware. But those precision-engineered pieces of plastic and metal signify a priceless intangible: personal freedom. For people whose mobility is limited by physical, sensory or cognitive impairment, devices such as OSU's patented wheelchair "docking system" that engages automatically upon boarding can make the difference between dependence and self-reliance. Assistive gear lets people move through the world at will, come and go on their own terms, escape solitude and isolation. They can cast off the encumbrances of their disabilities to embrace the fullness of their capabilities.

Three words distill Hunter-Zaworski's vision of accessible public transportation: safe, seamless, dignified. "These words, these ideas," she says, "underlie everything we do."

Attention to Dignity

With partners such as Boeing, Amtrak, Portland International Airport, Lane Transit District and Paralyzed Veterans of America, her team is forever honing the "trip chain," the series of movements that takes you from your starting point to your destination. For a traveler to arrive with both body and dignity intact, each point along the way must be free of hazards, barriers and clumsy or awkward transfers from, say, a wheelchair into an airplane seat.

More than 30 percent of wheelchair-bound passengers report a "loss of self-respect" when traveling by air, according to a new study funded by the National Institute on Disability and Rehabilitation Research. Surveying 2,756 respondents who are members of the National Multiple Sclerosis Society, Hunter-Zaworski and her team heard certain complaints over and over: Assistive personnel are often unaware of disability characteristics, fail to ask questions about the traveler's needs and neglect to wait for instructions. Another big gripe: The helpers are not adequately concerned with the traveler's dignity. Beefing up "traveler assistance training" for airport personnel is a key element of the center's work.

On the day Massey tumbled down the stairs while getting off a city bus, her dignity suffered along with her body. Seeking to retain as much independence as possible after her rehabilitation therapy, Massey had chosen a walker over

a wheelchair. Still unsteady on her feet, she usually used the mechanical lift to get on and off the bus. But one cool, autumn morning, she was running late for her volunteer shift at the library and tried to negotiate the steps without waiting for the lift. Her balance faltered. She fell hard. The bruises she got when she hit the concrete on Monroe Avenue, one of downtown Corvallis's busiest streets, hurt less than her battered pride.

"I hated it," she says. "I hate feeling weak and vulnerable." A second fall a year later wrenched her hips and forced her into a chair for good.

Tools for Access

Stories like this are what drive Hunter-Zaworski, a professor in OSU's School of Civil and Construction Engineering. Canadian by birth, she began her career nearly three decades ago when she was the first woman to earn a mechanical engineering degree at the University of British Columbia. After getting her master's in Tennessee and then designing shoulder joints for bilateral shoulder amputees in Toronto, she returned to Vancouver as director of rehabilitation engineering at GF Strong Rehabilitation Centre. There, she teamed with "MDs, OTs and physios" (doctors, occupational therapists, and physical therapists) to design custom equipment, including ergonomic seating systems and modified sporting gear, for individual patients. For one client, she developed a mechanical bed turner — a product now on the market and popular among parents whose children have Duchenne muscular dystrophy. Another patient, a little boy suffering from spinal muscle atrophy, got his first taste of independent mobility when she devised one of the original kid-sized power wheelchairs with an add-on she called the "outboard motor." This invention, too, was modified for the mass market and is widely distributed today.

Most of Kate Hunter's clients, however, were young men with spinal cord injuries, many from diving accidents. When they died of complications from their injuries, the young engineer would suffer profound emotional pain.



Marlene Massey of Corvallis arrives at her weekly library shift via the nonprofit service, Dial-a-Bus. (Photo: Karl Maasdam)

About that time, Vancouver, B.C., was at the vanguard of the public-access movement, led in large part by two activist quadriplegics, Doug Mowat, a legislator, and Ed Desjardins, a founder of GF Strong. City officials recruited Hunter to oversee barrier-free design on their planned transit system, SkyTrain.

She had found her calling.

“I was 25, working with severely injured quadriplegics, most about my age, some on permanent respirators,” she recalls. “It was a harsh reality. On the SkyTrain project, I started to realize that instead of designing equipment for one patient at a time, I could open the world to thousands of people simultaneously by making transportation accessible to them.”

Hunter-Zaworski’s multidisciplinary team at the national center includes her husband, OSU assistant professor Joseph Zaworski, who was a consulting engineer in Corvallis when she met him in Albuquerque at a meeting of the American

Society of Mechanical Engineers. After running into him again the next year and liking his stated philosophy of life (“The purpose of life is to have fun”), she invited him to visit her in Vancouver. He gamely agreed to a hike on Cypress Mountain. What he didn’t know was that even in June, snow lingered on the wooded trails. His leather shoes were ruined. To make amends, she took him to lunch at an out-of-the-way bistro with the slyly romantic name, The Amorous Oyster. Their engagement followed within months.

After they married, she joined him in Corvallis to work on her Ph.D. Several years later, Hunter-Zaworski could be seen pushing a two-seat baby stroller along the spruce-shaded sidewalks and linoleum-floored corridors on campus. In fact, the couple’s twins played a role in their mom’s volunteer project for Oregon State, an assessment of accessibility of the university’s buildings.

“My twin stroller was the same width as an adult wheelchair,” she explains. “If the stroller didn’t fit through the door to a building, I couldn’t get to class — and neither could a person in a wheelchair.”

Inclusive Design

Since then, she has relentlessly pushed the principle of “universal inclusive design.” Sitting at her desk in Owen Hall, she points to one convenient example: the lever-style handle on her office door. “That type of door handle is a universal design,” she says. “Not only is a lever easier to use than a knob for people with physical impairments, it’s also easier for anyone who has their hands full.”

Noting that the automatic garage-door opener every American takes for granted was originally an assistive device for a quadriplegic, and that the “curb cuts” built for wheelchairs are also handy for rolling suitcases and baby strollers, Hunter-Zaworski explains that the advantages of easier access do not accrue only to the 50 million Americans with disabilities, but rather to the whole community: the elderly and the obese, parents towing toddlers, patients recovering from surgeries, athletes suffering from sprains or breaks, shoppers lugging bags, travelers dragging luggage. “Everybody benefits,” Hunter-Zaworski says.

The next generation of assistive devices is already on the drawing board at OSU. Among them are rear-facing wheelchair restraints, real-time speech translation, ergonomic seat cushions and age-in-place technologies for boomers heading for retirement. “No-lift” transfer technologies will be big, too, bolstered by a finding of the April 2008 survey showing a strong preference for mechanical assistance over human assistance when moving from a wheelchair to an airplane seat.

