

periodiCALS

THE MAGAZINE OF CORNELL UNIVERSITY'S COLLEGE OF AGRICULTURE AND LIFE SCIENCES

VOL. 9 • ISSUE 1 • 2019



UNFILTERED

Protecting New York City's
water at its source





inside

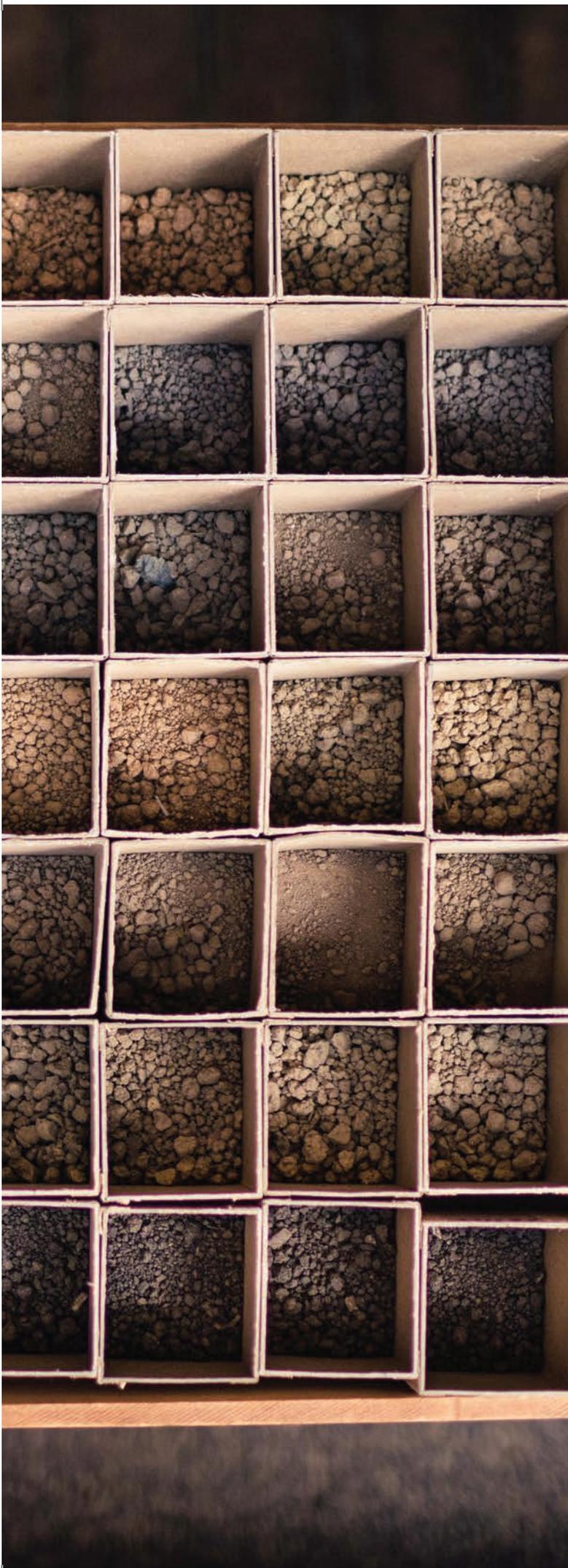
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Photo: Allison Usavage

LEFT: Healthy soil is vital to a healthy planet. The Cornell Soil Health Lab analyzes samples from all over the world, providing clients with comprehensive insights into the biological, physical and nutrient properties of their soil.

COVER ILLUSTRATION: Cristina Eagan



dean's message

Throughout U.S. history—including during the early days of our college at the turn of the 20th century—farms and rural communities have faced immense pressures from disruptive factors. Chronic stresses in agriculture include always being at the mercy of nature, while needing to maintain a labor force and to secure a reliable market. In addition to these ongoing challenges, more recent stresses include long-term low commodity prices, trade uncertainty and an increasingly unpredictable climate. These conditions have an impact on the rural and upstate communities we serve as New York's Land-Grant university and the rural economies across our nation and around the world.

In the face of such challenges, innovation and technology are essential. For example, farmers in the 1930s faced a great global economic depression and extended drought conditions. For those able to invest in new technologies—such as replacing draft horses with tractors—farm productivity and yield improved. By 1945, tractors overtook horse power on U.S. farms, helping to provide better returns. We are at a similar turning point today. Low commodity prices are constraining resources available to farmers for reinvesting in new capital equipment at a time when such investments are more important than ever to ensure a farm's future.

Cornell CALS aims to help farmers, communities and businesses embrace new technologies through innovation and the application of pioneering solutions to today's vexing challenges.

In this issue of *periodiCALS*, you'll read about our investment in innovative programs, collaborations and technologies that are focused on today's needs while anticipating tomorrow's areas of inquiry.

Specifically, you'll learn about our cross-campus research, teaching and extension initiative focused on digital agriculture. This pan-university initiative leverages Cornell's strengths at the intersection of engineering, data and information science and food systems research.

You'll also discover how we're transforming the traditional lecture-style



Photo: Jason Koski

Dean Kathryn Boor '80 and New York State Department of Agriculture and Markets Commissioner Richard Ball open the renovated Cornell Food Venture Center pilot plant at Cornell AgriTech.

classroom experience to an active learning environment to engage students who are used to immediately accessing any possible fact with the swipe of a finger.

And you'll read about our newly renovated Cornell Food Venture Center, which offers state-of-the-art food-processing technology to help New York's food businesses of all sizes turn their innovative ideas into safe commercial food products while fueling our economy from upstate to downstate.

These advancements illustrate the college's goal of meeting the changing needs of our world through investments in innovative research, teaching and extension. I hope these examples—along with the rest of the content featured in this issue—inspire your optimism for the future.

Thank you, as always, for your continued support and interest in CALS.

A handwritten signature in black ink, appearing to read 'Kathryn J. Boor'.

Kathryn J. Boor

Ronald P. Lynch Dean of the College of Agriculture and Life Sciences

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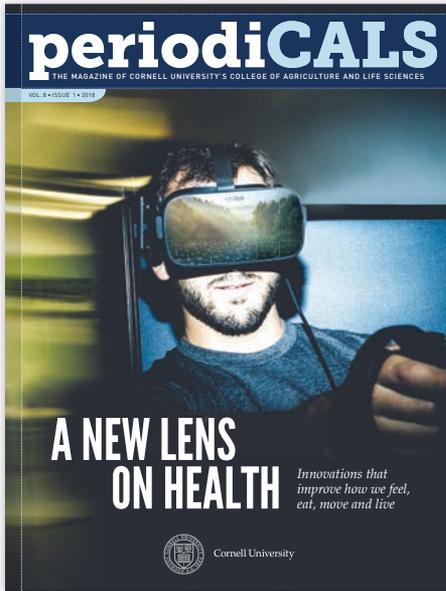
Help the Big Red go green by opting out of receiving the print edition at periodicals.cals.cornell.edu/go-green.

The College of Agriculture and Life Sciences has sustainability as a core value. The magazine was printed regionally using soy-based inks on post-consumer fiber paper certified by the Forest Stewardship Council in an eco-friendly process that recycles virtually all chemical, paper and metal waste.

SEND STORY IDEAS TO THE EDITOR AT
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readers' letters



Recent research on sleep problems suggest that it's healthier if you're not watching TV or using an iPad, cell phone or Kindle for reading in bed before sleeping. I like to read before I go to sleep, and I often read magazines, which help me relax before sleeping. Even though I have the option of reading the alumni magazine online (during the day at my computer), I prefer to receive the hard copy print version of *periodiCALS* at home and recycle it when I am done.

By the way, I enjoyed the latest print issue received at my home a few days ago (before getting it via email).

—Lee B. Kass, Ph.D. '75

periodiCALS arrived at about 2 p.m. yesterday, and I totally devoured it—from cover to cover! I can't even pick a favorite article. They were all so interesting: international, health, science, environment—it was all there. Great issue! THANK YOU!!!!

—Gail Clauer



—Maureen McCann '02, commenting on Alan Sealls '85 being named by *Reddit* as "Best Weatherman Ever"

We want to hear from you!
Connect with us on social media
or send story ideas to the editor
at calsnews@cornell.edu.

Letters may be edited for length and clarity.



Photo: Jenny Stockdale

The Cornell CALS Online Store

A new way to show your college pride

cals.cornell.edu/store



Cornell CALS
College of Agriculture and Life Sciences

around the quad



CORNELL AGRITECH GROWS LEGACY OF INNOVATION

For more than a century, innovations developed at our New York State Agricultural Experiment Station have propelled economic development and delivered practical solutions that help farmers and businesses thrive. In August 2018, our historic scientific institution was given a new name: Cornell AgriTech.

Agriculture and food are multibillion-dollar industries in New York, and the name change underscores the value Cornell AgriTech brings to improving the health of the people, environment and economy of the state and beyond. Located 50 miles from Ithaca in Geneva at the northern end of Seneca Lake, Cornell AgriTech is home to more than 300 of our faculty, scientists, staff and graduate students working together at the leading edge of food science, entomology and plant sciences research.

Cornell CALS scientists in Geneva have developed more than 280 new varieties of fruits and vegetables, pioneered insect attractants for pest control, and invented advanced technologies to improve crops and food safety. Today, Cornell AgriTech has expanded to more than 900 acres, including a dozen research farms, more than half a million square feet of laboratory and greenhouse space, and two associated laboratories in the Hudson Valley and Lake Erie regions.

