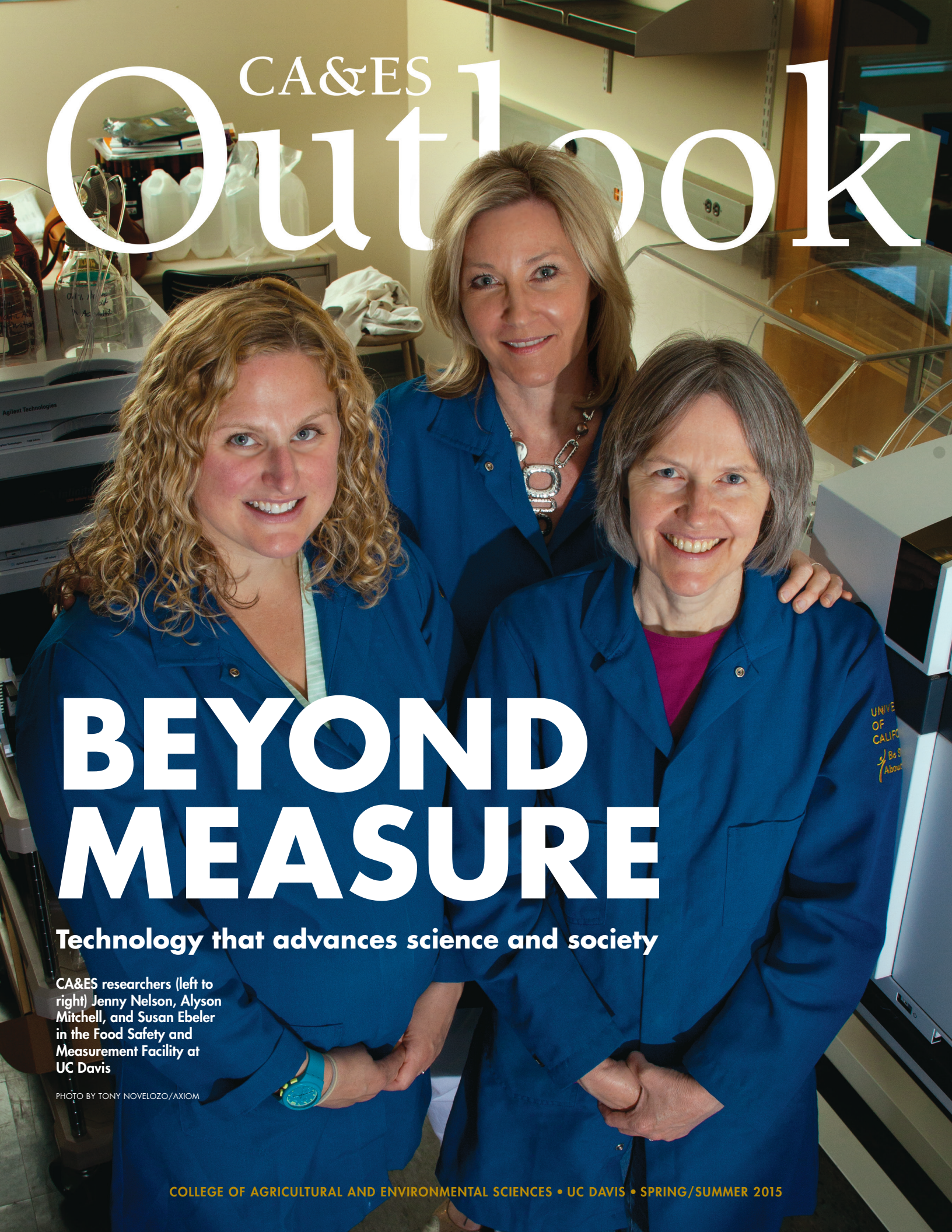
CA&ES Outlook



BEYOND MEASURE

Technology that advances science and society

CA&ES researchers (left to right) Jenny Nelson, Alyson Mitchell, and Susan Ebeler in the Food Safety and Measurement Facility at UC Davis

PHOTO BY TONY NOVELOZO/AXIOM

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COVER STORY

TONY NOVELOZO/AXIOM

▲ **ON THE COVER** A partnership between UC Davis and Agilent Technologies brought together adjunct professor Jenny Nelson and professors Alyson Mitchell and Susan Ebeler. Agilent employee Nelson is in the Department of Viticulture and Enology and offers expertise on equipment her company provided to the UC Davis Food Safety and Measurement Facility. Shown here are samples of almond volatiles that can be tested with the equipment.

Innovations fostered by CA&ES faculty are making an impact on food, on energy, and on water conservation. Learn about our scientists and their industry partners who work on the cutting edge of technology. **4**

JOHN STUMBOS/UC DAVIS

Navina Khanna (left) with senior Kristen Murphy

◀ **ALUMNI PROFILE**

Navina Khanna promotes equitable access to food. **19**

MAKING A DIFFERENCE

Donation lets landscape architecture students get their hands dirty. **21**

ALSO IN THIS ISSUE:

TECHNOLOGY TRANSFER

Partnerships help move ideas from discovery to real-world application

UNIVERSITIES FOSTER NEW DISCOVERIES. As a land-grant university, we have a long tradition of advancing the frontiers of science and engineering in ways that benefit society and promote economic development.

In recent years, our college has seen increased interest from industry and government in our research on food and agriculture. Investors are seeking to partner with UC Davis to go from innovation to application.

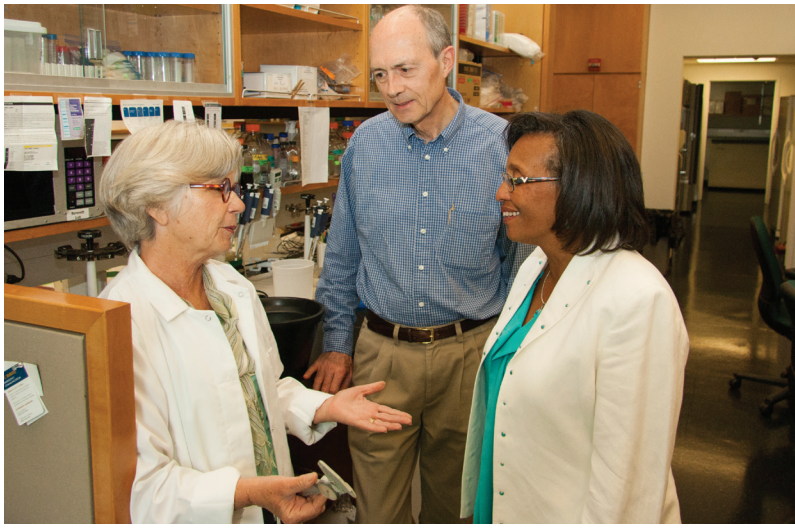
Agilent Technologies, a Silicon Valley giant in measurement technology, has partnered with CA&ES faculty in ways that have helped spur UC Davis innovations in methods of food authentication. In addition, seed companies such as HM•Clause and DuPont Pioneer are collaborating with UC Davis plant scientists to build a seed industry nexus surrounding Davis, modeling itself on Silicon Valley success.

We also have entrepreneurial CA&ES faculty and students who are interested in creating new business startups from their laboratory research. One recent example is the startup company Tule Technologies Inc., which grew out of evapotranspiration research at UC Davis. Tule's sensor technology makes it possible for growers to closely monitor crop water use over large areas, enabling more precise irrigation. Another startup, CleanWorld, licensed technology developed by Professor Ruihong Zhang to create renewable energy out of organic waste in anaerobic biodigesters.

We also have entrepreneurial CA&ES faculty and students who are interested in creating new business startups from their laboratory research.

Meanwhile, other CA&ES faculty innovations are in the pipeline toward commercialization. Our viticulture and enology faculty are collaborating with industry partners to develop new systems that use far less water in the commercial production of wine. Our biological and agricultural engineers are developing the technology to mechanize planting, harvest, weed control, and other aspects of agriculture that currently rely on a dwindling and increasingly expensive pool of labor. Our food scientists are collaborating with the food processing industry to reduce water and energy use.

JOHN STUMBOS/UC DAVIS



Plant scientist Ann Powell (left) and Seed Central managing director François Korn (center) speak with Dean Helene Dillard about Seed Central, which was formed in 2010 to facilitate connections between university researchers and industry. The organization holds monthly networking meetings that draw dozens of students, faculty, and company representatives who share an interest in taking new ideas out of the lab and into the field.