“Some of the battles I’ve fought for accessibility have been hard,” she says, looking down at the metal band encircling her little finger. “But I wear the iron ring. In Canada, this ring signifies a professional engineer’s responsibility to protect public safety. I take that responsibility very seriously.” **terra**

AIRSPACE

The Dreamliner’s roomy new lavatory

“Hi, I’m Kate Hunter-Zaworski, Ph.D., P.E. and P.Q.,” the OSU professor quips at an OSU faculty club luncheon. She pauses for effect. You can sense the wheels turning in diners’ minds: doctor of philosophy, professional engineer, but P.Q.?

Having properly piqued her audience’s curiosity, she pops the answer. “P.Q. stands for ‘potty queen’.”

After the snickers subside, she explains earning this ignominious title by engineering accessible toilets for aircraft. Her impressive rest-room resume includes membership on the U.S. Department of Transportation’s federal advisory committee studying access on single-aisle airplanes.

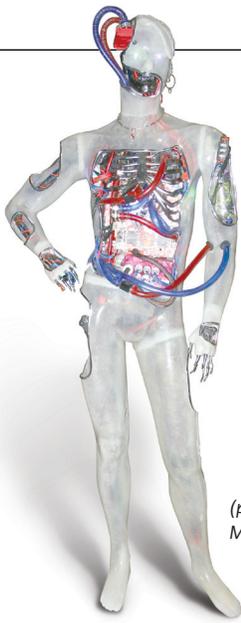
The lavatory for Boeing’s new 787 Dreamliner is the jewel in her P.Q. crown. In a press release highlighting the jet’s “improved access features,” Boeing boasts of the lav’s easy-to-grip door handles; “touchless” faucets, flushers, and waste flaps; repositioned doorways; extra usable space; and fold-down assist bars.

“The real estate on aircraft is extremely expensive, so we’re designing in millimeters,” she says. “The underlying principle — that you can’t get rid of seats because each seat generates revenue for the airline — means that every quarter-inch on a jet is critical.”



Millimeters matter in the wheelchair-accessible lavatory designed by Kate Hunter-Zaworski and her team for the new Boeing 787 Dreamliner. (Photo courtesy of Boeing)

Learn more about OSU’s National Center for Accessible Transportation at ncat.oregonstate.edu



(photo: CPU Magazine)

Wired Fantasies

There's a cyber-equivalent of souping up your car inside and out: "modding." It's part of the DIY ("do it yourself") computer culture. Instead of gutting and customizing your ride, you're modifying your PC.

Modder Richard Surroz sees himself as a kind of PC Picasso, or perhaps a Rodin. "I can't paint, I can't sculpt, but I can build computers," says the OSU College of Business grad student. "It's a piece of art that's functional."

In his Salem, Oregon, workshop, Surroz has crafted a computer case that is about as far from the usual beige, plastic box as you can get. Yards of wire and tubing snaking through an acrylic dummy have transformed the store-display mannequin into a glowing, flashing, humming, life-size humanoid machine. The "brains" of the PC, the hard drive, light up inside the transparent mannequin's head. Liquid-cooled refrigeration "overclocks" the \$300 processor, making it run as fast as a \$1,000 model. The dummy even wears tribal-style jewelry.

Surroz's creation, which he calls "Autopsy," cost him three months, a few thousand bucks, a badly burned hand, a demolished motherboard and a whole bunch of busted Dremel blades. But it was

worth the investment. "Autopsy" blazed onto the international scene when it took first-place in *CPU Magazine's* 2007 case-mod contest. A cover story in *CPU* earned Surroz \$12,000 in cutting-edge hardware products from Intel, NVIDIA, Danger Den, ATI, Smooth Creations and Mountain Mods.

The entrepreneur wasted no time in turning his notoriety into a business opportunity. His newly formed LLC, *outofthebox-mods.com*, will specialize in custom mods for corporations. Surroz credits his OSU business degree, with a management of information systems option, with "igniting my passion for hardware." Now taking advanced information systems courses, he hopes to join a corporate team in new-product development after completing his MBA.

His next mod? A "warrior chick" computer with a custom latex outfit. It's enough to make you nostalgic for struts, lift kits and racing stripes.

— LEE SHERMAN

Sustainable Supply Chains

Recycling spurs innovation

Recycling isn't just for consumers. Manufacturers are finding competitive advantages in what is known as "end-of-life product management," says OSU business professor Zhaohui Wu. While dealing with old desktop computers and other high-tech cast-offs can be expensive, innovative companies are redesigning their products — and their supply chains — in response to "take-back" laws cropping up from the Pacific Rim to the European Union.

That's one of the conclusions from a research team composed of Wu, Mark Pagell (former OSU professor now at York University) and Nagesh N. Murthy of the University of Oregon.

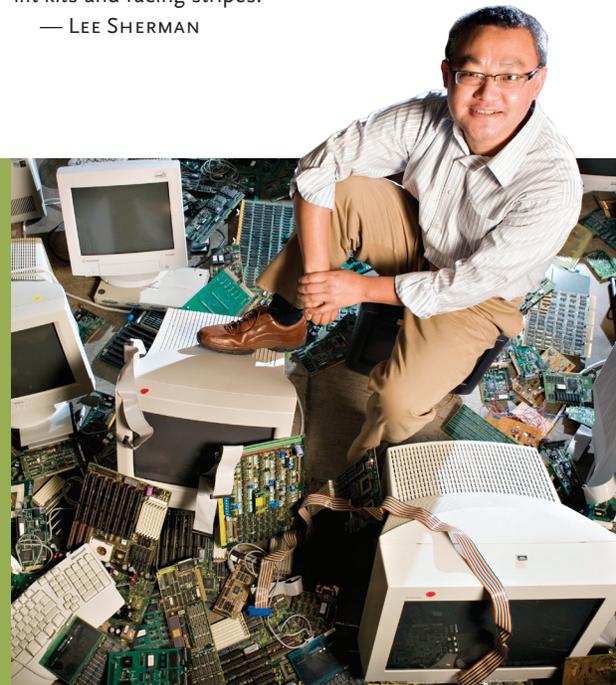
Wu specializes in business sustainability and supply chain management. In collaboration with the Green Electronics Council in Portland, Oregon, and the Chinese State Environmental Agency, he is studying e-waste policies at companies in

the United States and China. He focuses on how recycling processes affect resource efficiency and supply-chain relationships.