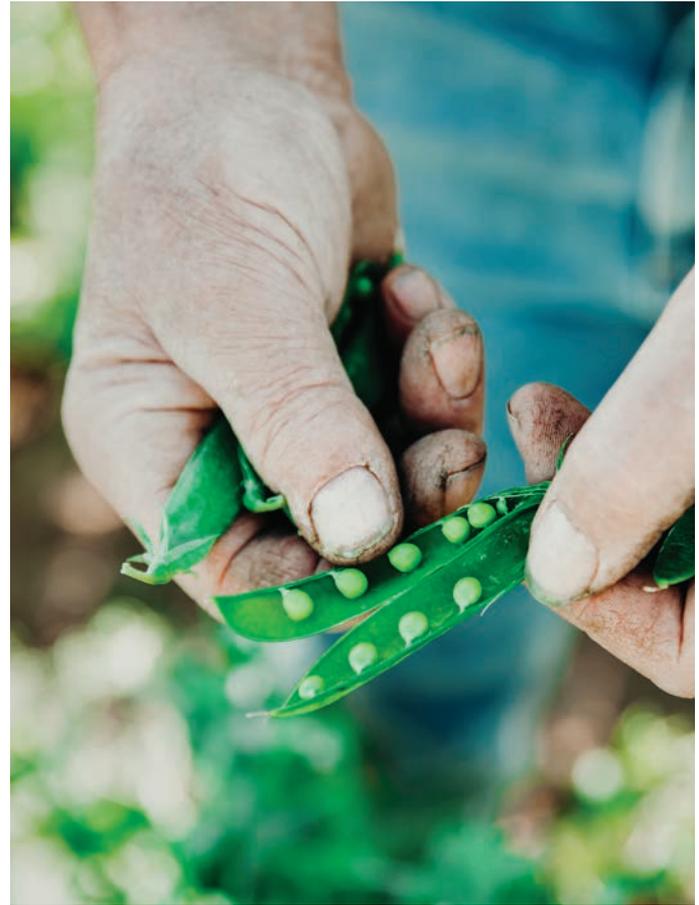
Guided by our Land-Grant mission, the Cornell AgriTech community continues to grow and evolve, working together across disciplines to reimagine the future of food and agriculture systems.



» Cornell AgriTech has a vibrant vision to improve the health of the people, environment and economy of New York and beyond through innovative food and agricultural science. "Our strategy for innovation in agricultural and food science encompasses three key areas," says Cornell AgriTech's Goichman Family Director Jan Nyrop. "Our expert scientists are leading the way through successful plant breeding, crop management and implementation of techniques by industries."

« Graduate student Larissa Osterbaan innoculates plants in a walk-in growth chamber in Barton Hall.





^ Faculty are using innovative ways to understand and manage crops and the conditions that affect them.

Cornell AgriTech expertise does not stay on campus. Researchers are disseminating expertise and resources to grow the food and agricultural industries of New York.

^ Plant breeders are working with some of the most popular food crops to improve flavor and nutrition and breed plants optimized to climate conditions.



Photos: drone, Allison Usavage; others, Justin James Muir

around the quad



KEVIN HALLOCK NAMED DEAN OF SC JOHNSON COLLEGE OF BUSINESS

Economist tapped to lead business programs

Economist and scholar Kevin F. Hallock has been named dean of the Cornell SC Johnson College of Business. His term extends through June 2024.

Hallock, a compensation and labor market expert whose term started in December 2018, served previously as dean of the School of Industrial and Labor Relations (ILR). Among his achievements, Hallock guided the school through a strategic planning process, made important investments in the student experience and student well-being and introduced an ILR initiative to bring together students, staff and faculty around a common theme.

Launched in 2016, the SC Johnson College of Business comprises Cornell's three accredited business programs. It jointly administers the Charles H. Dyson School of Applied Economics and Management with CALS, and oversees the School of Hotel Administration and the Samuel Curtis Johnson Graduate School of Management.

CROSS-COLLEGE PROGRAM IN ENVIRONMENT AND SUSTAINABILITY LAUNCHES

Major expands to offer humanities perspective

Launched in fall 2018, our program in environment and sustainability is guided by a single principle: Understanding and resolving environmental problems require an interdisciplinary approach.

With that insight firmly in mind, the environmental and sustainability sciences (ESS) major has been broadened to include a brand-new concentration in humanities, opening opportunities for students to explore how art, literature, music and communication influence how humans perceive and respond to environmental issues. The expanded major is a cross-college collaborative effort available to students in both the College of Arts and Sciences and CALS.

Bringing in the humanities perspective is crucial to helping society act on science, said Cliff Kraft, who directs the cross-college major and is a professor in the Department of Natural Resources. "Scientists often fall into this trap of thinking, 'Here is the answer; now the world will go out and do it.' But



The environmental and sustainability sciences major expands a curricular focus that incorporates strengths in environmental sciences, social sciences and humanities, which are dispersed across multiple departments and colleges.

that's not how humans respond," Kraft said. "I think there are instances where through literature, through art, through music you can actually better understand how people interpret the environment surrounding them than using either the social or natural sciences."

Deans of both colleges are making resources available to help faculty create new interdisciplinary courses in support of the ESS major.



Ikenna Onyekwere '19 and Sarah Aiken '18 joined other Intergroup Dialogue Project facilitators for a training session as they prepared for new student orientation.

INTERGROUP DIALOGUE PROJECT BROADENS STUDENTS' WORLDS

Diversity program expands to all incoming students

College is a time to connect authentically with people across cultures and identities. The Intergroup Dialogue Project (IDP), established at CALS in 2012, uses a structured process that operates on the premises that empathy can be learned and that students can practice creating a community in which people feel they can bring their full selves, without fear that they must change to be part of it.

IDP has become one of the main programs on campus to offer peer-facilitated courses and workshops that teach communication and collaboration across social, cultural and power differences to promote equity and democracy.

In the fall, for the first time, all of Cornell's 3,325 incoming first-year students took part in IDP sessions during orientation.

Experiential learning is a crucial component of the program. Participants reflect on their personal experiences while learning how they might be related to broader social and cultural structures, and everyone chooses a research topic related to their identity and to campus life.

"CALS is an extremely diverse college and was the first on campus to make diversity coursework mandatory, which was an important move because it ensures a variety of perspectives are represented in the classroom," says IDP director Adi Grabiner-Keinan. "This is crucial for learning about oneself and for engaging empathetically in a way that invites diverse perspectives in an effort to create shared meaning."

HACKING THE FARM

THE PLANET IS BECOMING MORE CROWDED.



The global population is **EXPECTED TO EXCEED 9.8 billion people** by 2050.



TO KEEP PACE with the population, world **FOOD PRODUCTION** will have to **at least double** by 2050.

TECHNOLOGY IS HELPING FARMS AND BUSINESSES RESPOND.

In 2016, **FARMERS** accounted for nearly **one-fifth** of all commercially used unmanned aerial vehicles,

COMMONLY KNOWN AS DRONES.



The **Cornell Initiative for Digital Agriculture (CIDA)** was formed to generate research across five colleges at Cornell at the intersection of agriculture, computer science and engineering.

More than **100 faculty** members from **FIVE DISCIPLINES** are collaborating on **DOZENS OF PROJECTS.**

» Turn to page 20 to learn more about CIDA and its efforts.

*Data from the National Academy of Sciences

NEIL LEWIS JR. '13, assistant professor
in the Department of Communication

Trained as a social psychologist, Lewis works in his Motivation and Goal Pursuit Lab to examine how and why people's identities and social contexts interact to influence their motivation to pursue their goals and success in achieving them. His research aims to understand processes underlying social disparities, especially in education and health, in order to better develop policies to address them.

As a social scientist, you explore how people's identities and their social context shape the meaning they make of their experiences and how that affects their behavior. What's the biggest takeaway from your research?

I really try to understand what motivates people to pursue their various goals in life and try to figure out what are things that we could do to help people achieve those goals. The domains that I focus on the most are education and health because the implications of that work are very clear. I want as many people as possible to attain a good education and good health. My research examines just how much the interactions between people's identities and their social context influence the meaning they make and their behavior. These interactions can matter a lot in trying to predict how people behave in particular situations.

American life is much different today than it was even 20 years ago. Do you feel as if we are moving in the appropriate direction to sustain the progress that has been made?

That's a tough one. I'd say yes and no. On the optimistic side, I see more companies and policy makers incorporating scientific evidence into their decisions and policies, and that can help us sustain some progress. The pessimistic side is that we sometimes overestimate the amount of progress that we have made. Americans tend to overestimate progress in economic and racial issues. And that's a problem because if we perceive more progress than has really been made and don't understand the reasons behind (lack of) progress, then we can start to think we don't actually need those policies—the very policies that enable progress to happen. That's a big problem.

Why is there that misperception? Is it because Americans are optimistic in general, or do we not realize the depth of the problem?

Both, actually. One example that comes up a lot when thinking about racial progress is Obama's presidency. His election has led many to believe that things must be fine now. Don't get me wrong—a lot of good things have happened. We've had a great deal of economic growth for instance. But at the same time, there's rising inequality; not everyone is benefiting equally from that growth. So if we are only looking at part of the picture, then we can misperceive what the whole reality is.

How does your work drive progress to make the world better?

I study basic communication and psychological processes, but



I also have a broader goal of making that work useful. That often involves going out in relevant real-world settings—whether that's a school, a health clinic or the community where the issues are happening—and studying those processes there. And that allows us to figure how useful the work can be in addressing the problems that we are facing. But then, in addition, we sometimes have to go outside of the academic box to communicate more broadly. Writing op-eds, meeting with policy makers, engaging on social media—these are a few ways that I engage with communities more broadly to make sure the results of our work gets out there and makes a difference.

These are huge, systemic problems you are tackling. What keeps you motivated?

One of my mentors in graduate school, Professor Frank Yates, used to tell us that we should study the things that keep us up at night. Whenever I pick up a new report—about education, health and/or increasing environmental disparities—I have a hard time sleeping, and I feel as if I have to do something. The thing I know how to do best is research, so I put those skills to use to study the issues. Then, when we learn something useful, we work with practitioners and policy makers to disseminate the research results so that it can hopefully move the needle on some of these disparities.