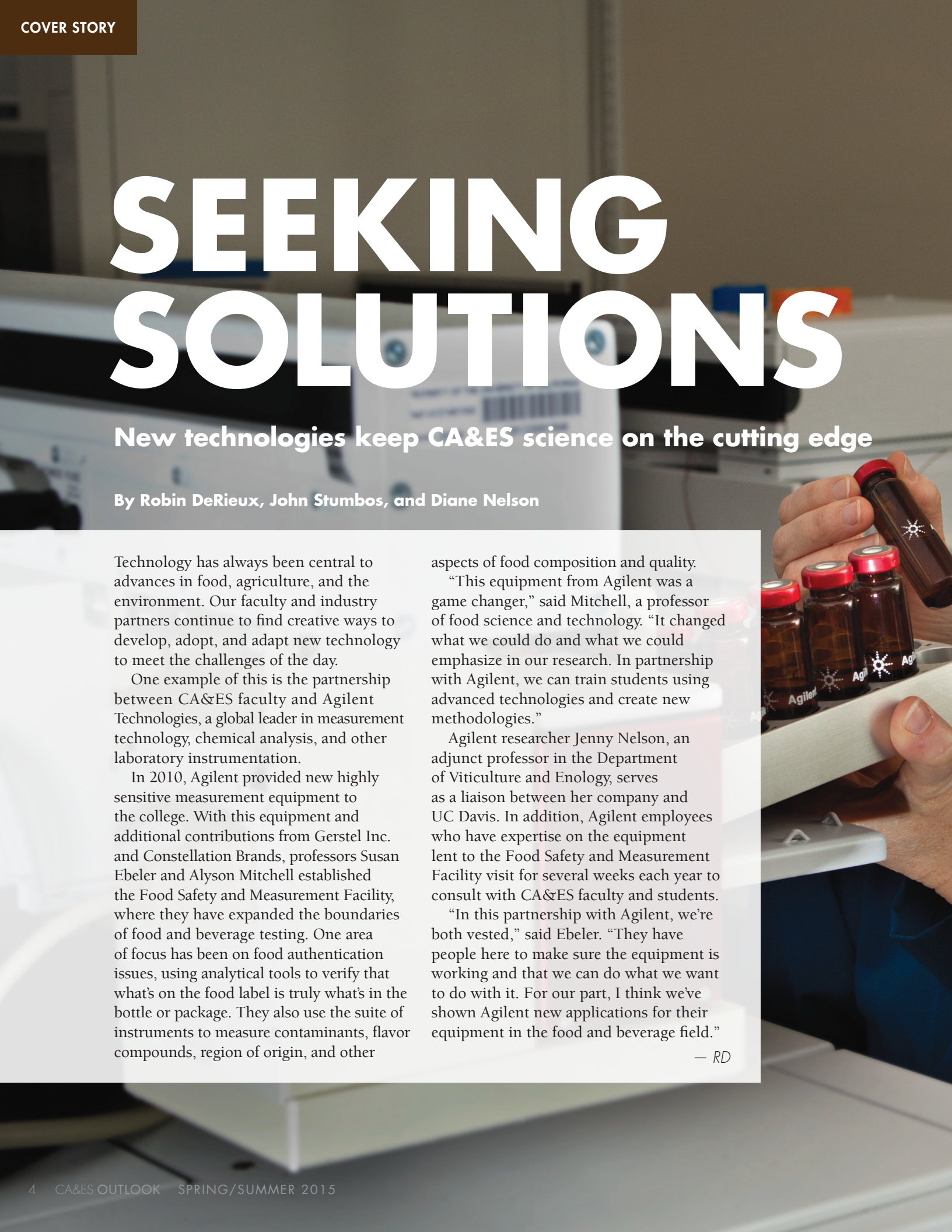
CA&ES discoveries lead to technologies that offer practical solutions to the tremendous variety of challenges we face in California and beyond. I am confident that our college will continue to bring research innovations to the marketplace and promote economic development through partnerships both public and private.

HELENE R. DILLARD, DEAN
COLLEGE OF AGRICULTURAL AND ENVIRONMENTAL SCIENCES

SEEKING SOLUTIONS

New technologies keep CA&ES science on the cutting edge

By Robin DeRieux, John Stumbos, and Diane Nelson



Technology has always been central to advances in food, agriculture, and the environment. Our faculty and industry partners continue to find creative ways to develop, adopt, and adapt new technology to meet the challenges of the day.

One example of this is the partnership between CA&ES faculty and Agilent Technologies, a global leader in measurement technology, chemical analysis, and other laboratory instrumentation.

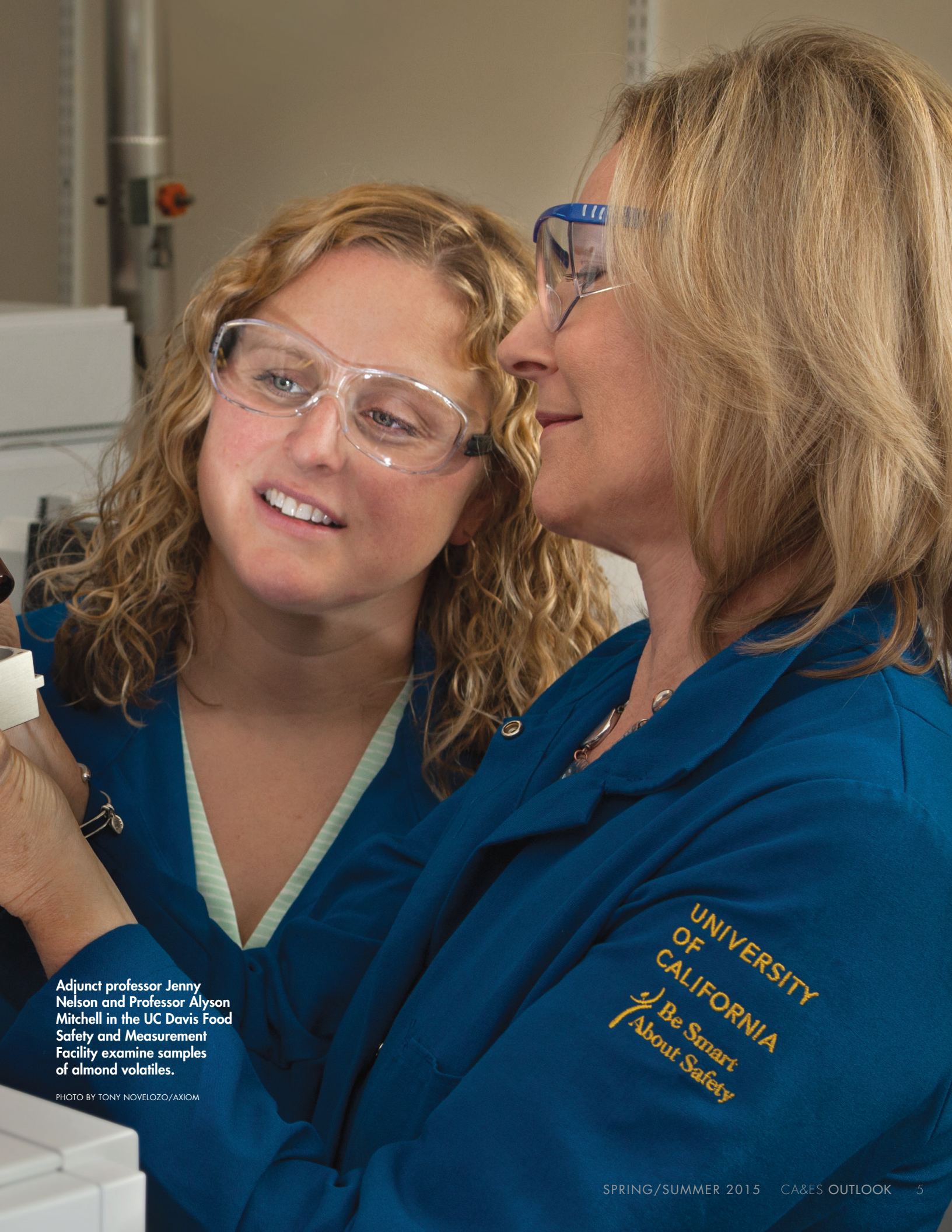
In 2010, Agilent provided new highly sensitive measurement equipment to the college. With this equipment and additional contributions from Gerstel Inc. and Constellation Brands, professors Susan Ebeler and Alyson Mitchell established the Food Safety and Measurement Facility, where they have expanded the boundaries of food and beverage testing. One area of focus has been on food authentication issues, using analytical tools to verify that what's on the food label is truly what's in the bottle or package. They also use the suite of instruments to measure contaminants, flavor compounds, region of origin, and other aspects of food composition and quality.

"This equipment from Agilent was a game changer," said Mitchell, a professor of food science and technology. "It changed what we could do and what we could emphasize in our research. In partnership with Agilent, we can train students using advanced technologies and create new methodologies."

Agilent researcher Jenny Nelson, an adjunct professor in the Department of Viticulture and Enology, serves as a liaison between her company and UC Davis. In addition, Agilent employees who have expertise on the equipment lent to the Food Safety and Measurement Facility visit for several weeks each year to consult with CA&ES faculty and students.

"In this partnership with Agilent, we're both vested," said Ebeler. "They have people here to make sure the equipment is working and that we can do what we want to do with it. For our part, I think we've shown Agilent new applications for their equipment in the food and beverage field."

— *RD*



Adjunct professor Jenny Nelson and Professor Alyson Mitchell in the UC Davis Food Safety and Measurement Facility examine samples of almond volatiles.

PHOTO BY TONY NOVELOZO/AXIOM

WASTE NOT, WANT NOT

Technology developed at UC Davis by Professor Ruihong Zhang has turned a waste problem into an energy solution. Over the past decade, Zhang's innovations in anaerobic digestion have carried the technology from lab to pilot plant to commercial enterprise.

Organic waste — it's a problem. Food scraps, food processing discards, postharvest agricultural residue, paper, wood, and animal waste are all types of organic waste that clog landfills, emit greenhouse gases, and squander resources. According to the California Department of Resources Recycling and Recovery (CalRecycle), compostable organic waste makes up approximately one-third of the more than 30 million tons of waste that are dumped each year in California landfills.

Anaerobic digestion is one solution for transforming organic waste into a commodity, turning these materials into renewable energy and valuable fertilizer products.

"Anaerobic digestion is key in CalRecycle's efforts to divert organic waste from California's landfills," said Caroll Mortensen, the director of the California Department of Resources Recycling and Recovery. "By converting this significant waste stream into low-carbon fuels and soil amendments, anaerobic digestion projects can help California reduce landfill use, cut greenhouse gases, and build healthy soils while creating the jobs of the future."

Zhang, a CA&ES professor of biological and agricultural engineering, serves as chief technical adviser to CleanWorld, a private startup that has launched three commercial anaerobic digesters in the Sacramento area since 2012. "I call Ruihong the Steve Jobs of anaerobic digestion because her innovations in technology are based on an understanding of the user," said Michele Wong, president of CleanWorld and a UC Davis alumna. "She solved the problems that the human race needed to solve with regards to organic waste. She understands who the customers really are, and she's devised very practical, elegant, simple solutions."

Michele Wong (left), president and CEO of CleanWorld, and UC Davis professor Ruihong Zhang have worked as partners to commercialize anaerobic digester technology.

In anaerobic digestion, bacteria break down biodegradable material in the absence of oxygen. Food scraps and other forms of organic waste are dumped into large, sealed tanks that look like silos and serve as giant composters. Bacteria in the closed system convert the waste into methane and carbon dioxide, also known as biogas.

Biogas can be combusted to generate electricity and heat, or it can be processed into renewable natural gas and transportation fuels. Along with biogas, the digestion of organic waste produces a nutrient-rich effluent that can be used to make fertilizer and soil amendments.