Markets and supply chain designs dictate which recycling options are best, Wu and his colleagues note in a paper published in the journal *Business Horizons* in 2007. But the biggest gains come from redesigning products and processes to increase efficiency and to leverage the public's desire for sustainability.

From California to the EU, manufacturers are increasingly required to take responsibility for their own products. Oregon's e-waste collection system covers computers, monitors and televisions and is due to be operating by January 2009. Companies can run their own collection programs or participate in a state-run system. Either way, they will pay.

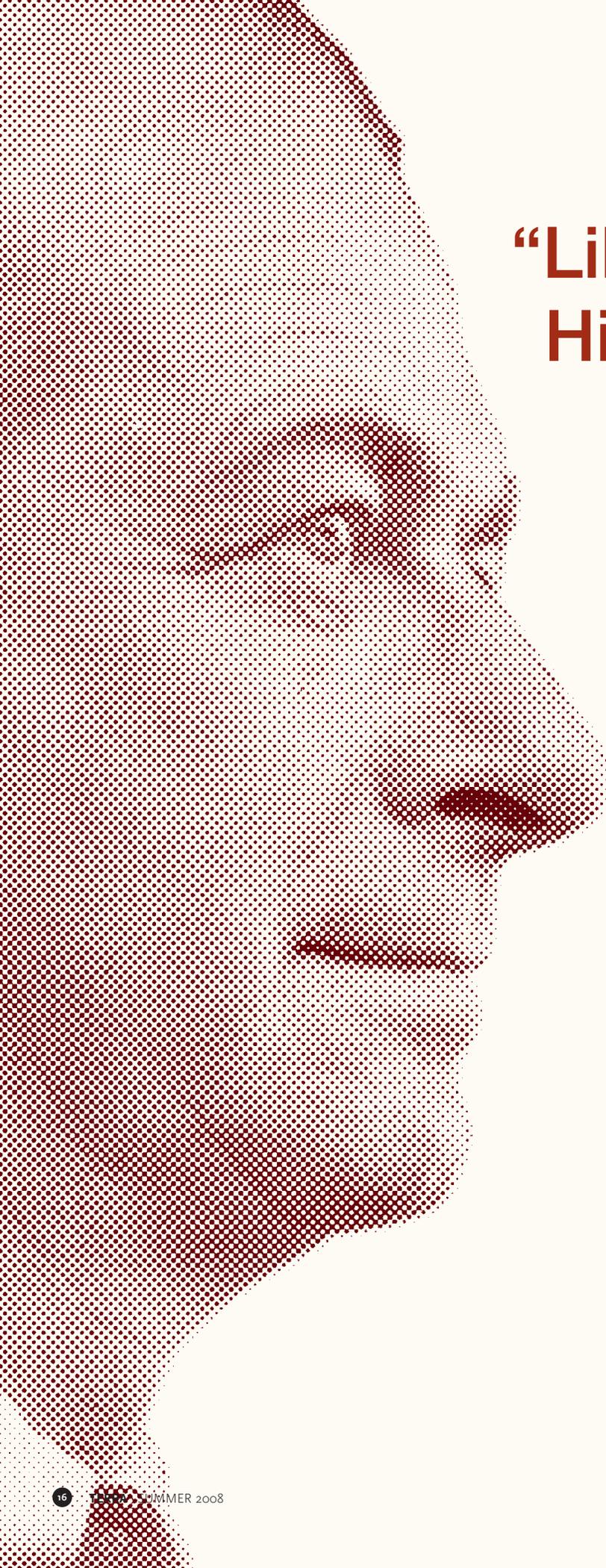
Recycling companies usually recover raw materials through a crush and separate



(Photo: Karl Maasdam)

process or disassemble products and sell components (computer chips, spare parts) back into the supply chain, says Wu. "Some original manufacturers choose to collect and recycle used electronics products on their own. This helps them to improve product design for more efficient recycling and even secure production materials when raw material becomes scarce."

— NICK HOUTMAN



“Like Looking Over His Shoulder”

Scholars pore over Pauling Papers for insights into a genius and his times

By Lee Sherman

When OSU librarian Cliff Mead leads you into the collected life history of one of America’s greatest minds, you step into the vortex of the last century. The Valley Library, where the papers of Linus Pauling reside, opens up a first-person portal into the most transformative events of the 1900s, an intimate avenue into 20th-century headline news. That’s because the Oregon scientist who was lauded for discovering the nature of the chemical bond — and then lauded again for tirelessly fighting nuclear proliferation — lived at the very nexus of scientific and social change.

The 500,000 items catalogued in the Ava Helen and Linus Pauling Papers — diaries and telegrams, photos and lab notes, correspondence from world leaders, hand-built molecular models, grainy home movies, tender love letters, solid-gold Nobel Prize medallions — document events both monumental and humble. Evidence of stunning scientific achievement and wrenching political controversy is preserved alongside mementos of a loving marriage and minutiae of an academic life. FBI files from the ‘50s Red Scare and original records of the Emergency Committee of Atomic Scientists share space with adolescent doodles and boxes of bank statements.

These objects and records are the raw materials of history.

“It’s a microcosm of 20th-century science, history, politics and culture,” says Mead, director of Special Collections and curator of the Pauling Papers since 1986, when the first batch arrived at OSU via Mayflower Van Lines tractor-trailer. “The four decades of the ‘20s through the ‘50s is considered the golden age of 20th-century science. Pauling was right in the middle of it. He knew everybody of import, everybody knew him.”

Pauling’s thinking was never cramped by traditional disciplinary boundaries. His investigations can be likened, not to a line drawn on a page, but to a drop of ink suffusing outward on the currents of curiosity and the tides of creativity. He saved everything, wrote everything down. “His notes are so clear, so legible,” says Paul Farber, chair of OSU’s Department of History. “It’s like looking over his shoulder in the lab.”

MILESTONES IN A NOBEL LIFE

The result is an information mother lode for scholars, particularly science historians.

“We’ve identified 23 disparate areas in which Pauling had a major hand: chemistry, biology, molecular biology, physics, orthomolecular medicine, peace studies and subsets of all these major areas,” says Mead. “The collection is a great point from which scholars can diverge in all sorts of directions.”

Researchers from as far away as southern China and as nearby as OSU’s Milam Hall mine this rich vein of primary sources. When scholars visit the collection in person, they are welcomed with open arms, by all accounts. Unlike some library collections, where researchers are made to feel like intruders, Mead and his staff at the Valley Library are very friendly, according to several frequent users. “Some archives take an overly protective view toward their holdings,” says Pauling biographer Thomas Hager,

The large colorful, “space-filling” molecular constructions, representing what Nye calls the “architecture of matter,” became a Pauling trademark.

whose work as a science historian has taken him to archives throughout the United States and Europe. “They can throw a lot of roadblocks in your way. Their attitude seems to be to make it as difficult as possible to get into those holdings.”