 @NeilLewisJr

CALS in quotes

“Almost every ant you’ve ever seen is female. They’re the workers that go out and gather food. They’re the soldiers that battle other colonies. They’re the caregivers for young ants. People think of toughness and industriousness as male traits. With ants, it’s just the opposite. I love that.”

—**Corrie Moreau**, professor in the Department of Entomology, speaks to *National Geographic* about insect evolution and the role of gender.

“Climate change is one of the most important issues of young people’s time. It’s more than just flicking off the lights at home. We have to engage people.”

—**Jeff Niederdeppe**, associate professor in the Department of Communication, speaks to *Reuters* about what drives young people to act on climate change.

“We were looking to develop very flavorful grapes with large berries and large clusters, and we’ve achieved that with Everest Seedless.”

—**Bruce Reisch**, professor in the School of Integrative Plant Science, talks to *Finger Lakes Times* about a new seedless grape he developed that is larger than a traditional Concord.

“Another five years will help us strengthen the long-term global sustainability of cassava—a crop important for food security and predicted to stand up to climate change and extended periods of drought or rain.”

—**Ronnie Coffman**, the Andrew H. & James S. Tisch Distinguished University Professor, director of International Programs at CALS and principal investigator of the Next Generation Cassava Breeding Project, talks about the second phase of the project to *Nigerian Tribune*, the oldest private newspaper in Nigeria.

“Flatfishes are total freaks of nature.”

—**Claire Fox**, doctoral student in the field of ecology and evolutionary biology, speaks to *National Geographic* about her research into fish locomotion and what it reveals about evolutionary traits.

“These phages can detect their host bacteria in sensitive situations, which means we can provide low-cost bacteria detection assays for field use—like food safety, animal health, bio-threat detection and medical diagnostics.”

—**Sam Nugen '99, Ph.D. '08**, associate professor in the Department of Food Science, tells *Forbes* about the genetically engineered viruses his lab has created to test water in hard-to-reach areas around the world.

“You don’t have these years where you can kick back and do what you normally do. You have to worry about bringing water in. You have to worry about irrigating your crop. You have to worry about whether you can get into the field early enough to plant corn because it may be too wet to get equipment in there.”

—**Art DeGaetano**, professor in the Department of Earth and Atmospheric Sciences, discusses in *The New York Times* the way unpredictable weather affects farmers in the state.

“She feeds them well past the period when they can forage on their own, and the nursing enhances their survival.”

—**Linda Rayor**, senior lecturer and senior research associate in the Department of Entomology, tells *The Atlantic* about jumping spiders that stay together as a family far longer than most spiders and continue to provide nutritious milk to their offspring.



“If Canada has to give up and reform the whole (dairy) system, it’s going to have a gigantic impact.”

—**Andrew Novaković**, professor in the Charles H. Dyson School of Applied Economics and Management, talks to *CNN* about the U.S. government’s efforts to restructure NAFTA.



UPSTREAM

Cornell CALS helps
deliver clean water to
New York City

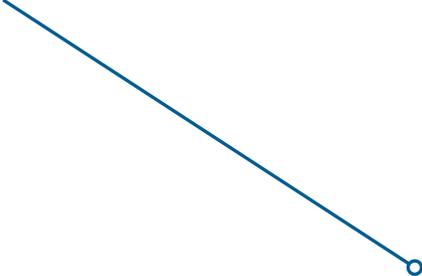


DOWNSTREAM

Photos, from top: Jason Koski; Deposit Photos



Millions of times each day, people living and working in the downstate New York area turn on their faucets and rely on a supply of unfiltered water from the Catskill Mountains about 125 miles away.



Delaware County, with its breathtaking scenery in the Catskills, is home to the watershed's headwaters, part of the largest municipal water supply in the United States. The entire system covers more than 1 million acres, delivering about 1 billion gallons of water daily through a vast infrastructure of reservoirs, aqueducts, tunnels and pipes to a million residents in Orange, Putnam, Ulster and Westchester counties and 8.6 million New York City residents.

Nineteen reservoirs on both sides of the Hudson River supply the New York City area's water. Those fed by older watersheds close to the city and east of the Hudson require filtration. But west of the Hudson, about 125 miles northwest of Broadway, the Catskill-Delaware watershed's six major reservoirs—Cannonsville, Pepacton, Rondout, Neversink, Ashokan and Schoharie—supply the unfiltered bulk.

Behind every drop of clean water traveling from Delaware County is a team of Cornell CALS scientists and Cornell Cooperative Extension (CCE) educators. For three decades, these experts have partnered with farmers, local and federal agencies and municipalities to develop custom plans to protect nearby streams from runoff, keeping drinking water pristine and affordable.

'SCIENCE WAS THE KEY'

Agricultural land dominates the watershed. Cannonsville, one of the largest reservoirs, is surrounded by nearly 200 dairy, beef, sheep and goat farms. Across the entire area, hundreds of farms are home to thousands of cows. Their nutrient-rich manure poses risks to aquatic ecosystems and downstream drinking water supplies. In the late 1980s, new surface water treatment laws set by the U.S. Environmental Protection Agency took effect. The EPA told New York City officials that the state would need to build a filtration plant—with a likely

price tag equivalent to nearly \$10 billion in today's dollars.

The New York City Department of Environmental Protection (NYCDEP), which has jurisdiction over the reservoirs and the surrounding land, received a "filtration avoidance" variance from the EPA. To qualify, the department needed to enlist the support of farmers, residents and other stakeholders in the watershed to keep the water clean.

The mission was straightforward but desperately complex in its implementation: Assist the watershed's farmers in spreading nutrient-rich manure in an environmentally sensitive way, and balance the needs of animals and cropland so that the manure improves soil health but its nutrients do not trickle into drinking water.

For years, Cornell's New York State Water Resources Institute had been providing practical knowledge for the region, so the agencies and farmers again turned to the university for additional scientific guidance. "The various organizations needed a framework to work together," said Karl Czymmek '86, senior extension associate in Cornell's PRO-DAIRY Program, which assists New York's dairy industry in economic development. "Science was the key," he said.

The effort was accelerated by the Cornell Nutrient Management Spear Program, led by Professor Quirine Ketterings in the Department of Animal Science. Ketterings, who joined CALS in 1999, pioneered an approach that accounts for nutrients entering a farm system and where they all go. The nutrient mass balance software her team developed provides precise accounting to manage feed and waste.

"We can calculate how much phosphorus, nitrogen and potassium arrives at the farm and then how much of it leaves by way of milk production—and how much stays on the farm and is potentially subject to loss to the environment," Ketterings said. ▶

Professionals working in the watershed were among the few around the country to develop and execute this style of precision feed management, said Paul Cerosaletti '89, M.S. '98, an agronomist and dairy cattle nutritionist for Cornell Cooperative Extension of Delaware County.

"Importantly, we went from developing the science to implementation on a large scale across a number of farms. It's more than a field-laboratory experiment," Cerosaletti said. "It's a water-quality program implemented across farms that's efficient and fits into the conservation world."

Tools to measure and prevent runoff continue to be improved. Mike Van Amburgh, Ph.D. '96, professor in the Department of Animal Science, is the driving force behind the Cornell Net Carbohydrate and Protein System, now one of the most widely used cattle nutrition models in the world. CCE educators input a farm's data into the model to evaluate the cattle rations and use the model's output to develop detailed, precision feed management recommendations.

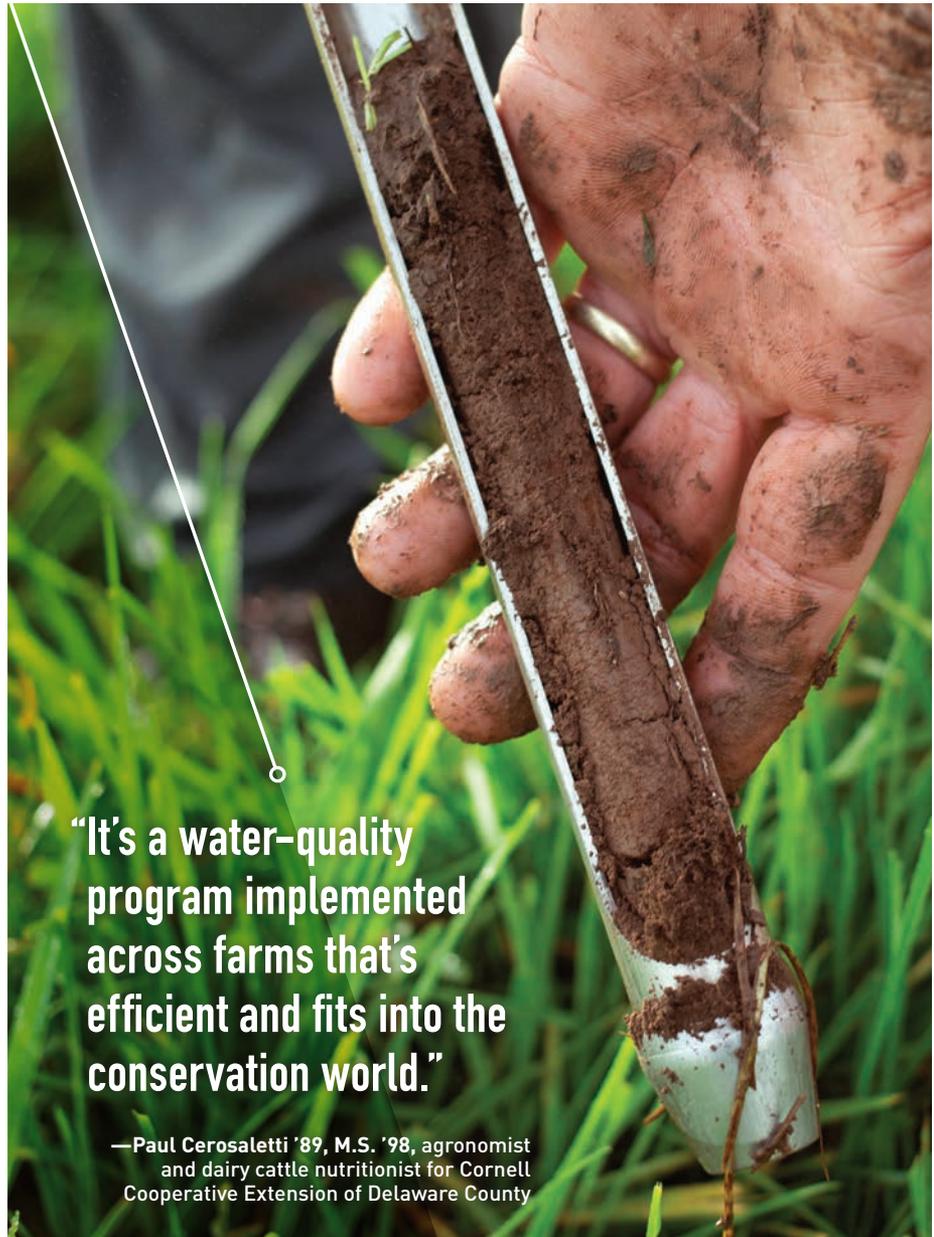
"We can tailor decisions to the forages and the cow to create a diet that maximizes cow health and minimizes the environmental impact of food production," said Van Amburgh.