"So it's farm to fork to fuel, and back to the farm,"

PHOTOS BY JOHN STUMBOS/UC DAVIS

said Zhang. "We've closed the loop."

Knowledge of anaerobic digestion has been around for a long time, though CleanWorld president Wong noted that Zhang's design innovations addressed the key obstacles to commercializing the process. "When Ruihong first began to imagine this technology a dozen years ago, she understood the challenges: we needed high gas-production efficiencies, the ability to process a wide variety of organic wastes, cost-effectiveness, speed, scalability, sustainability, and a small footprint," said Wong.

The path to commercialization of Zhang's technology began in 1995, when she first joined UC Davis and designed an anaerobic digestion process to biodegrade rice straw as an alternative to burning stubble left in the fields after harvest. With a patent in her pocket, Zhang attracted funding from the California Energy Commission, CalRecycle, and private companies to build a fully functioning pilot plant on the UC Davis campus.

Although the pilot plant required a significant expenditure of time and money, scaling up the technology captured the interest of investors who were reluctant to risk millions of dollars until they had seen an operational model. The pilot plant demonstrated that the technology could process tons of waste on site instead of grams of waste in the lab.

Zhang's anaerobic digestion technology has attracted private partnerships. Raley's, a privately held supermarket chain with headquarters in West Sacramento, became involved with Zhang and her project during the pilot phase by providing organic waste for testing in the biodigester. In 2015, Raley's began shipping all produce discards from its 126 stores to commercial anaerobic biodigesters owned by CleanWorld. While the supermarket chain has long diverted its organic waste from the landfill, the corporation switched to anaerobic digestion disposal because it's a win-win solution.

The UC Davis Renewable Energy Anaerobic Digester (READ) creates energy from waste using produce discards and other organic waste.

"If we can accomplish two goals with one action — save money by diverting organic waste from the landfill and also promote sustainability by helping create energy from waste — then we'll go after that solution every time," said Meg Burritt, director of wellness and sustainability for Raley's.

Through public and private partnerships, Zhang has taken her anaerobic biodigestion research from innovation to commercialization. The next challenge is profitability, and the outlook is promising. "Our major focus right now is to improve the economics of biodigesters by developing products such as fertilizer and soil amendments from the digestate. We are researching the production of algae and other products from the digestate," said Zhang. "We expect to earn substantial revenue from those in the future." — *RD*

LIGHTENING THE LOAD IN ORCHARDS AND FIELDS

UC Davis has a long history of helping California agriculture become more efficient, productive, and safe for humans and the environment. Today, as farm labor becomes scarce and more expensive, the need for new ways of growing and harvesting crops is greater than ever. CA&ES scientists, working with growers, county farm advisors, and many others are delivering the goods.

JOHN STUMBOS/UC DAVIS

Cooperative Extension specialist Louise Ferguson is helping industry find ways to mechanize the harvest of table olives.

DESIGNING A VIRTUAL ORCHARD

Fifty years ago agricultural engineers climbed into citrus trees and with a plumb bob on a string identified the location of individual fruits to help them build a physical model — an early effort to gain insight into how to mechanize the harvest. Stavros Vougioukas, a professor of biological and agricultural engineering, took the same idea and used modern digitization tools to create a virtual orchard for different crops.

"We came up with a way to measure the locations of fruits at a very high speed while they are being harvested," he said. A fruit picker wore a glove outfitted with an antenna that transmitted signals to four receivers. Every time the picker grabbed a fruit, its precise location in time and space was recorded.

With research support from the California Pear Advisory Board and the Cling Peach Mechanization Fund, Vougioukas has been collecting data from trees with different architectures to simulate how robots could work in an orchard without building expensive prototypes. Software calculates the picking efficiency and speed.

"The goal is to enable better and faster design for either harvest-aid platforms or robotic harvesters," Vougioukas said.

Vougioukas also is developing an intelligent transportation system utilizing small, mechanized carts to ease movement of harvested strawberries from the field to a collection site.

MECHANIZING TABLE OLIVE HARVEST

Traditionally, table olives are hand harvested by crews on ladders, a slow and expensive process. Labor costs can run 45 to 60 percent of producers' gross returns.

Mechanical harvesting has been developed for many tree crops, but table olives are tricky because they can bruise easily when ripe and then won't cure well. Recently, two types of harvesting technology have shown promise. The first is a tree shaker that grips the trunk and shakes the olives free. The second method utilizes a canopy contact harvesting head that gently moves through the branches to liberate the olives. Louise Ferguson, a Department of Plant Sciences Cooperative Extension specialist, has worked diligently with growers, engineers, fellow scientists, even family members to test these technologies.

Gavin Nielsen is an engineer who has worked with Ferguson for many years. His company, Nielsen Technologies, has successfully harvested table olives with an inertial trunk shaker: 100 trees per hour with an impressive 90 percent removal. "I am confident that mechanical harvesting will become the standard for olive harvesting in the very near future," he said.

Another approach for automating the olive harvest uses a contact head that looks like a giant bottle brush. It is attached to a tractor and moves through the orchard, passively engaging the tree and coaxing the olives from the branch. With help from retired UC Davis agricultural engineer John Miles and others, refinements have enabled this technology to harvest olives without bruising the fruit and at economically feasible levels. Importantly, both a consumer panel and a trained sensory panel couldn't tell the difference between the hand-harvested and mechanically harvested olives.

Ferguson is quick to credit many people who have helped her since she first started working on mechanical olive harvesting 20 years ago. "Progress is always incremental," she says. "We can do the technology and we can do the evaluations. Now it's ready for a commercial fabricator willing to make the machine."

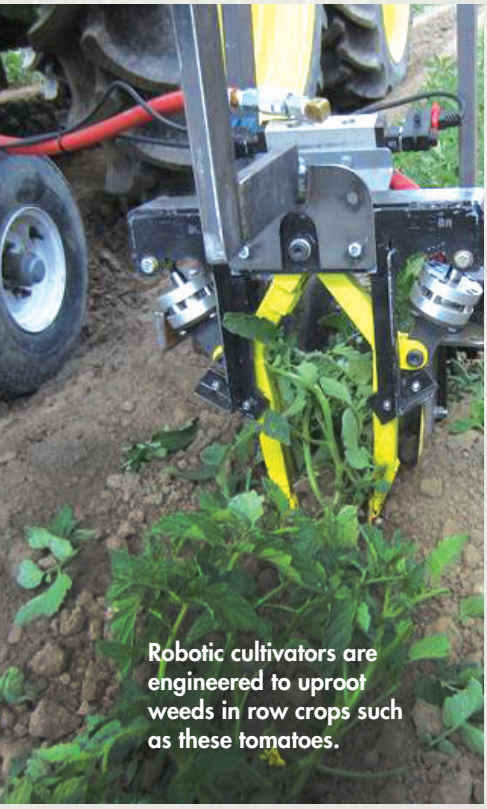
BUILDING A BETTER CULTIVATOR

Another team of researchers at UC Davis is designing a robotic cultivator that can remove weeds in commercial vegetable fields more efficiently than currently available technology.

"Machines can recognize a weed, and they can recognize a crop plant, but they have trouble distinguishing one pattern from another when they are commingled, as is often the case with weeds and young crops in the field," said David Slaughter, a professor of biological and agricultural engineering.

The "smart" cultivator in development by Slaughter and colleagues utilizes small knives that reach out to uproot weeds and then retract to keep crops intact. It will weed the beds of crops such as tomatoes and head lettuce. In densely planted crops like spinach, a precision sprayer will be used to kill weeds.

One of the keys to this system is a safe, simple seed coating that will signal the cultivator by emitting a faint fluorescent glow when seedlings emerge. This will enable the new cultivator to identify and avoid the seedlings and move more quickly through a field to eliminate weeds than current vision-sensor models.