Those who can’t make the trip to Corvallis can access huge chunks of the collection on the Web, where engaging narratives of the Pauling story are enhanced by thousands of scanned documents, photos, videos and audioclips.

Recent patrons requesting information have hailed from:

- LaSapienza University, Rome (researching the Cuban Missile Crisis)
- University of Berne, Switzerland (seeking materials on the Second International Congress of Pure and Applied Science)
- Belgian Museum for Radiology, Brussels (inquiring about Pauling’s research notebook entries with Charles Coryell on the magnetization of hemoglobin and oxyhemoglobin)
- Sharif University of Technology, Iran (looking for imagery of the amino acid sequence of hemoglobin)
- Shenzhen, China (gathering information for a book, published under the title *Pauling and His Vitamin Crusade*)
- TV2 Denmark (requesting vitamin C clips for Danish news)



1901
Born in Portland, Oregon

1922
Graduates from Oregon Agricultural College

1925
Receives Ph.D. in chemistry from Caltech

1932
Meets Albert Einstein, who attends Pauling’s seminar on quantum mechanics of chemical bond

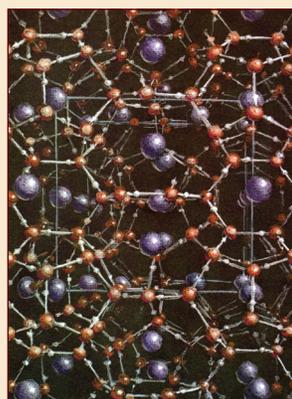
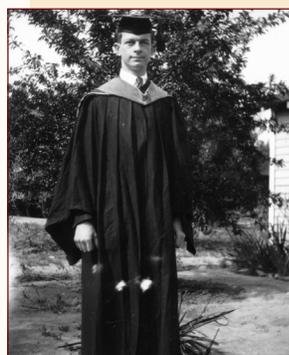
1939
Publishes *The Nature of the Chemical Bond*, which becomes “most cited book in scientific literature”

1946
At Einstein’s request, helps form Emergency Committee of Atomic Scientists

1954
Awarded Nobel Prize in Chemistry, presented by King Gustav Adolph VI of Sweden

1958
Presents 9,000-signature petition to halt nuclear testing to Dag Hammarskjöld at UN

Debates head of Atomic Energy Commission on Edward R. Murrow’s *See It Now*



1960

Appears before senate subcommittee on internal security; refuses to name fellow petition circulators

1961

Appears on *Time* magazine cover with “Men of the Year”

1962

Visits White House to protest nuclear testing and dine with JFK

1963

Awarded Nobel Peace Prize for 1962 in Norway

1970

Publishes *Vitamin C and the Common Cold*, a best seller

1973

Appointed director of Laboratory of Orthomolecular Medicine, which is renamed the Linus Pauling Institute of Science and Medicine in 1974

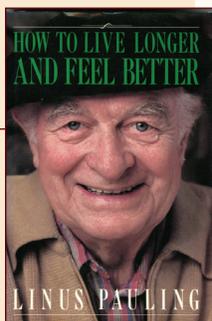
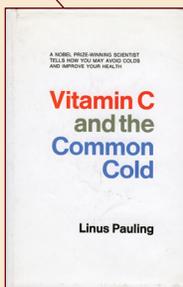
1986

Publishes *How to Live Longer and Feel Better*, a *New York Times* best-seller

Announces gift to OSU of all his papers

1994

Dies at Big Sur, California



Students, too, use the Pauling papers. Undergraduates in the University Honors College chemistry sequence, for instance, write term papers based on primary-source research in the collection. Ph.D. students, too, come from far and wide. OSU science historian Mary Jo Nye served on committees for two recent doctoral candidates in quantum chemistry — one from Harvard, the other from the University of Toronto — who used the collection for their dissertations.

Scholars uncover things both momentous and mundane, from grand achievements to psychological nuances. The range mirrors the scope of the collection itself. Pauling's sweeping innovations in chemistry textbooks and molecular modeling, for instance, stand in contrast to the psychological subtleties of demeanor and body language apparent during a friendly game of baseball with his colleagues at Caltech.

Magician of Molecules

“Pauling revolutionized the writing of chemistry textbooks by beginning with atomic and molecular theory,” says Nye, who used the Pauling papers to research a chapter for a 2000 book titled *Communicating Chemistry: Textbooks and Their Audiences, 1789 - 1939*. “He completely changed the format of undergraduate chemistry instruction.”

In addition to studying the various editions of Pauling's classic textbook *General Chemistry: An Introduction to Descriptive Chemistry and Modern Chemical Theory*, Nye burrowed into hand-scrawled notes, correspondence with publishers, comments from reviewers and letters to and from illustrators. “I was trying to understand what motivated him,” says Nye, who holds the Horning Chair in the Humanities.

Organized around the idea that “up-to-date theory” and “concrete imagery of atoms and molecules” are better starting points for chemistry students than the history of chemical discovery — the old-school approach — Pauling's textbook became an instant hit, Nye says. “Pauling introduced students immediately to definitions and pictures of atoms, molecules and crystals,” she writes. “Images abounded.”

FACULTY PROFILE

Clifford Mead is head of Special Collections at the Valley Library, a position he has held since 1986, when the Ava Helen and Linus Pauling papers first came to OSU. Previously, he served as rare books librarian in charge of special collections and also as acting director at Mason Library, Keene State College, New Hampshire. He has authored several publications, including *Thomas Pynchon: A Bibliography of Primary and Secondary Sources* (1989). He has co-edited *The Pauling Symposium: A Discourse on the Art of Biography* (1996) and *Linus Pauling: Scientist and Peacemaker* (2001). His most recent book, co-edited with Chris Petersen, is *The Pauling Catalogue: Ava Helen and Linus Pauling Papers at Oregon State University* (2006).



When *General Chemistry* was first published in 1947, the imagery that so greatly distinguished it had already morphed from two-dimensional drawings and illustrations to 3-D models in his lab. The large, colorful molecular “space-filling” constructions, representing what Nye calls the “architecture of matter,” became a Pauling trademark. Usually made of plastic balls (standing for atoms) linked by wooden sticks (standing for bonds), they “superficially resembled the toys of preschool children,” James Watson of DNA fame once remarked.