Efforts to mitigate farm runoff into the streams, along with upgrades to poorly functioning wastewater treatment plants proved successful. From the late 1980s to 2010, these projects caused the amount of phosphorus going into Cannonsville to drop by 55 percent, and 51 percent at nearby Pepacton Reservoir, according to the agency's statistics.

'THE WATER STARTS HERE'

Seven full-time professionals from CCE offer best-management practices backed by Cornell CALS science and experience. They help nearly 300 farms manage soil excellence, produce high-quality crops, feed balanced rations, maintain herd health and, most importantly for New York City's water supply, prevent manure runoff from wending its way into the streams.

Dennis Reinshagen tends to Holstein and Jersey cows in South Kortright, New



"It's a water-quality program implemented across farms that's efficient and fits into the conservation world."

—Paul Cerosaletti '89, M.S. '98, agronomist and dairy cattle nutritionist for Cornell Cooperative Extension of Delaware County

York. On dry days, he walks the cows from the barn to a rotation of pastures for grazing. On average, each cow produces 2,430 gallons of milk annually, and Reinshagen perpetually organizes feed, milks cows and spreads manure. But he remains mindful that his farm and hundreds of others in the nearby area affect the drinking water of 9.6 million people in and around New York City.

"The water starts here," said Reinshagen. "It's something to be proud of. Water quality is important to people who live in New York City, and it is important to farmers, too, as the watershed helps keep agriculture

sustainable," he said. "A dairy cow drinks 30 to 50 gallons of water a day, and milk is about 87 percent water—so it's in my best interest to maintain good water quality."

The partnership among the farmers, governmental agencies and Cornell is unique. "You don't really see this around the country, but it is an integral part of our watershed program," said Craig Cashman, executive director of the Watershed Agricultural Council. "This kind of expertise is critical to watershed success. Cornell scientists and Cornell Cooperative Extension bring a skill set that is unmatched."

—BLAINE FRIEDLANDER



FARMS AND MILK PRODUCTION IN NYC'S CATSKILL-DELAWARE WATERSHED

290 farms

.....
1 million
ACRES OF
FARMLAND

Milk
IS ABOUT
87% water

1 cow
PRODUCES ABOUT
2,430 gallons
OF MILK ANNUALLY

1 cow
CONSUMES
30 to 50 gallons
OF WATER A DAY

THE CATSKILL-DELAWARE WATERSHED BY THE NUMBERS

.....
125 miles
FROM NYC

.....
1 billion
gallons
OF DRINKING WATER
TO NYC PER DAY

.....
1.8 million+
WATER-QUALITY
TESTS AND ANALYSES
PER YEAR

.....
APPROXIMATELY
\$10 billion
SAVED BY REDUCING
NEED FOR
FILTRATION PLANT



Learn more at
cals.cornell.edu/unfiltered

A RECIPE FOR SUCCESS

How the Cornell Food Venture Center supports food entrepreneurs



Olga Padilla-Zakour, Ph.D. '91, director of the Cornell Food Venture Center, back left, with, clockwise, Bruno Xavier, Ph.D. '08, Sue Brightman, Cynthia James and Shannon Prozeller in the pilot plant at Cornell AgriTech.



Bisharo Ali prepares bottles of apple fenugreek juice in her commercial kitchen in Buffalo.

Bisharo Ali and her family arrived in the U.S. as refugees from Somalia in the mid-1990s. At their home in Buffalo, New York, Ali regularly experimented with family recipes using fenugreek and tamarind, traditional ingredients known for their health benefits in Somalia. Over time, she perfected an apple fenugreek drink and marinade, and dipping sauces made from a tamarind base.

Friends and family who tasted Ali's sauces recognized something special, and they encouraged her to start her own company. Najah Foods, using the Somali word "najah," which means "success," was born.

Entering into the startup world is no easy task, so Ali turned to the Cornell Food Venture Center (CFVC) for help in turning a family favorite into a store-ready product.

"Experienced cooks can make the same delicious food without ever writing a recipe down, but a set formulation and manufacturing process is the first step to ascertain safety of the final product," said Bruno Xavier, Ph.D. '08, a food microbiologist and extension associate at the CFVC. "So, our first goal is to work with the manufacturer to translate the recipe into a scheduled process—which is an exact and

reproducible formula that is revised to ensure safety—without compromising the quality of the final product."

With Ali, the center worked closely to optimize her products so that they conformed to food safety regulations. The Cornell food scientists recommended acidity adjustments to keep the sauces stable on the shelf and offered guidance on creating a standard overall production process, like shifting from fresh tomatoes to canned to accommodate larger scheduled production.

Today, Ali sells her healthful sauces in eight stores in the Buffalo area, with a goal to "move my product through every store in America," she said.

More than 500 small food manufacturers like Ali work with the CFVC each year on food safety standards and regulations as the experts provide tools, techniques and solutions for meeting those codes. Now in its 30th year, the center helps in bringing approximately 2,000 products to market each year, aiding startups and established companies alike.

"Technology-driven solutions are key to advancing today's food industry, and our facilities here at Cornell allow food entrepreneurs across New York and the Northeast to develop products that are safe, stable and marketable," says Olga Padilla-Zakour, Ph.D. '91, director of

the CFVC and professor and chair of the Department of Food Science.

The family-owned, Rochester-based grocery chain Wegmans, with 98 stores across New York, Pennsylvania, New Jersey, Virginia, Maryland and Massachusetts, has long relied on its partnership with CFVC food science experts. Collaborations to ensure safety, stability and shelf-life extension of more than 400 products have enabled them to focus on innovation.

The Wegmans deli operations, for example, which rely on sandwich toppings prepared in bulk and shipped to stores across the chain, would not have been possible without collaboration with the CFVC, explains Kathleen O'Donnell '83, M.S. '95, director of food science and regulatory affairs at Wegmans Food Markets.

"The Cornell Food Venture Center is an invaluable resource for New York companies. We use it not just for what we are doing at Wegmans, but we've sent many of our suppliers to Cornell to develop and work on their products," O'Donnell said. "It's something that we have in New York state that is so important to the food industry and agriculture."

—HILLARY CREEDON AND
KRISHNA RAMANUJAN

NEW ROOTS ARE FOUNDATION FOR BIG CHANGES

Rootstock program reimagines how apples are grown

Bite into an apple, and you're tasting the fruit of scientific progress with deep roots. Apple-growing operations over the past half-century have undergone a stark transformation. Large, stately trees have given way to diminutive ones spread across wires like grapevines. But the story of the modern apple orchard begins in many ways below ground.

Almost all commercial growers now graft branches of a preferred apple variety—say Gala or SnapDragon or any one of the thousands of other options—onto chosen rootstocks. These rootstocks provide optimal attributes below ground while allowing growth of any fruit variety above. Rootstock breeding has made a dramatic shift in orchards around the world, influencing attributes such as the size and shape of the trees and their resiliency in withstanding disease.

The Cornell University/U.S. Department of Agriculture apple rootstock breeding program at Cornell AgriTech in Geneva is one of only six functioning programs worldwide and the only one in the western hemisphere. The Cornell program has released 15 apple rootstocks since 1982, and it continues to influence major changes in orchards across New York, the U.S. and around the world.

"Dwarfing rootstocks have allowed fruit growers to plant apple trees only two to three feet apart and to develop tall, slender, spindle-type trees that have much higher yield and better fruit quality resulting in much greater profitability for New York apple growers," said Terence Robinson, professor in the School of Integrative Plant Science and co-leader of the program since 1994. "The dwarfing rootstocks are central to this progress."

The first shift in apple orchards started more than a century ago when scientists at East Malling Research in the United Kingdom discovered rootstocks that produced shallower roots. In turn, the tree above grew shorter and produced earlier than traditional apple trees. The resulting trees, which look more like



bushes, made harvest simpler and production less expensive. East Malling's standard-bearer rootstock, the M9, is still planted in orchards throughout Europe and America.

But while that rootstock improved production in many ways, it also introduced vulnerabilities, particularly to a disease called fire blight. This bacterial pathogen infects the flowers of apple trees as they bloom. The disease gets its name because of the way leaves and flowers of infected trees look as though they've been burned. Plus the pathogen spreads like wildfire: One epidemic in Michigan in 2000 caused an estimated \$42 million in damages, and the disease has ravaged orchards from New York to Washington.