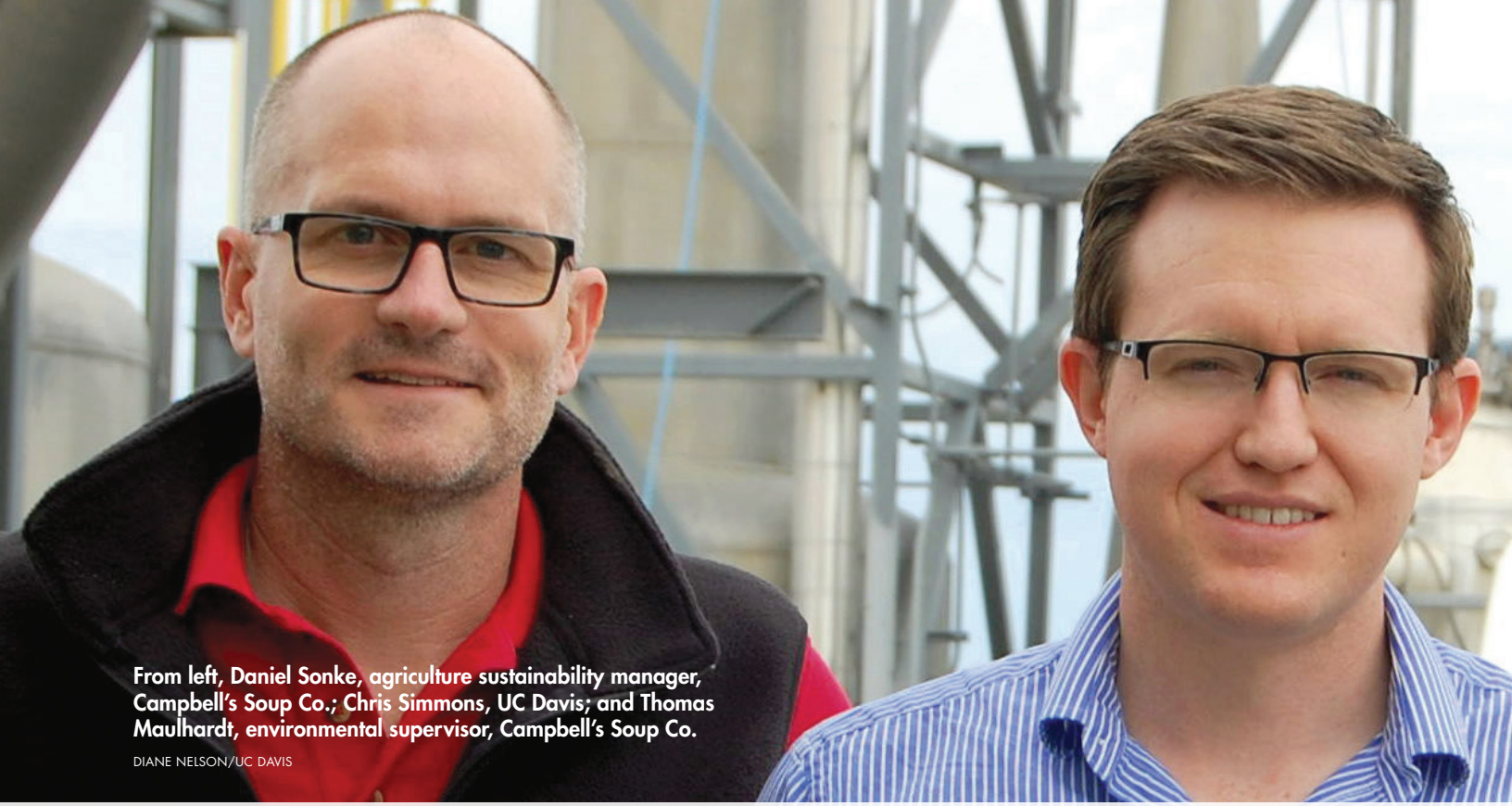


Robotic cultivators are engineered to uproot weeds in row crops such as these tomatoes.

This is good news for vegetable growers such as Alain Pincot, managing partner of Bonipak Farms in Santa Maria. "As the cost of labor rises in California, mechanical cultivators become more important to both organic and conventional ag production," Pincot said.

— JS and DN

High-density Bartlett pears grown at Chris Ruddick's ranch near Ukiah. Professor Stavros Vougioukas has been collecting data from trees with different architectures to simulate how robots could work in an orchard.



From left, Daniel Sonke, agriculture sustainability manager, Campbell's Soup Co.; Chris Simmons, UC Davis; and Thomas Maulhardt, environmental supervisor, Campbell's Soup Co.

DIANE NELSON/UC DAVIS

WORKING TOGETHER TO MANAGE DROUGHT

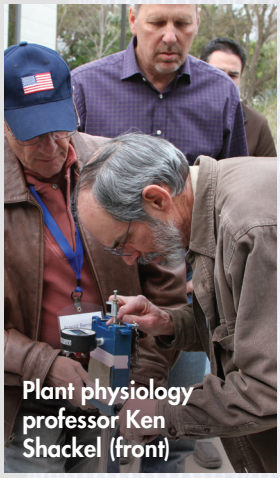
In fields, orchards, wineries, and food-processing plants across California, the agriculture industry is coping with the fourth straight year of drought. Many people haven't fully recovered from last year's drought, which was responsible for the greatest water loss ever seen in California agriculture. Some 17,000 agricultural jobs were lost and 425,000 acres of farmland were laid fallow.

But California's agriculture industry is not in it alone. Working with growers, industry, and agencies throughout the state, CA&ES researchers are developing and improving technology to help California manage its vital, scarce water resources.

OPTIMIZING IRRIGATION

Are there practical ways growers can stretch water without reducing crop production, quality, and yield? Yes, researchers say, and the key is optimizing irrigation — watering not too much and not too little. For decades, a UC Davis technological advance has helped growers find that fine line: pressure chambers.

Pressure chambers are tools that measure how hard a plant is working to pull moisture from the soil, providing an accurate read of a crop's changing water needs. Many growers irrigate when it's hot outside and the soil is dry, which can lead to overwatering.



Plant physiology professor Ken Shackel (front)

"Just because the soil is dry, doesn't mean plants are suffering," said plant physiology professor Ken Shackel, whose research led to routine use of pressure chambers on orchard crops and vineyards in the 1990s.

Dry soil and arid atmosphere can cause water stress, but those aren't the only causes. And some crops can manage fine in drier conditions, based on a variety of factors such as root health.

"That's why we like to ask the plant directly," Shackel said.

As the drought wears on, more growers are making the $1,200 to $3,000 investment, and they're glad they did.

"Pressure chambers are a fantastic tool for making sure you're watering your trees only when they need it," said Jerry Sneed, field representative for Crain Ranch, a walnut producing and processing operation in Los Molinas, California. "I have total faith in them. They've never steered us wrong."

PRODUCING WINE WITH LESS WATER

A typical winery uses four to six gallons of water after the grapes are harvested to produce one gallon of wine, with most of that water used to wash equipment. Viticulture and enology professors Roger Boulton and David Block are developing self-cleaning fermentors capable of recycling 90 percent of that water. The goal:

affordable technology that uses one gallon of water to produce one gallon of wine.

Winemakers currently remove sticky, fermented, grape residue from tanks with water and elbow grease. Clean-in-place technology replaces hand cleaning with an automated system that sprays tanks with a hot, caustic solution such as sodium or potassium hydroxide.

"The dairy industry has used clean-in-place technology since the 1960s and the pharmaceutical industry since the 1990s," said Block, who helped the pharmaceutical industry manage clean-in-place technology before coming to UC Davis in 2008. "It's a little different with dairy and pharmaceuticals, where poor sanitation can kill you, but the concept is similar."

There's still work to be done to ensure the technology is affordable on a commercial scale, but wineries are already interested.

"Clean-in-place technology is very attractive to us," said Ashley Heisey, director of winemaking at Long Meadow Ranch in Rutherford, Calif., and a UC Davis viticulture and enology graduate (M.S. '91). "Water is such a critical issue. Long Meadow Ranch owners Ted, Chris, and Laddie Hall built our facilities with great concern for the environment, and thanks to UC Davis, we can take it one step further."

FINE-TUNING FOOD PROCESSING

New technology can save water. But sometimes, all it takes is fine-tuning what already exists. New research from food science and technology professor Chris Simmons helps food processors improve equipment efficiency, which saves water, energy, and money.

"We analyze a processing plant's entire system — its water supply and where and how it's being used," said Simmons. "We look at every pipe, pump, and procedure and tell companies what modifications would have the biggest impact on water and energy savings."

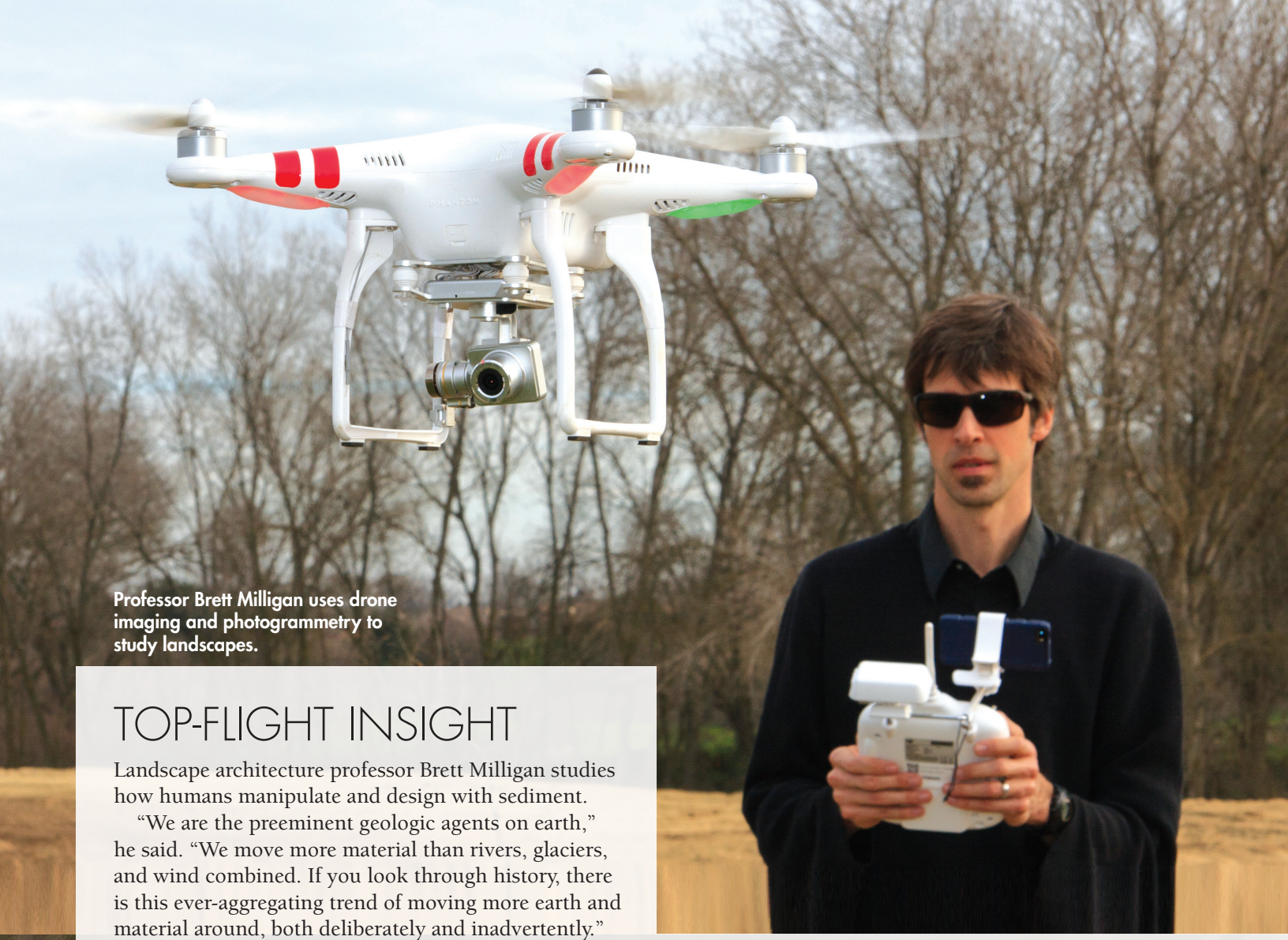
Alumna and winemaker Ashley Heisey

Simmons and his team visited the Campbell's Soup tomato processing plant in Dixon, Calif., for example, and found ways to reduce water use by 20 percent and energy use by 3 percent.