After analyzing Pauling’s passion for hand-built structural representations of molecules such as protein, penicillin, insulin, benzene, ethylene, Nye concluded in another book chapter: “These new tools resulted in important experimental and theoretical discoveries, in new methods of pedagogy, and in a revolutionized positive image of the chemist as a magician of molecules” (*Tools and Modes of Representation in the Laboratory Sciences*, 2001).

For researchers who want to get beyond science into Pauling’s persona, the collection provides plenty of clues. Biographer Hager spent years scouring the library’s holdings in search of the essential Linus. One day he came across home movies from the ‘30s. A grainy film clip captured a young Pauling playing baseball with the Caltech chemistry department — a lighthearted, unrehearsed moment that revealed an appealing personality brimming with confidence, ambition and competitiveness. “It illuminated the kind of person he was at that time in his life in a way that a written document simply could not do,” says Hager, author of *Force of Nature: The Life of Linus Pauling*.

Archival Gumshoe

When questioned about being the sort of person whose pulse quickens with anticipation as he rummages in the dustbin of history, Hager grins sheepishly. “It’s a strange personality quirk,” the Eugene, Oregon, writer confesses. “It’s like detective work. That’s the part of it that excites me. Much of history remains undiscovered, and much of that undiscovered history resides in archives. So you never know what you’re going to find, and you never know how significant it’s going to be. It’s the thrill of the hunt.”

Hunting among the Pauling Papers is, from all accounts, very, very good.

“The Pauling collection is one of the most extensive and significant single-scientist collections in the world,” says Hager. “It is extraordinary.” **terra**

On the Web Hear Linus Pauling in his own words and explore his landmark discoveries at osulibrary.oregonstate.edu/specialcollections/coll/pauling

“Dear Dr. Pauling”

The correspondence of a century

Curator Cliff Mead will let you hold the satin shoes Ava Helen wore in 1923 when she wed Linus. He’ll also show you an ordinary-looking navy-blue sport coat made extraordinary by its one-time wearer. “Linus Pauling’s DNA,” Mead says, “is on this jacket.”

The genetic traces of an entire era are, both literally and figuratively, all over the collection, observes author Thomas Hager, whose most recent book is *The Demon Under the Microscope*. Historic forensics are especially evident in the correspondence, which comprises about two-thirds of the holdings. Meticulously filed in towering cabinets of gunmetal grey are personal letters from every U.S. president since Harry Truman, from senators, congressmen and world leaders, from movie stars, novelists, philosophers and musicians. With great care, Mead will take out letter after letter, typed or handwritten, bearing the salutation, “Dear Dr. Pauling” or, now and then, “My dear Pauling.” There are letters penned by Ho Chi Minh and Marlon Brando, Jawaharlal Nehru and Frank Sinatra, Eleanor Roosevelt and Lena Horne. Signatures of such luminaries as Robert F. Kennedy, Martin Luther King Jr., Henry Kissinger and Nikita Khrushchev are sandwiched in 385 archival-quality boxes protected by massive steel shelving units.

Along with letters from the century’s most prominent scientists — giants like Einstein, Oppenheimer, Watson and Crick — are notes from its most exalted humanitarians, Albert Schweitzer among them. With the lofty coexists the quirky. Letters from Jack Keavorkian, the notorious “Dr. Death,” are one example. In the collection’s files are exchanges with:

- Odd Hassel, Norwegian physical chemist and Nobel laureate
- Carleton Gajdusek, American physician, researcher and Nobel laureate
- The Institute for Optimum Nutrition and the Institute for Orthomolecular Medicine
- William Astbury, English physicist and molecular biologist

It seems fitting, given the extent of Pauling’s correspondence, that the U.S. Postal Service should honor him with a stamp, as it did in March when it rolled out its “American Scientists” commemorative series. The stamp celebrates his discovery of the molecular nature of sickle cell anemia.

Out of the Depths

Voracious “red devil” squid
are on the move

by Mark Floyd

It was like
a scene from a
grade-B horror film.
On a gently rocking vessel
in the warm waters of the Sea
of Cortez, a young oceanographer
earnestly watches her computer screen
while colleagues lower a cable into the water.

Instruments aboard the ship, the Pacific Storm, ping sound waves toward the cable. The oceanographer's eyes flicker across the screen to make sure the signal is clear. Tethered to the cable is a 5-pound Humboldt squid, and the sound waves, set at 38 kilohertz, bounce off the squid. An image shows up on the screen.

The oceanographer raises her fist in triumph. It marks the first time scientists had clearly picked up a strong sonar signal for squid, which lack the bones and swim bladders that give away other marine creatures.

Suddenly a second image appears, darting up from below. The acoustic signal tracks it from the depths toward the cable — and the tethered squid. It is another squid, larger than the first, and it attacks the tethered animal. The oceanographer screams.

Fade to black.

Seeing with Sound

“Actually, I think I swore instead of screamed,” says Kelly Benoit-Bird cheerfully. “We were watching it in ‘real time,’ and it was like a scene from a scary movie. But in this case, the science is real.”

In April, Benoit-Bird, an assistant professor in Oregon State University's College of Oceanic and Atmospheric Sciences, published a paper in the journal *Acoustical Society of America* on her success, and she received 19 e-mails from colleagues the first day the article appeared. “I've never had such a response before,” she says.

The reasons for the excitement are two-fold. On one hand, the ability to track squid with sonar may reveal new details about how ocean ecosystems work. Squid are thought to be a primary food source for sperm whales, but

ecologists have never been sure how the whales hunt. A study just five years ago concluded that whales couldn't use echolocation to target squid because signals wouldn't reflect off the squids' soft bodies. Now researchers will need to re-examine the capacity of whales, dolphins, porpoises and other marine creatures to use their own sonar.

Benoit-Bird's research is also important, however, because it gives scientists a new way to look at an important link in the marine food chain. Squid may not have been properly appreciated, but their impact is becoming apparent. The Humboldt squid appears to be expanding its territory, moving from the Pacific Ocean off Mexico and California into the colder waters near Oregon.

And that is causing some concern.