"The Washington apple-producing region has experienced increasing fire blight pressure for the last five years," said Tom Auvil, a grower and researcher from Washington state. "In 2018 the losses have reached epic levels. Several leading firms have been transitioning to new rootstocks from Geneva as the cornerstone of efforts to combat this disease."

In 1968, visionary Cornell CALS apple breeders James Cummins and Herbert Aldwinckle recognized the



shortcomings of M9 and established the rootstock breeding program at Cornell with the express purpose of producing rootstocks that were resistant to fire blight. The researchers retained the useful “dwarf” feature but worked to find roots that could also withstand real-world orchard villains: bacteria and viruses, fungi, drought and flooding, among others.

The first fire-blight-resistant Geneva rootstock was released in 1991, and 13 more have followed.

One of those, G.41, now makes up 20 percent of the national market for apple rootstocks. Released in 2005, it was selected as an elite variety for its high productivity and resistance to diseases like fire blight and crown rot, and to pests. By 2011, about 1 million plants were in production. G.41’s popularity has since soared, with 5 million plants in production in 2017, and it is the primary rootstock used in the launch of the new apple variety Cosmic Crisp.

A company in Washington planted two orchards of 150,000 trees each—one with G.41 rootstock and another with M9. None of the G.41 trees were lost during the 2018 spring fire blight epidemic, while about 20 percent of the M9 rootstock was lost.

“Dwarfing rootstocks . . . have much higher yield and better fruit quality resulting in much greater profitability for New York apple growers.”

—Terence Robinson, professor in the School of Integrative Plant Science

“When you lose a large number of trees like that, you end up having costs for replacements, missed revenue for each tree lost, costs of infrastructure and wasted spray treatments,” said Gennaro Fazio, a USDA-Agricultural Research Service scientist and adjunct Cornell professor who took over as head of the rootstock breeding program in 2002. Fazio estimated that the G.41 trees saved the orchards hit by the blight more than \$20 million.

The Geneva rootstock line has flourished in recent years as fruit growers and researchers have discovered additional benefits beyond fire blight resistance. G.41 is also resistant to apple replant disease, which causes new apple trees to grow poorly in soil that previously had apple trees. The rootstock is cold hardy and can withstand the extremely cold winters in northern states and Canada. Additionally, it is resistant to woolly apple aphids, produces almost no root suckers (shoots) and increases yields up to 20 percent. Those characteristics have resulted in worldwide interest in the line.

“Our newest rootstocks produce many more fine roots than normal rootstocks, and we think this allows them to explore the soil more efficiently,” said Fazio.

Apple growing combines the beauty and the patience of good science. The newest rootstocks released in the last few years were first crossed in 1976. The varieties have undergone trials for disease, stress and drought, and have been planted in dozens of test orchards across the country.

“And yet, even after all the testing, we still find new things about these rootstocks,” Fazio said. “We’re always learning new things.”

—KRISY GASHLER

ADAPTATION

The world is changing; plant evolution shows how life responds

Plants develop and change constantly throughout their lives: One plant growing in the sun might grow shorter and stockier to support more fruit, while another in the forest might change the size or abundance of its leaves to maximize photosynthesis. Over time, these modifications have resulted in the development and evolution of a breathtaking abundance of forms and functions among plant life.

“Plants can’t get up and walk away, so they have to constantly adapt,” said Chelsea Specht, the Barbara McClintock Professor of Plant Biology in the School of Integrative Plant Science. In her lab and from research field trips conducted around the world, she combines molecular genetics, comparative genomics and evolutionary biology to study diversification in plants and the forces creating and sustaining that diversity.

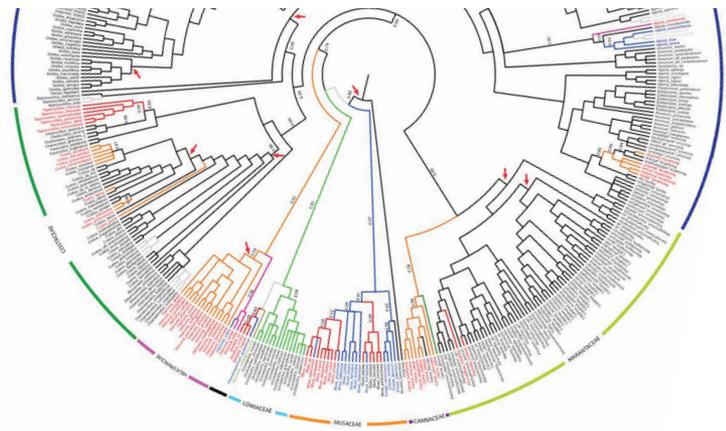
Understanding how plants have evolved in the past is

crucial to understanding how they might adapt in the future—especially under the existential threat of global climate change.

In the *Costus* genus, for example, plants were once pollinated only by insects. Over time, they evolved certain forms that enabled them to be effectively pollinated by hummingbirds. To understand why the plants evolved that way, among many other questions, Specht’s lab is cataloguing roughly 115 species in the genus. This process will inform questions about how genetic or environmental factors may have interacted to shift the way the plant evolves new species and diversifies its form over time.

“Plants have a whole toolkit of genes that they can deploy to enable them to adapt to different environments and eventually evolve new traits,” Specht said. “Can this evolution happen quickly? We hope so, because it’s going to need to.”

—KRISY GASHLER



Neotropical species such as *Costus curvibracteatus* (left) have evolved structures that allow pollination by hummingbirds from ancestral insect pollinated species native to Africa, such as *Costus maboumiensis* (right). The graphic (top) indicates the phylogeny of the order Zingiberales, with branches colored to indicate known pollinators.

Photos: Chelsea Specht. Top: Specht and P.J.M. Maas



Joseph McFadden, right, assistant professor in the Department of Animal Science, inspects a newborn calf with graduate student William Myers at the Harford Animal Science Teaching and Research Center.

MAPPING THE LIPID UNIVERSE OF COWS

Insulin resistance research in cows may have human health implications

As diabetes cases—particularly gestational and Type 2 diabetes—steadily increase in Americans, research into what causes insulin resistance in cows is holding promise as a way to inform care for cows and humans alike.

Cows do not develop diabetes, but they do develop a form of insulin resistance. This serves the important purpose of supporting milk production; however, if uncontrolled it may impair the health of the animal and dramatically reduce fertility and longevity. The swirl of complex lipids—fat-like substances known in the aggregate as the lipidome—in cows holds clues to the way insulin resistance develops. Joseph McFadden, assistant professor and the Northeast Agribusiness and Feed Alliance Partners Sesquicentennial Fellow in Dairy Cattle Biology, is using the analytical technology mass spectrometry-based lipidomics to biochemically map hundreds of complex lipids inside cows. By studying this constellation of lipids, McFadden has been able pinpoint ceramide, a known causal agent of insulin resistance.

When cows develop their own form of

insulin resistance, their ceramide levels are elevated. If ceramide rings familiar, it's because it is sometimes found in shampoo for its moisturizing properties. In cows, McFadden believes the molecule is driving a process that contributes to milk synthesis. Understanding it better could improve their milk production and overall health.

"We're testing different pharmacological and primarily nutritional approaches to modulate ceramide supply. With that, we hope to influence sensitivity and milk production," McFadden said. "This is opening new avenues to keep cows healthy and productive."

The lipid ceramide is also found in humans and Type 2 diabetics and might be part of the innate physiology of all mammals, McFadden said. Ceramide is being used as a diagnostic tool for cardiovascular disease and is considered a diagnostic and prognostic tool for diabetes, too.

"Although we study the dairy cow, we are also actively interested in determining whether ceramide is a predictor for diabetes in humans," he said.

McFadden said there is promising

research for humans and cows suggesting that through diet, ceramide production can be controlled. Using livestock models to study human conditions is "something we should do more of," said McFadden. Though his primary research is on cows, he hopes the biomedical community can learn from some of his work.

—KELSEY O'CONNOR

"This is opening new avenues to keep cows healthy and productive."

—Joseph McFadden, assistant professor and the Northeast Agribusiness and Feed Alliance Partners Sesquicentennial Fellow in Dairy Cattle Biology

THE GREAT DISRUPTION

Nearly 10 billion people will live on Earth by 2050; digital agriculture will help to keep them fed



Garrett Miller '07 moves deliberately through the dairy barn, looking for specific new and expectant mothers after an alert on his computer indicated signs of illness.

As with human mothers, pregnancy can stress bovine health. Previously, cows at Oakwood Dairy in Auburn, New York, were examined daily by farmers. Now, the more than 1,200 animals at the dairy wear collars equipped with sensors that provide constant health monitoring, which translates into individual care.

"The sensors catch cows so quick sometimes we don't know what's wrong with them. Sometimes they look fine, and then have a disease," said Miller, who manages the herd at Oakwood. "My job has changed to provide overall higher levels of care. I grew up on a 200-cow dairy; I love cows, and it's why I chose to farm. We're working to feed the world."

These types of rapid and radical changes are happening across agriculture as digital technology expands a farmer's capacity to produce high-quality, nutritious food. The stakes are high: Global population is expected to increase by more than 25 percent in the coming

decades, reaching nearly 10 billion people by 2050.

"Critical resources needed to meet this challenge are already strained," said Susan McCouch, Ph.D. '90, the Barbara McClintock Professor of Plant Breeding and Genetics. "Globally, most arable land is in production. The planet's supplies of freshwater and energy are being tested, and food security is being jeopardized by climate change, harvest loss and food waste. The world is at a precarious point."

To address some of the most critical issues affecting the future of the global food supply, the Cornell Initiative for Digital Agriculture (CIDA) was created by faculty to leverage interdisciplinary research strengths across the university. More than 100 faculty have partnered on projects that integrate information and data science, engineering, and food and agricultural systems. These collaborations are creating disruptive and cutting-edge technologies and fostering a pipeline of practical innovations that improve real-time decision making throughout the food system.