"That represents a significant monetary savings, too," said Dr. Daniel Sonke, manager of agriculture sustainability programs for Campbell Soup Company. "Dr. Simmons and his team gave us a new way to look at how we use water and energy. Before, we might not know a pump is deteriorating until it gives out, for example, but they helped us quantify how much replacing or refurbishing it could increase efficiency."

Simmons' team has visited several food processing plants in California, and is happy to work with others.

"Sustainability is the key to keeping California's food processing industry — and agriculture in general — viable and strong," Simmons said. — *DN*



Professor Brett Milligan uses drone imaging and photogrammetry to study landscapes.

TOP-FLIGHT INSIGHT

Landscape architecture professor Brett Milligan studies how humans manipulate and design with sediment.

"We are the preeminent geologic agents on earth," he said. "We move more material than rivers, glaciers, and wind combined. If you look through history, there is this ever-aggregating trend of moving more earth and material around, both deliberately and inadvertently."

Society has had to get smarter and more creative in working with this material. Ports create tremendous amounts of dredge material to keep shipping channels open and trade flowing. Dredge material from the Stockton shipping channel is being used to rebuild the nearby Antioch Dunes, home to two species of endangered wildflowers and the world's only population of Lange's metalmark butterfly.

Milligan is using new tools to understand how the landscape takes shape on the wind-blown dredge sediment, which is mostly sand. "We're hoping to use drone imaging and photogrammetry to learn how that sand moves over time and how it might optimally be placed and formed to create habitats," he said.

With a drone-mounted, wide-angle camera, Milligan can pinpoint what he wants to see in microscale detail and obtain real-time footage. Sophisticated software can then stitch together the high-resolution imagery for use in 3-D models that run in a geographic information system. The resulting simulations give scientists and managers greater insight into landscape processes.

Milligan also has looked at other dredge sites such as the former Hamilton Air Force Base in Marin County, Calif., where tidal wetlands have been created by building up subsided lands and reconnecting them to the San Pablo Bay.

The drought has created an opportunity to utilize this technology to study California's reservoirs. With unmanned aerial vehicles and high-resolution photography, researchers are learning how to create bathymetric surveys that might help assess accumulated sediment in the exposed bottoms of reservoirs.

This type of imaging technology also has applications in urban forestry. Milligan recently worked with the Climate Action Reserve to create a protocol for quantifying carbon sequestration in urban trees.

Milligan began using drones in 2014 and has been working with graduate researcher John De Goede to see how they can use the technology in combination with a variety of mapping and modeling software. They are enthusiastic about the wealth of new information this technology can provide. "I think with drones it's about what you do with the applications," Milligan said. "From an environmental point of view, this has opened up all sorts of new realms." — *JS*

JOHN STUMBOS/UC DAVIS

SUMMER INTERNSHIPS

CA&ES students and Salinas Valley employers find common ground

UC DAVIS TOOK A BUMPER CROP OF TALENTED students to meet with potential employers in Salinas during spring break.

The CA&ES Dean's Office arranged the field trip in collaboration with the Grower-Shipper Association of Central California to showcase opportunities for summer internships and entry-level jobs in the agricultural industry of the Salinas Valley. Onboard the UC Davis bus were nearly 30 undergraduate and graduate students with interests in food science, plant science, biotechnology, biological systems engineering, and other fields.

The students were seeking employment opportunities with hands-on experience to supplement their classroom learning. They toured farm fields and research plots and also suited up in sanitary garb to visit a food processing facility at Taylor Farms.

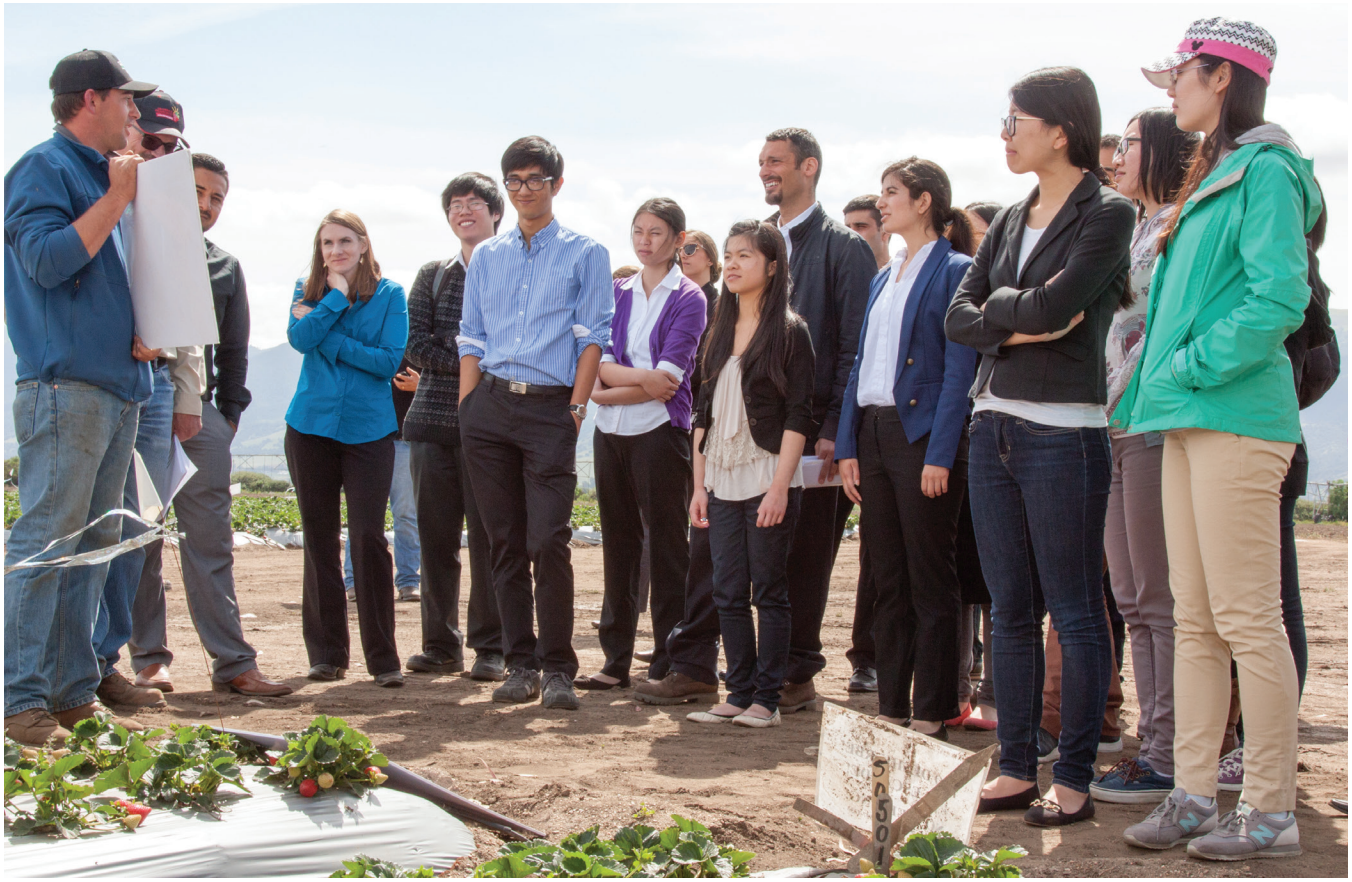
Food science junior Yanyao Yu said the visit to Taylor Farms expanded her understanding of the connections between food science and agriculture. "When you see grower-packer-shippers who are doing product development as well, you realize that the industry is all vertically connected," said Yu. "It was cool to see how industry really works."

UC Davis students also got their boots muddy in the field, where the spectacular Salinas soil can produce three crops a year. At an afternoon reception, Salinas-area employers gave brief overviews of their businesses and had a chance to connect directly with students.

UC Davis alumnus Ernie Farley, who works with Andrew & Williamson Fresh Produce and is chairman of the board of the Grower-Shipper Association, helped host the UC Davis students. A former Salinas Valley intern himself, he stressed the importance of students to the industry. "In agriculture, there are so many opportunities for young people to come up with the answers we need to solve our future challenges," said Farley.

— Robin DeRieux

ROBIN DERIEUX/UC DAVIS



Robert Wall (left), a technician with berry producer Reiter Affiliated Companies, explains a strawberry research project to students.

The Rangeland Watershed Program at UC Davis has been working with ranchers, agencies, and others to foster good stewardship practices for more than 25 years.

KNOWLEDGE ROUNDUP

Rustici Rangeland Science Symposium draws crowd to UC Davis

FOR TWO DAYS IN MARCH, THE "NEW frontier" of livestock grazing in California was on full display at UC Davis as more than 200 ranchers, researchers, regulators, and others gathered for the third Rustici Rangeland Science Symposium.

"The path forward is integrated research and management to address the ecological, economic, and social aspects of grazing," said Ken Tate, a UC Davis Cooperative Extension specialist in rangeland watershed science and one of the principal organizers of the event.

The symposium focused on sharing knowledge about maintaining rangeland water quality, which is of particular concern as the State Water Resources Control Board considers new regulations for water quality on lands used for grazing livestock.

"Public land grazing is a difficult topic with substantial polarization about its suitability and acceptability on our state's rangelands," Tate said. "Water quality is a topic that transcends private and public rangelands, so we addressed both topics."

Eighty percent of California's surface water passes through 57 million acres of public and private rangeland. In addition, a $3 billion cattle and sheep industry, as well as thousands of plant and animal species, depend on surface water. The Rangeland Watershed Program at UC Davis has been working with ranchers, agencies, and others to foster good stewardship practices for more than 25 years. A ranch water-quality short course, for instance, has been conducted in 35 counties since 1995.