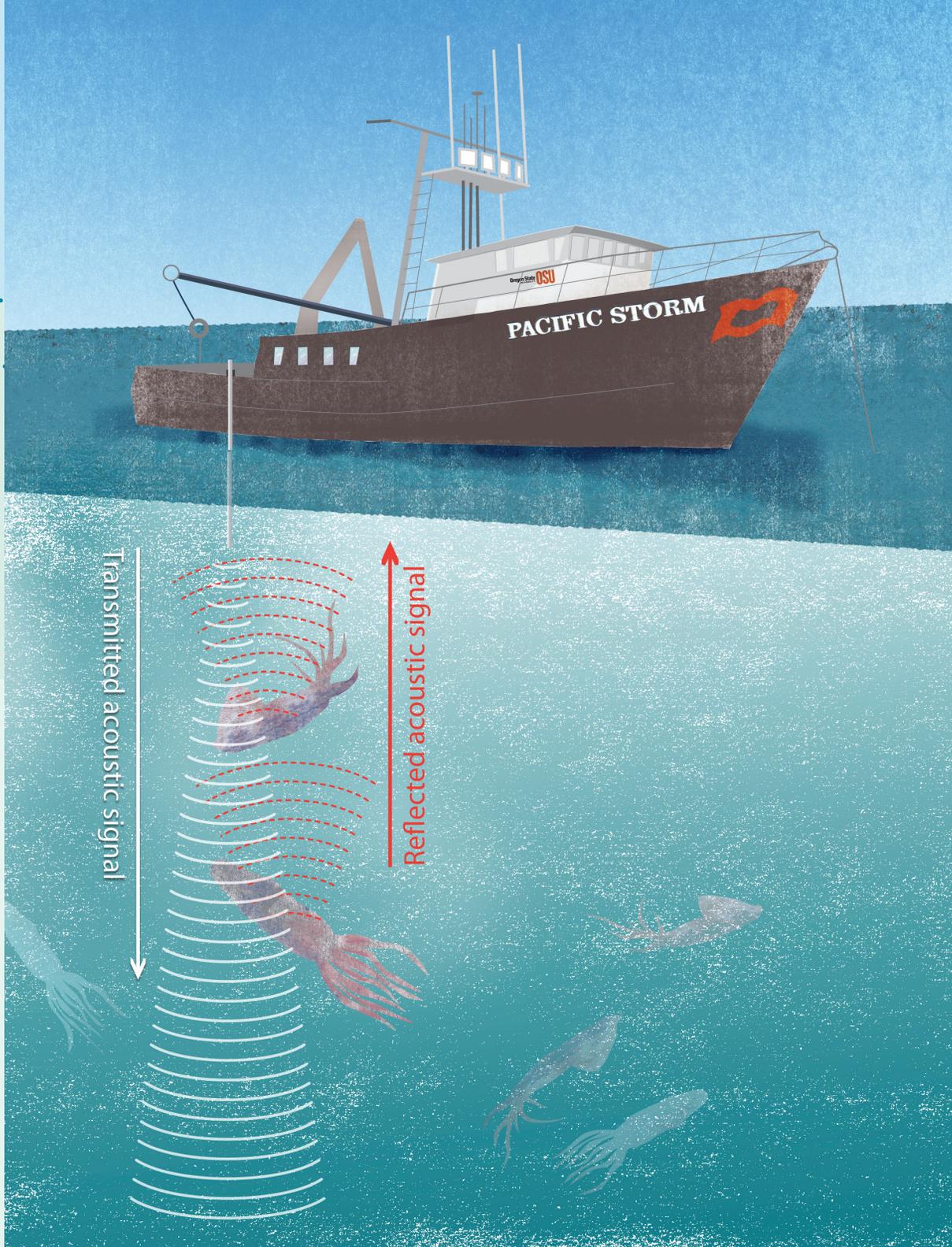
“The Humboldt squid is a voracious predator that will eat anything it can get its tentacles on,” Benoit-Bird says. “We put a pair of 10-pound squid into a tank and one immediately beheaded the other. These are fierce little beasts.”

Mexican fishermen have a name for the Humboldt squid: *diablos rojos*, or red devils. Known for their for their strength and razor-sharp beaks, these animals flash red and white at the end of a fishing line. They can get as large as six feet in length and weigh up to 100 pounds, though adults more typically weigh 20 to 40 pounds. They travel in schools of up to 1,000 squid and will eat any fish in sight.

In the Sea of Cortez, the Humboldt squid target lanternfish but are opportunistic feeders. They are highly energetic and require a lot of food to maintain their metabolic rate. Their move into northern California, Oregon and Washington — at a time when salmon stocks are depressed — is a concern to scientists like Benoit-Bird, who studies ecological interactions among marine species.

“Typically, when a species moves into a new area, it adapts,” she said. “If they can't find the lanternfish they ate in the Sea of Cortez, they may look at juvenile salmon, as well as herring, sardines and other species that salmon may eat.

“Then there is the flip side of the equation,” Benoit-Bird points out. “What will target the Humboldt squid as prey? In Mexico, it is the sperm whale, but they are uncommon off Oregon. Most of our whales are baleen whales, and



Kelly Benoit-Bird and her team found that the strength of acoustic echoes from Humboldt squid depends on the length of the mantle, an external hood covering the animal's vital organs. The voracious predators prey on lanternfish — and each other. (Illustration: Mary Susan Weldon)

these squid will be too big for them. Perhaps orcas, perhaps sharks...or they may have free rein.”

Next to sperm whales, the primary predators for the Humboldt squid in Mexico are coastal villagers who row their wooden boats offshore at night, when the red devils are closer to the surface. Fishermen catch squid by the hundreds and sell them for food. It doesn't appear that over-fishing is a problem. *National Geographic* recently

reported that some 10 million squid might be living in a 25-square-mile area off the city of Santa Rosalia.

Reliable estimates have been hard to achieve and are historically based on catch rates. With the new acoustic advancement made by Benoit-Bird and colleagues, scientists now have a tool to better monitor the squids' range and habits.

Density Matters

Scientific advancements are rarely easy, and this one was no exception. In 2006, Bruce Mate, director of OSU's Marine Mammal Institute, was taking the Pacific Storm to the Sea of Cortez to study sperm whales and invited Benoit-Bird along to look at its prey, the Humboldt squid. She assembled funding from a variety of sources to pay for the necessary technicians and instruments.

The Pacific Storm is a former fishing vessel, donated to OSU for use by the Marine Mammal Institute and retrofitted for research. Once they were in the Sea of Cortez, Benoit-Bird and her colleagues had to catch squid and dissect them, carefully measuring each body part and experimenting with different sound frequencies to see what signals might work.