McCouch, who directs CIDA, said now is the time to re-envision global

agriculture, including food production, processing and distribution; how natural resources are used and conserved; and the ways social and agricultural systems interact to support healthy individuals, communities and the environment.

"Cornell, with its prestigious Ivy League researchers and Land-Grant mission to serve, is uniquely positioned to transform collaborative insights from the lab into applied solutions in the field. The combined passions and talents of our faculty, staff and students manifest into creative approaches and solutions needed to tackle these intractable challenges and to do it sustainably," she said.

The work is diverse and vast: Researchers in one project are working on real-time sensors to provide up-to-the-minute weather forecasting predictions for farms, while elsewhere engineers collaborate with plant scientists to develop soft-touch robots that count vineyard grape clusters and predict yield.

Cornell research is revolutionizing the 10,000-year history of plant breeding, as robots, artificial intelligence (AI) and machine learning are deployed to measure plant traits in real time. Mike



Gore, Ph.D. '09, associate professor of plant breeding and genetics in the School of Integrative Plant Science, and his team are developing AI for autonomous vehicles that can count individual plants, measure plant height and check individual leaves for disease. The data inform breeding decisions, which can speed release of new plant varieties by years.

Maricelis Acevedo, associate director for science for the Delivering Genetic Gain in Wheat project, managed by International Programs at Cornell CALS, is collaborating to develop forecasting and prediction models that guide decisions on fungicide use and resistant wheat varieties with near-real-time data. Multispectral cameras, drones and sensors are being used to help plant breeders select better wheat germplasm for variety development.

Freely available shareware, apps and databases created on campus are expanding Cornell's outreach. Kristan Reed, assistant professor in the Department of Animal Science, is creating an open-source model that looks at the farm, from crops to cows, as a whole system. The model simulates flows of carbon,

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Learn more at
digitalagriculture.cornell.edu

“The combined passions and talents of our faculty, staff and students manifest into creative approaches and solutions needed to tackle these intractable challenges and to do it sustainably.”

—Susan McCouch, Ph.D. '90,
the Barbara McClintock Professor of
Plant Breeding and Genetics

nitrogen and phosphorus to identify how to improve farm production efficiency and minimize environmental impacts.

At Oakwood and other dairy farms, Julio Giordano, St. John Family Sesquicentennial Faculty Fellow in Dairy Cattle Management in the Department of Animal Science, is combining sensor data with AI machine learning to improve disease diagnosis and predict future performance.

These and other digital agriculture technologies offer cost-effective solutions for farms of all sizes. For small enterprises, reducing labor-intensive tasks can open room for growth. For large operations, enhancing or replacing hard-to-find labor can ensure financial stability.

“There is a great need for agriculture and food systems at large to be resilient, efficient and equitable,” said Jan Nyrop, associate dean and director of the Cornell University Agricultural Experiment Station and Cornell AgriTech. “Digital agriculture is not just about solving current issues; it’s also about anticipating the challenges and designing the future farm to meet them.”

—JULIE BERRY '97

URBAN EXPANSION

Cornell specialists help grow agriculture in cities across New York

From the rooftops of New York City to the weathered sidewalks of inner-city Buffalo, urban farms are sprouting across the Empire State. Working these small plots are farmers young and old from backgrounds as diverse as their agricultural needs and challenges—and urban agriculture specialists from Cornell Cooperative Extension (CCE) are helping these farmers make the most of these distinctive environments.

In New York City, growing space is a major limiting factor. Farmers there are being helped by urban agriculture specialists Sam Anderson and Yolanda Gonzalez, who joined CCE's Harvest New York program in 2017.

"One thing I love about working in agriculture in this city is that there's such variety," said Anderson. The New York City specialists work on everything from rooftop farms in Manhattan to shoreline farms on Rockaway Peninsula along the coast of Queens. "People in the city are coming into agriculture from a gardening background or from an activist background or from an interest in food or social justice. Not many

are coming into it with a commercial vegetable-growing background."

The Cornell specialists host workshops sharing the latest in plant science research and food safety best practices to help current and prospective growers improve profitability. The pair provide educational programming and on-site technical assistance in all five boroughs for commercial vegetable growers and nonprofits operating commercial urban gardens.

They also provide one-on-one technical assistance on certification requirements and help create food safety plans. Gonzalez said consultations on food safety certifications options with large-scale urban farms have allowed those operations to sell produce directly to distributors and retail outlets, such as the Wegmans supermarket slated to open in Brooklyn.

On Brewster Street in Buffalo, a tiny organic farm sits among apartment complexes and convenience stores. Newly resettled refugees from around the world farm the two-acre operation at Green Shoots for New Americans

Refugee Agricultural Program.

The produce they grow is sold locally through farmers' markets and in local restaurants, and shared with families in the inner-city neighborhood.

For the past four years, the farm has relied on Cornell Vegetable Program specialist Judson Reid for technical expertise and horticultural experience. "Experts like Jud help us decide when, where and what to plant and help us troubleshoot plant disease issues," said farm manager Jenna Walczak.

Reid, who consults on urban farming initiatives in cities across New York, has helped the Buffalo farm grow tomatoes using vertical trellises and employ advanced integrated pest management and soil fertility techniques. Reid said CCE puts research-based knowledge in the hands of people—in this case, those who want to grow their own food to eat, or grow food as a business.

"We often find that urban agriculture gives people an opportunity to develop a sense of belonging, a sense of contribution to the greater community," said Reid.

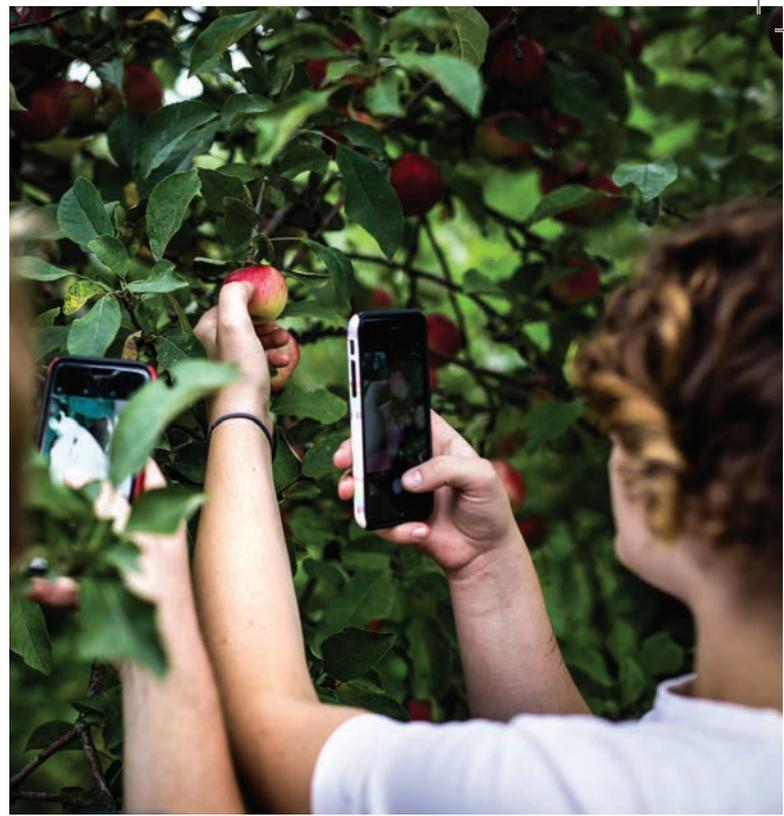
—R.J. ANDERSON

"One thing I love about working in agriculture in this city is that there's such variety."

—Sam Anderson, urban agriculture specialist at Cornell Cooperative Extension

In the shadow of Hell Gate Bridge, Cornell Cooperative Extension urban agriculture specialists Yolanda Gonzalez, left, and Sam Anderson, center, scout for harlequin bugs and consult with farmers at Randall's Island Park Alliance's Urban Farm in New York City.





Faculty are shifting emphasis away from the traditional lecture to techniques that use hands-on learning while dedicating classroom time to problem solving and engagement.

ACTIVE LEARNING ENERGIZES CLASSROOMS

Technique preps students to be 'problem solvers of tomorrow'

Jumbled on the classroom tabletop lay cards scrawled with words that, when properly arranged, tell an exquisite story: the complicated flow of genetic information in a cell.

Students in the introductory microbiology class broke into small groups and conferred with each other about the best way to organize cards with words like "RNA polymerase," "start codon," "mRNA" and "promoter." When they felt confident they had it right or had a question, they called over an instructor and explained the process in detail.

The students were given reading assignments outside class to learn the flow of information in the cell. Classroom time was dedicated to learning the intricacies of DNA replication, transcription and translation in a more engaged way.

Chloe Carpenter '20 said learning actively in this manner enhanced her ability to understand the subject matter.

"Working with the material in this way is better for your cognition level. It's learning as you go, so you're much better prepared for exams," said Carpenter, a biological sciences and animal science double major.

Research shows that the more students are involved in their own education, the better they learn. Teaching techniques like these are increasingly being used in classrooms at CALS and across the university.

CALS is supporting faculty with grant funding that promotes active learning. This academic year, six proposals split \$500,000 to help hundreds of students sharpen critical-thinking skills, develop in-the-field experience and become equipped with skills to tackle scientific problems rather than be passive learners.

"Students today are used to having all possible information at their fingertips," said Kathryn J. Boor '80, the Ronald P. Lynch Dean. "As a consequence, universities have to be able to teach them differently than the classic 50-minute lecture. Here at CALS, we are committed to preparing our students to be the problem solvers of tomorrow."

—KELSEY O'CONNOR

"It's learning as you go, so you're much better prepared for exams."