Nutrients and pathogens are top water quality concerns. However, updates presented at the symposium indicate that livestock grazing is a minimal source of water quality impairment. In one study, grazing was identified as a potential problem in only 4 percent of 7,294 state-listed impaired water bodies — "a much lower number than expected," Tate said.

The symposium was organized by Tate, who is a faculty member in the Department of Plant Sciences, project scientist Leslie Roche, graduate student researcher Tracy Schohr, and UC Davis soil science professor Randy Dahlgren. Russell Rustici was a North Coast cattle rancher who bequeathed a substantial part of his estate to the university to support rangeland science. Both Tate and Dahlgren hold endowed chairs from Rustici's gift and have used endowment proceeds to keep symposium registration costs low to ensure access to as many stakeholders as possible.

Updates presented at the symposium indicate that livestock grazing is a minimal source of water quality impairment.

Jeff Wiedemann, a Pleasanton rancher whose family has been in the cattle business since 1867, attended the symposium. "The public demands that ranchers be more environmentally conscious and that's a good thing," he said. "I don't think ranchers are environmentally conscious because they have to be. That's the way we've always been."

— John Stumbos

ONBOARD

New associate deans join college leadership team in October 2014

PROFESSOR RON TJEERDEMA, DEPARTMENT of Environmental Toxicology, represents the environmental programs. Cooperative Extension specialist Dave Campbell, Department of Human Ecology, represents the human/social sciences programs. Professor Ed Lewis, Department of Entomology and Nematology, represents the agricultural programs.

They report to and work collaboratively with CA&ES Executive Associate Dean Mary Delany on the planning and administrative coordination of departments and programs in the college. In addition to working with department chairs on research and outreach, the associate deans also work with Dean Helene Dillard to represent CA&ES to other colleges, schools, stakeholders, and visitors, and work with development staff to advance college fundraising objectives.

— Outlook Staff

Get to know the associate deans

RON TJEERDEMA

Born: Elmhurst, Illinois

Colleges attended: Humboldt State (B.S.), University of California, Santa Barbara (M.S.), UC Davis (Ph.D.)

Favorite spots: any redwood forest

Hobbies: cutting and splitting firewood for my Sierra cabin

Cooking specialty: anything on the BBQ

Something that might surprise us: played competitive tennis in college and worked as a tennis instructor

DAVE CAMPBELL

Born: Maryville, Tennessee (pronounced Murvul)

Colleges attended: Westminster College (B.A.), Ohio State University (M.A.), University of Oregon (Ph.D.)

Favorite spots: any place in Oregon (lately the Bandon Dunes golf course)

Hobbies: avid golfer

Cooking specialty: cheesecake

Something that might surprise us: did his best teaching at Sunday school

EDWIN LEWIS

Born: Auburn, New York

Colleges attended: Cayuga Community College (A.A.S.), Cornell University (B.S.), University of Missouri (M.S.), Auburn University (Ph.D.)

Favorite spots: Owasco Lake (one of the Finger Lakes in central New York state)

Hobbies: boating, fishing

Cooking specialty: spaghetti alla puttanesca

Something that might surprise us: worked as a carpenter after graduating from Cornell and before attending grad school

A HANDY DEVICE

Students invent award-winning sensor to assess olive oil quality

EXTRA VIRGIN OLIVE OIL SALES HAVE TRIPLED in the United States in the past two decades, but there's no easy way to tell if the oil inside the bottle is, indeed, extra virgin. In fact, as much as two-thirds of the extra virgin olive oil sold in the U.S. is actually much lower-grade oil, lacking the flavor and health benefits of the real deal.

JAMES LUCAS/UC DAVIS

This team of bright UC Davis students won a major award and the praise of industry for a portable device that can quickly assess olive oil quality.

Fortunately, a team of UC Davis students has built an award-winning biosensor that can quickly and inexpensively test olive oil quality. The student invention took grand prize at the 2014 iGEM (international Genetically Engineered Machines) competition, which invites the brightest minds from universities around the world to engineer solutions to real-world concerns.

"Winning was surreal," said Simon Staley, a biological and agricultural engineering major and one of seven students on the UC Davis team. "In the finals, we were going against huge teams. We were like 'The Little Engine That Could'."

Current tests to assess olive oil quality are expensive, cumbersome, and provide only a crude measurement of olive oil freshness and authenticity. Rancidity — that stale taste and smell you get when oil oxidizes over time or when exposed to light, heat, or air — is the most common defect, but it's hard to measure. Olive oil has tens of thousands of different chemical compounds, and there isn't a single one that signifies rancidity.

Staley and his fellow iGEM team members — Sarah Ritz, Lucas Murray, Brian Mamsut, James Lucas, Aaron Cohen, and Julie Yeonju Song — designed an enzyme-based electrochemical biosensor that detects rancidity using a concept similar to the way a glucose meter

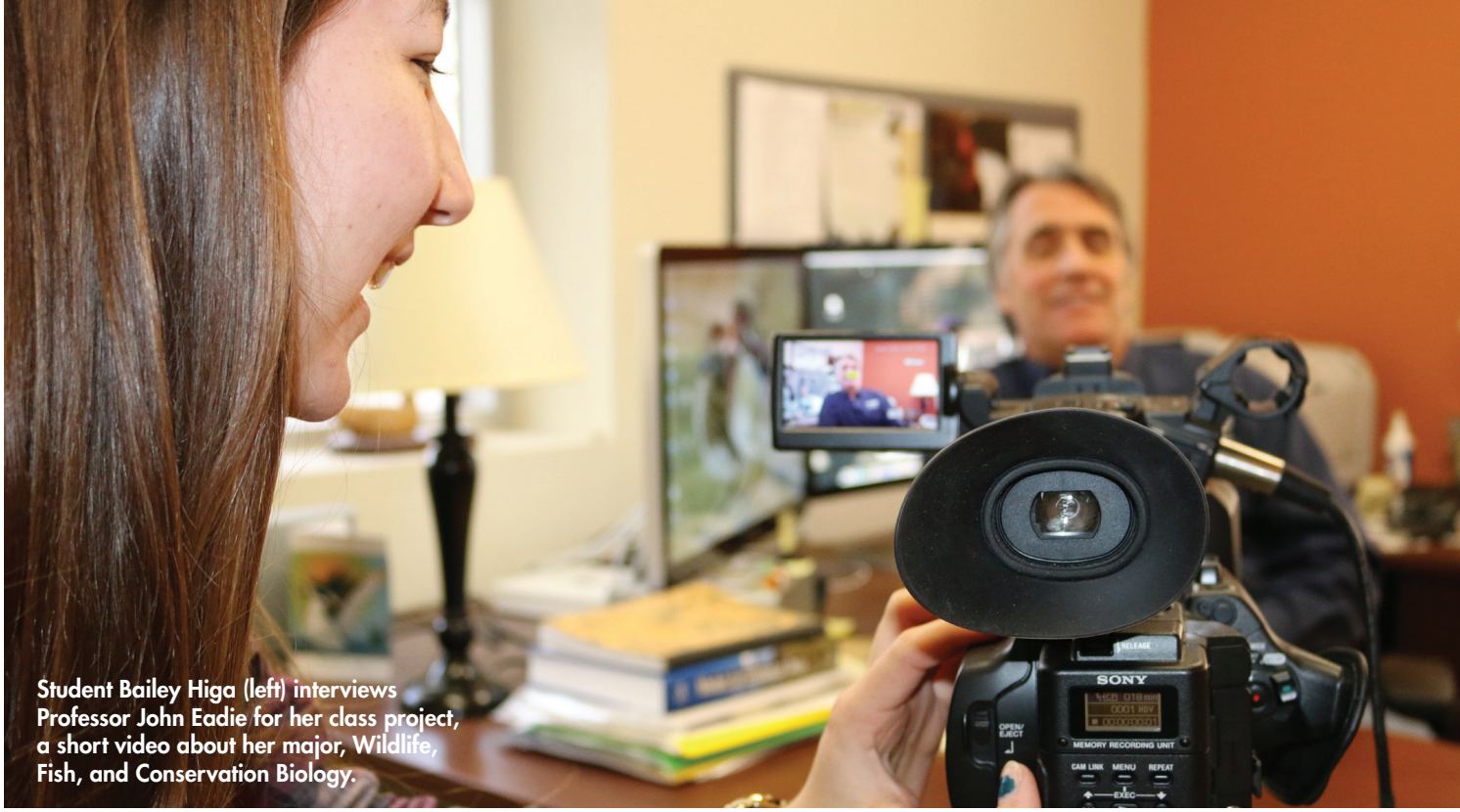
> "In the finals, we were going against huge teams. We were like 'The Little Engine That Could'."

measures blood sugar. Their palm-sized sensor could hit the market in a few years, retailing for about $80.

Initially, the biosensor will be best suited for producers, buyers, and retailers because it may be too complicated to easily test olive oil quality at home. Future iterations will be more user-friendly, including, perhaps, a version built right into bottles of extra virgin olive oil so consumers can assess quality at a glance.

"Their project has great potential," said David Garci-Aquirre, production manager at Corto Olive Co. in Lodi, California. "A biosensor that provides an easy, affordable way to help ensure the quality of our olive oil would be an incredibly useful tool for us, for retailers, and especially for consumers. This kind of innovation will help get good oils in the hands of those trying to buy good oils."

— Diane Nelson



CHRIS NICOLINI/UC DAVIS

Student Bailey Higa (left) interviews Professor John Eadie for her class project, a short video about her major, Wildlife, Fish, and Conservation Biology.

LIGHTS, CAMERA, AG-TION!

Students learn video and multimedia skills for a multitude of careers

FOR DECADES, CA&ES STUDENTS AT UC DAVIS have learned how to milk cows, drive tractors, and grow plants. But a new class may add one more skill to the Aggie traditions list: video production.

Students expect their courses and instructors to cover all of the skills and information necessary to land a future job. But in the connected world of today, it's not just what you know, it's how to communicate that knowledge as well.

To teach students multimedia production skills, the college now offers "Developing Digital Communication Skills in Agricultural, Environmental, and Human Sciences." The two-unit course teaches students interested in digital communications how to organize, plan, and produce topic-specific videos.