"You need a density difference to get back scatter," Benoit-Bird says, "and squid are difficult because they have no hard parts. Eventually, we used multiple frequencies and were able to pick up a clear signal, probably from the brain case, but perhaps from the teeth on the suckers along their arms."

Through days of experiments, the researchers were able to calibrate the signal to pinpoint individual squid and even estimate their size. They were able to observe a squid group, how individuals moved in the water and when they rose from the depths to feed. Using this technology, Benoit-Bird says, scientists should be able to transect a fishing ground and get a better estimate of the squid population.

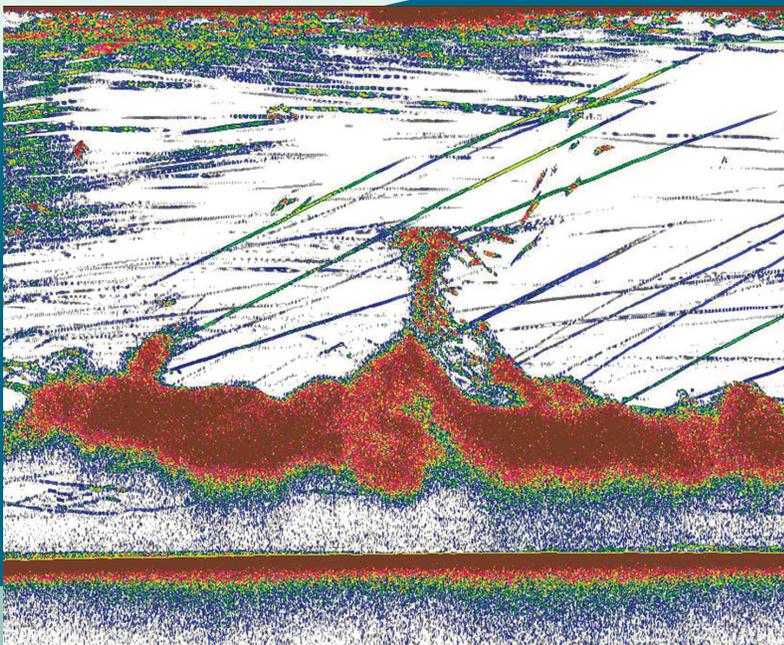
She also hopes to go back through 20 years of hake surveys from the National Marine Fishery Services and recalibrate their acoustic signal to look for evidence of squid.

"We don't know why Humboldt squid are moving north up the coast," Benoit-Bird adds, "but now we have a better chance of studying their movements and impact on the environment." **terra**

Editor's note: This story also appears on LiveScience.com *Behind the Scenes* in collaboration with the National Science Foundation. See more about Kelly Benoit-Bird's research at oregonstate.edu/~benoitbk

RESEARCHER PROFILE

An assistant professor in the College of Oceanic and Atmospheric Sciences, Kelly Benoit-Bird uses optical and acoustic methods to study interactions between plankton, fish and marine mammals. She collaborates with researchers at OSU, the University of Hawaii, Rutgers and other universities and with federal agencies and businesses to develop new technologies and to understand ecological processes. She has received funding from the National Science Foundation, the Office of Naval Research, the National Oceanographic Partnership Program and the National Oceanic and Atmospheric Administration.



This echogram, or time-depth plot of echo strength, shows how acoustics can reveal the behavior of squid. The panel shows a large school of squid as an intense red mass around 50 meters deep. Individual squid, indicated by the upward streaks, are leaving the school and swimming up to the surface. Researchers could see these squid from the boat, but it took acoustics to reveal the massive school below them. (Echogram courtesy of Kelly Benoit-Bird)

Birth Mothers

Anthropologist leads study with Oregon midwives

“Would you like to help us listen to the baby?” Melissa Cheyney asks 8-year-old Isaiah. “OK, push that button!”

As Isaiah carefully holds an ultrasound device against the pregnant belly of his mother, Amanda Wise, ocean-like sounds fill the bright, freshly painted living room. The eyes of Isaiah and his younger sisters and brother widen, as their father Jesse and Amanda exchange smiles.

“Lots of moving in there, huh?” laughs Cheyney, a certified midwife. “It won’t be long before you get to see your baby!”

The Wise family is among the 1 to 2 percent of Americans who make the choice to give birth at home. This would be the 367th homebirth that Cheyney has attended and one with significance for maternal health policy in Oregon and beyond. It is part of a statewide study led by Cheyney to document the impact of midwives in a health-care system that overwhelmingly favors giving birth in hospitals.

“Among the most wealthy countries, the United States now ranks 31st in infant mortality. The vast majority of our nation’s births are in hospitals, and about one-third of those are by Caesarean section. The World Health Organization recommends no more than 10 to 15 percent, so our rate is two to three times higher than what is considered safe. And yet, society maintains the myth that births *at home* are risky,” says Cheyney.

As an Oregon State University anthropologist, Cheyney takes a participatory approach to her work. “My active practice is an immersion. Every client interview, every birth I attend, I am conducting primary research: witnessing, listening. It continues to add to my understanding of the enormous range of normal in human birth.”

Cheyney accepts 10 to 20 clients a year in her midwifery practice. At each prenatal visit, she conducts examinations and provides information about birthing options, offering guidance as families make their own choices. She is certified in neonatal resuscitation and is able to administer anti-hemorrhagics and other medications that help to make childbirth safer.

Her goal is to inform medical educators and to support consumer protection and choice. She and her co-researchers in the Oregon Midwives Study will identify how midwifery education and licensure may be modified to optimize safe, affordable and high-quality services.

“The Oregon Midwives Study is part of a larger, nationwide prospective study, and we are already compiling an enormous database of sound scientific data,” she says. “We are looking at over 100 variables for each birth and will have a sample size of close to 20,000 deliveries by the end of this data collection cycle.”

Cheyney has consulted with policy-makers in Indiana, Idaho and Oregon as they deliberate on issues of legalization and licensure for midwives. In Oregon she has testified at hearings held by the Oregon Health Licensing Agency on changing licensure from voluntary to mandatory.

As the political process winds on, the pregnancies at the heart of Cheyney’s work come to term at their own pace. On May 29, Amanda Wise gave birth to Evan Judah (9 lbs., 10 oz.) without complications in a waterbirth tub, a specially designed warm-water pool. He was the first of the five Wise children born at home.