—Chloe Carpenter '20, biological sciences and animal science double major



A NEW SOCIAL ORDER

How social media influences the way we engage with news, politics and each other

Time was, if you wanted to share your opinion about politics, you had to do it deliberately, by sending a letter to the editor or standing up at a public meeting. Or you could state your case in person, knowing that you would immediately feel the social ramifications of your opinions.

Then came social media. And along with it, the ability to instantly post, tweet, pin and upvote every story or opinion that crossed your path—and the simultaneous ability of your boss, your uncle and your college roommate to see your opinions, and react to them, in real time.

People could once maintain control over their social boundaries and the topics they discussed within those groups, but on social media, all those contexts are “collapsed,” says Natalie Bazarova, associate professor in the Department of Communication and director of the Cornell Social Media Lab.

“You have relatives, colleagues, neighbors, high school friends, liberals, conservatives, independent friends all collapsed into a single network,” Bazarova says. “It really complicates how people present themselves online.

UNDOING SPIRALS OF SILENCE

Social media amplifies mass expression—of a mood, an ideology or a joke—in a way never before possible. Connections form online and build into full-blown movements, for good and bad.

The #MeToo movement is one of the most potent expressions of social media’s power. In the past, accusations of sexual misconduct may have made it onto the news if the individuals involved were famous, but many women felt trapped in a “spiral of silence,” says Drew Margolin, assistant professor and the Geri Gay Sesquicentennial Faculty Fellow in the Department of Communication.

“Something happens to you, but you never see it talked about. So you feel isolated and fear being embarrassed, and so you don’t talk about it, which continues the spiral. We have the ability to undo a lot of spirals of silence with platforms that enable and encourage everyone to share their experiences,” Margolin says. “Before social media, the mainstream media might have said, ‘Sure, Harvey Weinstein is a criminal, but this is extreme behavior by a unique individual.’ Now the Twittersphere is there saying, ‘No, you need to pay attention to this as a general social issue.’”

Online organizing done in private and secret groups has also been crucial to mass demonstrations like the Women’s March, the March for Science and Black Lives Matter.

Secret and moderated groups on Facebook and other social media channels have allowed people to feel

safer about expressing their political opinions without fear of backlash or repercussions from those in their offline networks, according to Brooke Erin Duffy, assistant professor in the Department of Communication.

“There’s a sense of community and collective solidarity that can flourish in these spaces,” she says.

One reason that marginalized groups, especially women, have sought out closed groups is to avoid the harassment common in more public media spaces. Pew Research Center found that while both men and women experience harassment online, women are twice as likely to be harassed because of their gender.

“The criticism women receive tends to focus on their gender rather than the content of what they post,” Duffy says. “This problem is particularly pronounced in domains that are stereotypically masculine, such as sports, gaming and politics. Women trying to participate in these spaces may experience incredible backlash.”

ANGER = ENGAGEMENT = MEDIA COMPANY PROFITS

Online advertising revenues are based on attention: how many stories people click and how “engaged” readers are with the stories, based on time spent reading, shares and online comments. So, which emotion elicits the most engagement? Anger.

Margolin studied people participating in social media groups during and after NFL games. He found that the discussions that elicited sadness caused people to disengage while those that aroused anger kept people hooked.

“The pattern we saw was that anger keeps people talking,” Margolin says.

Media companies work to maximize engagement, and one method is through distorted headlines, according to Margolin. In an effort to get people to click, media companies of all types run headlines that go beyond the factual assertions in the stories themselves or that insert bias into a straight-news story.

Distorted headlines are particularly damaging because on social media, people may only read an article’s headline and then “engage” based on its tone or exaggerated, unsupported claims.

“It’s not only people on the fringes who believe fake news. Fake news is an extreme version of a click-bait world,” Margolin says.

AUTHENTICITY

Those old enough to feel jarred by the changes wrought by social media might learn some lessons from young people who have never known a world without social media. How do they cope?

Duffy says young people are continually concerned about how they are perceived on social media. There are implications of feeling that you’re being surveilled—and judged.

“Young people used to have spaces where they could share personal experiences and not fear retaliation, but because of collapsed social media contexts, many express concerns about, ‘What happens if this material gets in the wrong hands?’” Duffy and doctoral candidate Ngai Keung Chan argue that such “imagined surveillance” can be paralyzing.

One strategy is creating accounts that re-establish real-world social contexts. Users may keep a professional LinkedIn account while allowing themselves to be sillier on Facebook. Online there’s a constant tug between being authentic and circumspect about what you publish. Some seek to protect their privacy by creating multiple accounts: a “rinsta,” or real Instagram with their real name, which they maintain in a highly curated form to give a certain impression to the world, and a “finsta,” or fake Instagram, where they feel freer to express themselves, warts and all. It’s one more irony of the digital age that the “fake” accounts are the ones where users present themselves authentically.

“The original idea behind social media was that you would have this giant public forum and people could attend to the views of people who think really differently from them—from all around the world,” Margolin says. “But we never tried to regulate the social norms online. You can’t just have the technology—you also need a considered approach to the technology. Media literacy isn’t just about interpreting what the media says; it’s also about how we interact with each other.”

—KRISY GASHLER

HOW DO YOU COMBAT FAKE NEWS ONLINE?

Here are some tips, based on research by Cornell CALS’ social media experts:

- **RE-ESTABLISH CONTEXTS** on Facebook by joining or creating groups based on your real-life associations, such as family, church friends or colleagues. If you want to discuss politics online but not with everyone you know, **CONSIDER JOINING OR CREATING A MODERATED GROUP** with people who are politically engaged and capable of discussing politics respectfully.
- For even more privacy, **BE COGNIZANT OF YOUR CUSTOMIZED PRIVACY SETTINGS.** Use your real name for your “public” profile and a pseudonym for a profile just for friends.
- **RESIST THE URGE TO IMMEDIATELY SHARE POSTS,** fact-check every post before sharing and read articles—not just headlines—before sharing or commenting.
- **FACT-CHECK POSTS** of friends who share your politics; they are more likely to reject fake news if it’s pointed out by a like-minded friend.
- **CALL OUT MEDIA BIAS SPECIFICALLY.** If you see a factual error, contact the media company and request a correction. If a headline on a news story is biased or exaggerated to encourage clicks, complain about the headline specifically. Crying “fake news” without evidence increases polarization without solving the problem.

THEN AND NOW



More online at
cals.cornell.edu/thenandnow

Since our founding, we have evolved continuously to meet the changing needs of our world. We invited current and former students to talk about challenges across generations.

The Cornell CALS experience empowers us to explore the boundaries of knowledge, supported by the leading minds of today and surrounded by the leading minds of tomorrow. We sat down with agricultural science majors Daniel Frea '18 and Aleah Butler Jones '19 and former dean David Call '54, M.S. '58, Ph.D. '60 to discuss their CALS educations, the state of agriculture and how digital technologies are changing all of our lives.

AGRICULTURE EDUCATION AT CORNELL

DAVID I came to Cornell in 1950. At that time, if you could graduate from high school and were raised on a farm, you were pretty sure you could come to Cornell. I majored in general agriculture, and I met my future wife on the first day of classes. When I was here, it was almost 100 percent New York residents and probably 95 percent male. The college has changed tremendously since that time. The student mix is quite different now, and I think you're all much brighter than we were.

ALEAH I'm not from a traditional ag background, but I've found that I was really attracted to the major in terms of the study and its interdisciplinary aspect. And I really love working outside.

DANIEL I come from a dairy and almond farm in California. I came to Cornell thinking I would be pre-vet but realized that I like business more than I like animals. I ended up in ag science with a business concentration.

DAVID I've traveled a lot in the United States, and I've been on farms in a lot of the states. When you mention the name Cornell and agriculture, the doors open up.

DANIEL The agricultural sciences major creates many opportunities on campus. Aleah is involved in plant genetics and

vegetable systems, and I'm more into the business side. There are so many different backgrounds—people from farms, people from more urban areas—that it allows you to see a variety of perspectives. I think our major does an awesome job of connecting the dots within CALS.

ALEAH Within the major, you have to take an animal science course, you have to take a business course, you have to take soil science, you have to take field crops. And as you get more advanced in the major, you hone in more on what you are passionate about. I would think it is a very different array from what was offered to you.

DAVID Where you're talking about CRISPR and plant genetics, we were talking about pollinating by hand.

DANIEL It's hard to think about college without the internet. It's also hard to imagine just agriculture without technology being a big focus. The idea of a tractor being monitored and guided by GPS is very cool.

DAVID I think your education is so much better because of technology. You have access to the world in a way that we didn't have. Everything was hand written, and when I graded papers, you can imagine looking at a hundred different types of handwriting. Another change is women's diversity. And agriculture itself has changed just as much as Cornell has changed.

PERSPECTIVES ON AGRICULTURE

DAVID In the early 1950s, supermarkets hadn't really shown up yet. When you went to buy food, you went to a grocery store. You sat at the counter and [the clerk] would take things off the shelf. Now, you can have it delivered to your home. You can go on Amazon, and you can get anything you want. The transition

in marketing food and agricultural products has just changed tremendously, and that has had an enormous influence on what's taught at the college.

DANIEL There's this growing disconnect between the farm and the actual consumer. More and more people are moving to urban areas. I think agriculture needs to step up and take some of that power back and educate consumers.

ALEAH I think there are a lot of misconceptions in general about agriculture, especially for people who don't come from agricultural backgrounds. I'm from 45 minutes outside of New York City. It's a very interesting thing to see, in terms of agriculture trying to bridge that gap between urban and rural populations. That's really important because [nearly] half the population of the state lives in the New York City metropolitan area.

DAVID Just about.

ALEAH But the other half lives in a much more rural area. But, if you think about voting bases, that's half of your constituents that agriculture needs to remain relevant for. So I think communication is definitely one of the biggest issues facing agriculture. Related to that is getting people interested in the field. Then, finally, I think a big issue is sustainability.