"Students come to the university and they need to learn how to write, to speak — everybody understands that — and I think how to produce video is another important skill because of how video is exploding in society and gaining traction here at the university," said James Carey, a distinguished professor of entomology and co-instructor of the video course.

The concept of creating a class to develop and improve digital communication skills for CA&ES students began in 2008 when Carey connected with Professor Arnold Bloom of plant sciences, an early adopter of video technology. As the idea grew, Susan Ebeler — associate dean for Undergraduate Academic Programs — suggested that students in the course could produce videos about their major that would be posted on the college website.

"One of my goals was to highlight our majors so that we could tell prospective students and their families what our college is about," said Ebeler. "Our current students know about their majors, and they can readily express their own enthusiasm. As a result, they communicate the information to their peers in a very effective way."

Students enrolled in the class quickly realized that good video production requires much more work than just picking up a camera and pressing the record button. There are many logistical and scheduling challenges that need to be addressed before filming can begin. Since the videos for the class were limited to two minutes, the students also learned to communicate the most relevant information concisely.

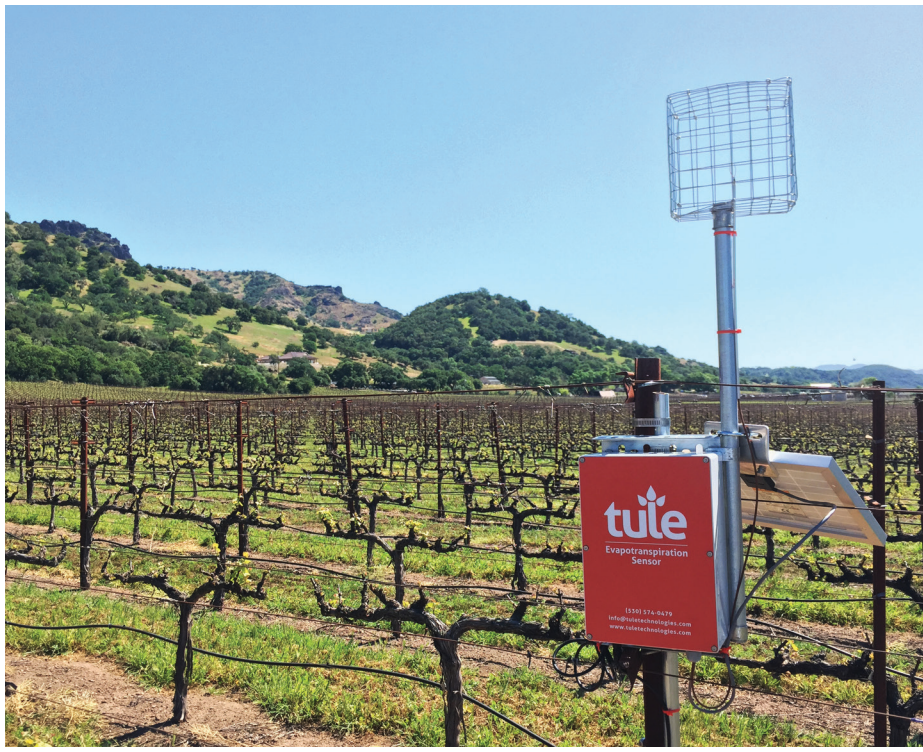
"It's very cool being in charge of producing a video, and it taught me a lot," said Bailey Higa, a junior majoring in wildlife, fish and conservation biology. "Watching the videos we make in the class is a great way to see the majors that UC Davis has to offer through the eyes of the students."

— Chris Nicolini

TULE SENSORS MEASURE UP

Alumnus improves irrigation management with novel technology

ALAN WELLS/TULE



Alumnus Tom Shapland licensed technology developed at UC Davis and cofounded a business that is maximizing irrigation efficiency in California vineyards, orchards, and fields.

AS A UC DAVIS STUDENT, TOM SHAPLAND learned about and then refined a technology that could revolutionize irrigation management.

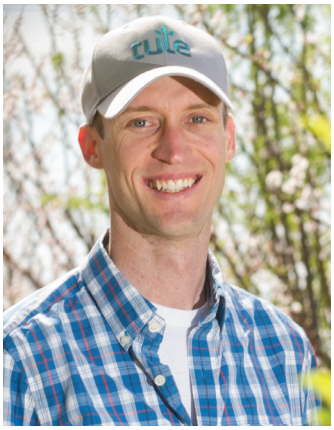
Shapland made the most of his time at UC Davis: B.S., '07, viticulture and enology; B.A., '07 classical civilization; M.S., '11, horticulture and agronomy; Ph.D., '12, horticulture and agronomy.

His love of plants led him to study viticulture and a quick realization of the significance of water in California agriculture. "The most important thing for a farmer's livelihood is his or her decision around when to irrigate and how much to irrigate," he said.

Farmers typically use soil or plant sensors to gauge water use, but they haven't had a way to measure it over a broad area — until now.

Evapotranspiration (ET) is a measure of the amount of water used in a crop field. "Surface renewal" is a novel method to measure ET by monitoring wind currents. It was invented by UC Davis atmospheric science professor Kyaw Tha Paw U. In his graduate studies, Shapland figured out a way to eliminate the need for calibration of the surface renewal monitoring equipment.

KARIN HIGGINS/UC DAVIS



Tom Shapland, B.S. '07, B.A. '07, M.S '11, Ph.D. '12

"This was a huge advance for agricultural science because the method dramatically reduces the cost to measure ET," said Richard Snyder, a Cooperative Extension biometeorologist and one of Shapland's faculty advisers.

In 2013, Shapland licensed the technology from UC Davis and started a new business named "Tule" with cofounder Jeff LaBarge. The San Francisco-based company now installs and maintains Tule sensors in vineyards, orchards, and strawberry and tomato fields throughout California.

Data is transmitted from field sensors that cover up to 10 acres through a cellular network to Tule's computer servers. For a flat fee, growers and managers can log on to a website and get information on water use, predicted atmospheric demand, and a plant response index. Email alerts are sent out weekly, and a mobile app is in development.

"Growers are just paying for the data," Shapland said. "They don't want one more piece of hardware they have to worry about, how to make it run, or what to do if it breaks."

"We've been able to confirm irrigation decisions in real time and push the envelope of quality without sacrificing the long-term health of the vines," said Matt Crafton, winemaker for Chateau Montelena Winery in Calistoga, Calif.

Shapland has high praise for his UC Davis mentors: Snyder, Paw U, and plant physiologist Andrew McElrone. "I can't overstate what a world-class education I received at UC Davis," he said. "The campus is about bringing forth new knowledge and coming up with original ideas. I love that environment."

— John Stumbos

FOOD FOR THOUGHT

Alumna blazes trail for food justice in California

AT THE FOREFRONT OF THE FOOD JUSTICE movement, trailblazer Navina Khanna (M.S., '07, International Agricultural Development) is working hard to ensure her community — and others throughout the U.S. — have access to proper nourishment. Her goal: an equal and just food system.

Khanna's interest in agriculture began as a 17-year-old high school student in India. "I had the opportunity to go on a three-week wilderness trip with an ecology class where we discussed how our relationship with nature changed when we decided to domesticate plants and animals," said Khanna. It was then that she began to form questions about how and why certain plants were grown and produced as food for human consumption. Those early questions about agriculture,

> "Everybody should have both the rights and the means to produce or procure, prepare and to share food that is good for people and good for the planet."

plants, and food led Khanna to her life-long passion in the studies of international agriculture and food justice.

Once Khanna received her Bachelor of Arts degree from Hampshire College, she began to prepare for graduate school. Looking for a graduate program that was strong in international agriculture and one that could provide hands-on experience, she chose UC Davis. She did research and assisted in creating curricula that helped lead to the development of a new undergraduate major in sustainable agriculture and food systems. Khanna later decided to use this research as her master's thesis project.

After graduation, Khanna moved to Oakland and cofounded and directed Live Real, a national initiative that helps youth reshape their food systems. She is also serving as a Movement Strategy Center Innovation Fellow, and is on the boards of Food Policy Action and the Oakland Food Policy Council.

"Everybody should have both the rights and the means to produce or procure, prepare and to share food that is good for people and good for the planet," said Khanna. "Our food should be nourishing people, nourishing communities, and nourishing their cultures."

JOHN STUMBOS/UC DAVIS

Navina Khanna, M.S. '07, won the Community Food Leadership Award from the James Beard Foundation.

Khanna has been educating consumers, organizing grassroots campaigns and protests, and trying to improve public policy. She wants to convince consumers and corporations that, "Whoever controls the food system controls our seeds, controls our water, and controls our land — that's who controls our lives."

Khanna was recently recognized by the James Beard Foundation with the Community Food Leadership Award for her work as a food justice activist organizing across communities for equitable and ecological food systems on local, regional, and national levels. Khanna will continue to follow her passion on transformative change through agriculture and food systems until liberty and food justice is obtained for all.

— Charleen Floyd

UNCORKING A TRADITION

Rich Kunde changed the way wine is made and sold in the U.S.

AS A UC DAVIS STUDENT, RICH KUNDE ('64, fermentation science; M.S., '66, horticulture) learned about French appellations, geographical names that are used to identify and market wine. The idea stuck with Kunde, who grew up tending vineyards on the family's Sonoma County ranch. In fact, it helped him land a job as a field representative with the California North Coast Grape Growers.

"I got in front of the board and asked them, 'Where is the North Coast?'" he recalled. "They told me 'Napa, Sonoma, and Mendocino counties, of course.' I said, 'But you can buy wine labeled North Coast that's made from Thompson Seedless grapes from Bakersfield. I think you need to protect your appellation, North Coast, and actually define it by law.'"

Kunde got the job and also worked with industry leaders to pursue his idea. "I wanted to create appellations for America, but I didn't want to call them appellations," Kunde said.

He proposed calling them American Viticultural Areas (AVA) to avoid confusion. He contacted the then-named Bureau of Alcohol, Tobacco, and Firearms. "I explained how AVAs would give consumers a guarantee that the wine actually came from that area," he said. "I also requested that varietal wines be increased from 50 percent to 75 percent of the named variety."