— JANA ZVIBLEMAN



For Melissa Cheyney (left), data collection begins with a home visit, this one with Amanda Wise and three of her four children. (Photo: Karl Maasdam)

RESEARCHER PROFILE

An assistant professor in the OSU Department of Anthropology, **Melissa Cheyney** focuses on the politics, culture and biology of human reproduction. She has studied homebirths among the Amish in the Midwest, Bedouin tribes in Jordan and Mexican families in Juarez. She is a Certified Professional Midwife (through the North American Registry of Midwives) and director of the Reproductive Health Lab at OSU. With funding from the Foundation for the Advancement of Midwifery and the Center for the Study of Women in Society, she is the primary investigator on the Oregon Midwives Study.



(Illustration: Santiago Uceda)

Call to Order

Science on the agenda

Problem solver and data provider. Advocate, explorer and teacher. Scientists play these and other roles in the often contentious environmental policy process, but not everyone agrees on which role is most important or even proper. And many scientists shy away from policy arenas where they can see their efforts to understand complex systems reduced to sound bites or buried when results conflict with politics.

When it comes to those who want scientists to take an active role in policy, members of special-interest groups (timber, mining, ranching, conservation and environmental nonprofits) and the general public stand out in a recent national survey by two OSU researchers. In a project funded by the National Science Foundation, political scientist Brent Steel and sociologist Denise Lach found that special interests and the public — more than scientists and professional natural-resource managers — regard science as a standard of truth and want researchers involved in policy development.

Lach and Steel also found differences within each group. For example, self-identified conservatives tend more than liberals to be skeptical of the objectivity of science and to prefer that scientists not offer policy advice. Younger respondents and women

are more supportive than older people and men of scientists' taking an active role in policy-making.

For their part, natural-resource managers tend to want scientists to provide clear information and analysis without complicating their conclusions with uncertainty. "Managers at all levels don't like scientific uncertainty," says Steel. Statements about probability and uncertainty "drive the managers nuts."

Science has long been considered an essential ingredient in setting policy. In 1863, President Abraham Lincoln signed legislation creating the National Academy of Sciences, whose mission is to "advise the federal government on scientific and technical matters." Today, reliance on the "best possible science" is a benchmark for decision-making under federal environmental laws such as the Endangered Species Act. Nevertheless, this traditional approach calls for scientists to provide information and then to back out of policy development, leaving decisions to others.

In recent years however, attitudes toward both the objectivity of science and its proper role in policy have shifted, Steel and Lach note in their study. So they explored definitions of science and the policy-making preferences that stem

Special interests and the public regard science as a standard of truth and want researchers involved in policy development.

from how respondents view the scientific enterprise.

Scientists themselves see their profession as partly subjective. Few researchers today, they write, completely accept the idea that science produces "a logically ordered, objective reality that we can understand once and for all, even with the most powerful resources of contemporary scientific research."

Nevertheless, scientists such as Jane Lubchenco, OSU professor and former president of the American Association for the Advancement of Science, have suggested that researchers should be directly involved in environmental decision-making. Driven by the urgency of achieving ecological, economical and socially equitable policies, they argue for better integration of science in the meetings, hearings and other venues where policies are hammered out.

The survey by Lach and Steel also found support for public and special-interest participation in the process of doing science. "It's not just top down," says Steel. "The literature suggests this is the way to go, ground-based, community-based science. And there's a lot of support for this from a variety of policy actors."

— NICK HOUTMAN



The new covered arena at the OSU College of Veterinary Medicine will enable Stacy Semevolos and other OSU veterinarians to diagnose horse injuries under a greater variety of conditions. (Photo: Karl Maasdam)

Horse Power

New facilities strengthen treatment options

When a horse develops an infection, its owners usually turn to a rural veterinarian. But when lameness strikes an Oregon Appaloosa or quarterhorse, rural vets increasingly refer their patients to OSU's College of Veterinary Medicine for treatment.

And with good reason. A team of highly qualified surgeons, working in facilities that just underwent a \$12 million expansion, is providing Oregon's large-animal industries and independent owners with some of the best care available anywhere.

Among the new diagnostic and animal-care resources available are a "64-slice" CT scanner, a covered arena for evaluation and isolation units for cattle and horses suspected of carrying contagious diseases. The Wayne and Gladys Valley Foundation of Oakland, California, laid the groundwork for the expansion with a \$5 million gift. This is the most recent capital improvement project to be completed during the The Campaign for OSU, which has a goal of raising \$625 million to support students, faculty, programs and facilities.

By summer's end, a new equine treadmill will let large-animal specialists like Stacy Semevolos test animals in motion. "The treadmill will be extraordinarily helpful to clinicians and researchers because animals may show signs of lameness or restricted breathing at performance speeds that they don't while standing still," says Semevolos, an assistant professor and large-animal surgeon in the college.

According to a 1998 estimate, treating lameness cost horse owners between \$678 million and \$1 billion annually. Expenses are

much higher now, adds Semevolos. She and her colleagues perform about 300 surgeries a year on large animals. Most of the patients are horses, but the surgeons also use their skills on llamas, alpaca, cattle, goats and even the occasional pot-bellied pig. OSU veterinary students benefit from training with the latest techniques for detecting and treating lameness.

The new facilities are not only a boon to large-animal treatment; more laboratory space and sophisticated instrumentation have increased the research potential for the college. With funding support from the American Quarter Horse Association, the Willamette Valley Llama Foundation and the College of Veterinary Medicine, Semevolos studies muscular-skeletal issues in horses and llamas, particularly equine osteochondrosis, a developmental condition that affects the joints. She is looking at equine gene expression in hopes of finding the cause.

"As affected horses exercise, their joints become swollen, and it can lead to lameness in the hock and stifle (rear-leg joints)," she points out. "If it progresses, it can become debilitating. Horses that grow rapidly seem more prone to the condition, so it's important that we learn to identify the disease in its early stages."

Horses are rarely far from her mind. At home, Semevolos and her husband, a horse trainer, have six Belgian draft horses that perform in pulling contests and exhibitions around the Pacific Northwest.



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Online: **CampaignforOSU.org**



Mary Arnold, center, coordinates a youth development program for Oregon 4-H. She works with colleagues to train teams of teens and adults to evaluate options and to take action. Projects focus on jobs, family events, underage drinking and local facilities. "We create a context that provides youth with opportunities for belonging, mastery, independence and generosity," says Arnold. Working on a beautification project are Lane County 4-H members (from left) Audrey Rhoades, Shelby Stepper, Brett Deedon and Carolyn Ashton. See "From Risk to Relationship," Page 2. (Photo: Lynn Ketchum)

Listen to OSU researchers, follow their stories and see more photos, at oregonstate.edu/terra 



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