Kunde prevailed. Today California has dozens of AVAs, such as Napa Valley, Santa Lucia Highlands, and Sonoma Coast. The AVAs add value to the wine industry, and the higher varietal content helps the regions distinguish themselves from one another.

At UC Davis, Kunde also learned how to run a greenhouse, knowledge that served him well when he began to manage Sonoma Grapevines in 1976. Kunde started advertising, attending trade shows, and building a network of growers. He built up the struggling business, and then bought it in 1982. Within 10 years, Sonoma Grapevines became the largest grapevine nursery in the country with 800 employees and 600 acres in Sonoma and Fresno counties.

The nursery also sold flowers, and that's how Kunde met Saralee McClelland, a dedicated advocate for Sonoma County agriculture who managed the local harvest fair. She needed flowers to decorate the exhibit hall. After Kunde arrived with a load of marigolds, they shared views on flower arranging. He was smitten. They married in 1980.

STEVEN KNUDSEN/SONOMA COUNTY FARM BUREAU

Rich Kunde with his late wife, Saralee Kunde.

She left the fairgrounds to manage the Kundes' growing vineyards. They grew 84 varieties on 500 acres, selling their grapes to 63 wineries. But the workload took a toll, so they sold the nursery in 2000 and scaled back on vineyard acreage.

The Kundes have been extraordinarily generous with their success. They raised millions of dollars for agricultural causes and created scholarships for youth involved in agriculture and the food industry. At UC Davis they established the Richard and Saralee Kunde Scholarship for viticulture and enology students. Plans are in the works to establish an endowed faculty position in the Department of Viticulture and Enology.

Sadly, Saralee passed away in January 2014. Kunde is raising funds to build her dream — a $1.9 million pavilion at the Sonoma County Fairgrounds that will be the showcase for agricultural education.

"She did so many things for young people," Kunde said. "They thank me so much for Saralee."

Their shared legacy lives on at UC Davis and beyond in the lives they have touched.

— John Stumbos

UC Davis landscape architecture students work on design-build projects outside Hunt Hall.

KATIE HETRICK/UC DAVIS

DESIGN IT, BUILD IT

Truscott donation allows landscape architecture students to dig in

MORE LANDSCAPE ARCHITECTURE STUDENTS will have an opportunity to acquire hands-on experience before graduation with the creation of a new fund that supports design-build projects. The endowment for CA&ES undergraduates majoring in landscape architecture was kick-started with a donation from Marq Truscott and his wife, Rachel Ragatz Truscott.

"Rachel and I love to build things," said Marq Truscott, president of the landscape architecture firm Quadriga. "We thought this was an excellent way to help landscape architecture students learn how to choose the smartest way to put things together, while still achieving their design aesthetic. They will understand how things come together physically in the field, and that will be part of their toolkit."

The design-build endowment provides money for materials to allow students to "learn by doing" in their advanced landscape architecture classes. It augments existing opportunities for hands-on experience, which are costly and limited by financial constraints.

"I've been hiring UC Davis landscape architecture students for years, and they are amazing thinkers," said Marq Truscott. "They write and they research really well. Getting hands-on design and build experience — this technical component — is the final piece of the puzzle that will set them apart from their competitors."

Although Marq Truscott is a graduate of Cal Poly Pomona, he has many ties to UC Davis. He is a CA&ES lecturer in landscape architecture, and his firm has worked on projects for campus such as the new Aggie Stadium. Rachel Truscott completed her landscape architecture degree at UC Davis in 2007, worked in the field, and then returned to campus to do a master's degree in civil engineering with the Center for Watershed Sciences.

Both Truscotts hope to inspire their peers to contribute to the endowment they started that will allow more landscape architecture students to get their hands dirty.

— Robin DeRieux

NEW FACULTY RECRUITS

Joining CA&ES in 2014 were 17 new faculty members. Additional faculty searches are underway.

For more information, visit **caes.ucdavis.edu** and click on New Faculty Profiles.

TIM BEATTY
Associate Professor, Agricultural and Resource Economics
My research relates to the empirical analysis of food consumption behavior, in particular as it relates to health outcomes. I focus on food consumption and the demand for nutrition and health at both the household and aggregate levels.

GAIL BORNHORST
Assistant Professor, Biological and Agricultural Engineering and also Food Science and Technology
My lab uses quantitative approaches to describe transport, breakdown, and absorption of food in the digestive system. Our goal is to increase consumer health benefits, improve food safety, and optimize food processing.

CHARLIE BRUMMER
Professor, Department of Plant Sciences, and Director, Center for Plant Breeding
My research program focuses on developing cultivars and germplasm of alfalfa and other crops for forage and bioenergy uses.

YUFANG JIN
Assistant Professor, Land, Air and Water Resources
My lab seeks to improve our ability to monitor and understand changing ecosystems on a landscape scale using remote sensing technology. As climate change and extreme weather events cause rapid change in both natural and agricultural ecosystems, this research can provide support for more effective resource management, mitigation, and adaptation decisions.

MAELI MELOTTO
Assistant Professor, Plant Sciences
We investigate how the plant immune system works to fight against pathogen infection and how pathogens employ virulence strategies to overcome plant defenses. This research helps minimize the impact of diseases and economic losses in agriculture worldwide and helps reduce food contamination in crops such as leafy vegetables.

MICHAEL MIENALTOWSKI
Assistant Professor, Animal Science
I am a veterinarian who specializes in how cell biology and niche affect an animal's musculoskeletal system. I am particularly interested in musculoskeletal injuries and disorders for performance species such as dogs, horses, and humans, as well as for production species such as cattle, swine, and poultry.

CHRISTIAN NANSEN
Assistant Professor, Entomology and Nematology
We investigate innovative crop management as a form of "preventive medicine" that reduces reliance on pesticide applications. This requires an in-depth understanding of how insect pests select host plants and how crops can be grown to reduce their susceptibility to these pests.

ELINA L. NIÑO
Assistant Cooperative Extension Specialist, Entomology and Nematology
Honey bees are facing a global decline. My lab focuses on the characterization of biological factors that regulate queen reproduction in order to maintain resilient honey bee stock, as well as understanding various stressors impacting honey bee health.

CLARE CASTEEL
Assistant Professor, Plant Pathology
I focus on the different ways pathogens can alter plant-insect interactions and the key molecular mechanisms responsible for these relationships. These discoveries can help improve current control strategies for plant diseases in agricultural systems.

DANIEL EWON CHOE
Assistant Professor, Human Ecology
My research focuses on the early lifespan development of antisocial behavior and mental health problems. Ultimately, I hope to inform prevention efforts and policies that reduce the burden of antisocial behavior to society.

AMÉLIE GAUDIN
Assistant Professor, Plant Sciences
The goal of my research program is to use agroecological principles to help develop efficient and resilient cropping systems. We study how management practices alter agroecosystem productivity and the delivery of ecosystem services along input and stress gradients.

DANIEL GEISSELER
Assistant Cooperative Extension Specialist, Land, Air and Water Resources
I examine nutrient turnover and plant nutrition in agricultural systems, particularly nitrogen, and the impact of different nutrient management practices on California crops. The ultimate goal is to develop accurate, user-friendly tools for growers to support their nutrient management decisions.

MATTHIAS HESS
Assistant Professor, Animal Science
The goal of my lab is to understand microbial systems and processes on multiple levels — from molecule to organism, to community, to ecosystem. We seek to identify microbes and microbial enzymes that will have beneficial applications in agriculture, industry, and medicine.

JORGE RODRIGUES
Associate Professor, Land, Air and Water Resources
My research focuses on microbial biodiversity in soils and how the microbe population varies when there are changes in the way land is used. These discoveries will help mitigate the risks of biodiversity losses, particularly in tropical forests, since these rich sources of biodiversity are the last frontier for agriculture.

AMEER TAHA
Assistant Professor, Food Science and Technology
The adverse effects of linoleic acid are thought to be caused by chemical transformations that occur during cooking or food processing. I examine the extent of oxidized linoleic acid metabolite formation during various food processing or handling conditions and the impact of these metabolites on the brain.

ANNE TODGHAM
Assistant Professor, Animal Science
My research group examines the impacts of climate change stressors on the physiological performance of aquatic animals in ocean, estuarine, and freshwater environments. A better understanding of the vulnerability of aquatic organisms will help identify management opportunities for the conservation of wild species and help evaluate the impact of intensified aquaculture practices under a changing climate.

FLORENT TROUILLAS
Assistant Cooperative Extension Specialist, UC Davis Plant Pathology, at Kearney Agricultural Research and Extension Center in Parlier
My research goals are to contribute to the understanding of plant diseases in fruit and nut crops and to develop strategies to control them.

— Robin DeRieux

CA&ES Outlook

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ONE PLANET, ONE FUTURE
One UC DAVIS

Left, Professor Coby Lorenzen with his experimental apricot pit removal mechanism. Below, a faculty and staff holiday party in 1955.

DEPARTMENT OF BIOLOGICAL AND AGRICULTURAL ENGINEERING

CENTENNIAL GALA

Saturday, October 3, 2015 • 6 p.m. • UC Davis, Shields Library Courtyard

The Department of Biological and Agricultural Engineering (BAE) will celebrate 100 years of engineering excellence on Saturday, October 3 at the Shields Library Courtyard.

"Join us as we celebrate our tradition of excellence in teaching, research, and outreach," said department chair Bryan Jenkins. "We will honor our past achievements and look forward to how the department will contribute in helping solve the great challenges and opportunities of this century."

BAE is one of the oldest departments on campus, starting in the University Farm era. Over the last century the department's engineers helped change California agriculture. Faculty innovations include the inertial tree shaker for mechanical harvesting of many tree fruits and nuts, forced air cooling of produce, and a rollover protection structure for tractor drivers. The department revolutionized the tomato industry with the mechanical tomato harvester. In addition to agricultural and natural resource engineering, the department has programs in biotechnology and food engineering that have helped the department integrate engineering and life sciences for more sustainable production of food, energy, and materials.

Learn more about the centennial celebration: **bae.engineering.ucdavis.edu**.