DAVID It's very interesting that, currently, more and more students at Cornell want to get a minor or want further depth in sustainability issues. I had never heard that word when I was an undergrad.

ALEAH I'm from an urban area, and when I told people in high school that I was going to study agriculture, I got quite a bit of backlash. Quite a few people said something along the lines of, "Why would you waste your talents and intelligence studying agriculture?"

DANIEL I know that when I tell people on



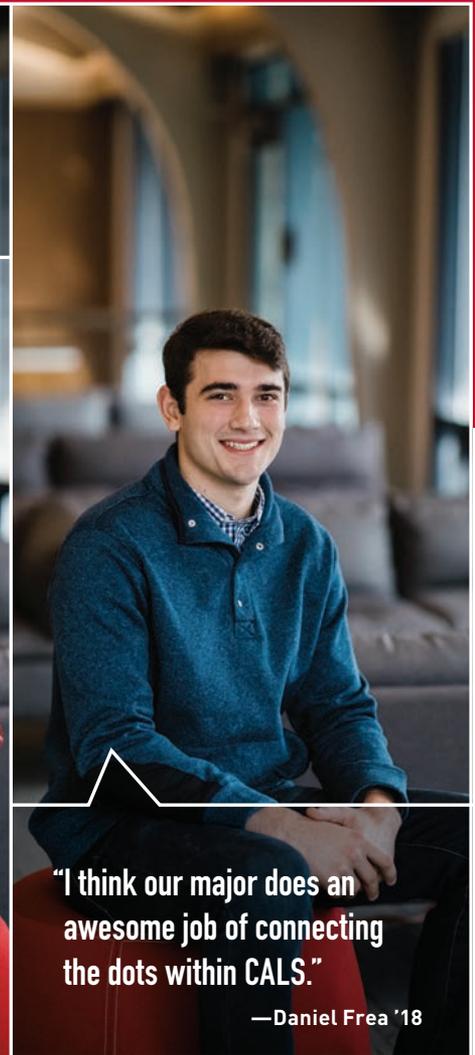
"I think there are a lot of misconceptions in general about agriculture, especially for people who don't come from agricultural backgrounds."

—Aleah Butler Jones '19



"Agriculture itself has changed just as much as Cornell has changed."

—David Call '54, M.S. '58, Ph.D. '60



"I think our major does an awesome job of connecting the dots within CALS."

—Daniel Frea '18

campus that I'm an agricultural sciences major, I get, "So you want to grow corn for the rest of your life?"

DAVID When anybody asked me why I would want to be a dean of a college of agriculture, I said, "Do you eat?" I just look at the importance of the food system in the economy—not agriculture but the food system. We have to think—and I've preached this from day one—broader than agriculture. We have to think about the food system.

DIGITAL AGRICULTURE

DAVID Have you had experience with digital ag?

ALEAH Last summer when I was at Cornell AgriTech, there were tractors rigged for GPS guidance. When you looked at the end of the field, you'd see basically perfectly straight rows.

DAVID It's become quite common, particularly in vegetable production. The planting style has such an impact on mechanical harvesting, which is something that really grew through my

whole life. This started in the 1950s, and it's still going on.

DANIEL Robotic milking is becoming a big thing. A lot of guys in AGR [agricultural fraternity Alpha Gamma Rho] are starting to switch to robotic milking, and even small herd farms are looking into it right now just because labor is so expensive.

DAVID They're expensive machines, but they work quite well. It's going to continue. I mean, it has to continue because we have to increase not only U.S. productivity but world productivity as well, if we're going to feed the world. And that's when we get into the debate about GMOs, because it's the use of plant breeding that's going to allow us to increase the productivity of agriculture around the world.

ALEAH There's such a huge history in genetic engineering and its development at Cornell. People oftentimes fear what they don't know and what they don't necessarily understand. Communication is one of those key things to bridge that gap.

In almost every single science class I'm in today, they bring up how to communicate these ideas to the general public.

DAVID It just hurts me to see people preaching anti-GMO. I guess I feel deeply about that because I was the one who put together a new program in molecular biology, and I brought in five new faculty members all at once to capitalize on genetic engineering. I think in the long run, once people accept it, like they have with grain production, it'll become more widespread. As our society has changed, the college has changed, and my thinking has changed. I sort of grew in that process. I had to understand sustainability. I wasn't educated in that area. So I think that we're trying to get people to think of the system, of the breadth, that here is what you're eating, and here's your health, and that agriculture is a part of that. We've been lucky that in New York state we've gotten good support.

ALEAH I don't think it will ever get boring.

DETERMINED BEAUTY

Daily life can sometimes feel mundane.
For these alumni, beauty inspires what they do and how they live.

TONY CRADDOCK JR. '10

ATMOSPHERIC SCIENCES MAJOR

Saxophonist and recording artist at Cold Front Music

"Music and weather are canvases of natural beauty—one invisible, the other mostly visible. My love for them both began in my childhood, tuning into the Weather Channel's smooth jazz, which led me to study atmospheric sciences in CALS. Now I uplift listeners with songs on the saxophone by using titles, sounds and accompanying lyrics that connect the messages of the songs with the emotions people experience through the weather. Whether it's the radiance of a sunrise or the invisible force of wind, I hope my music paints pictures that help listeners feel the inspirational messages I created especially for them."



Photo: Hector Emanuel

SUMMER RAYNE OAKES '04

NATURAL RESOURCES MAJOR

Author and founder of Homestead Brooklyn, an initiative to help people become more attuned to nature in New York City

"Ever since I was a young girl, I found beauty in that which often goes unnoticed—from the tattered remains of insect-chewed leaves to the thin filaments of mycelium festooned beneath the forest floor. As an environmental communicator, I find it's a joy to be able to take these often-overlooked elements of nature and rekindle people's love for the outdoors. Sometimes this starts off with something as humble as a houseplant. But once someone is hooked, it's easy to begin to share the beauty in all of Earth's creations."



STEVE LEFTON '94

LANDSCAPE ARCHITECTURE MAJOR

President and CEO of Kimley-Horn, a planning, engineering and design consulting firm with projects worldwide

"As a landscape architect, I have always drawn my inspiration from the human condition. We create places for people, whether it's a park, plaza, resort or downtown master plan. When you see a child's exuberance as she explores a park or watch a young couple holding hands as they stroll down a streetscape you designed—to me, those human emotions, elicited by the place they are in, are beautiful. That is the reward of being a landscape architect!"



Photos, from top: Joey L.; Hector Emanuel



SARAH BELLOS '04

NATURAL RESOURCES MAJOR

CEO and founder of Stony Creek Colors, a Tennessee-based company offering naturally dyed clothing

"The concept of beauty can be superficial and fleeting in the fashion world. I am inspired by conscious designers and consumers who look at beauty through the lens of an entire supply chain, rather than just through the merchandising or selling of a garment. What is or is not left behind in the parts to creating the sum too often are the invisible parts of fashion: a pair of jeans whose dye helped sequester carbon and nutrients in the soil where it was grown, a T-shirt made from responsibly farmed cotton where beneficial insects can thrive, a waterway not polluted due to responsible dyeing of a garment. The beauty that inspires me lies in the integrity of the garment and the intentions of the maker and the wearer."

HOW DOES BEAUTY INSPIRE YOU?

Share with us the ways beauty enlivens your work, your hobbies and your life. Send us a photo and a short quote to calsnews@cornell.edu, and we might share it online!

Photo: Alysse Gafkjen

in memoriam

The CALS community remembers with gratitude faculty members who recently passed away.

MICHAEL H. DICKSON

(b. 1932)

Professor emeritus of the Horticulture Section of the School of Integrative Plant Science

A prolific and multidisciplinary scholar, Dickson helped develop disease-resistant cabbage, insect-resistant crucifers and cold-tolerant beans. A professor emeritus in the Horticulture Section of the School of Integrative Plant Science, Dickson was best known for his work breeding orange cauliflower. He worked for more than 20 years to cross a mutant-variety orange cauliflower, high in beta carotene, with traditional, better-tasting white cauliflower. The result, “Cheddar,” was released in 2004, and has helped ameliorate the scourge of vitamin A deficiency—which can lead to blindness in children and compromised immune systems—in developing countries.

OLAN D. FORKER

(b. 1928)

Professor emeritus and chair of the former Department of Agricultural Economics

A dairy farmer, soldier and economist, Forker researched the production and distribution systems of farm commodities, especially milk and eggs. Forker was devoted to helping farmers worldwide: He and his family lived in Turkey for a year while he worked for USAID, and he collaborated with farmers and economists in Guatemala, India and across Europe. He was department chair from 1976 to 1985. Forker also served one year active duty in the U.S. Army in South Korea and was in the U.S. Army Reserve for 24 years, attaining the rank of lieutenant colonel.

CARL F. GORTZIG '52

(b. 1931)

Professor emeritus and chair of the former Department of Floriculture and Ornamental Horticulture

Gortzig was a respected floriculturalist and devoted teacher. He held joint appointments in the former Department of Floriculture and Ornamental Horticulture, where he was chair from 1975 to 1988, and at Cornell Plantations (now Cornell Botanic Gardens), where he was the Elizabeth Newman Wilds Director from 1993 to 1995. His dedication to the floriculture industry in New York was recognized in 1989 with the George L. Good Gold Medal of Horticulture, the highest honor of the New York State Nursery and Landscape Association. His care for his students and advisees was celebrated in 2002, when former advisee Joanna Beitel '92 created the Carl Gortzig scholarship in his honor.

RICHARD MCNEIL

(b. 1932)

Professor emeritus of the Department of Natural Resources

As a wildlife biologist, McNeil was a trailblazing scholar who helped broaden Cornell's Department of Natural Resources to include perspectives from social sciences, environmental sciences and ethics. McNeil argued for the importance of discussing ethics in wildlife management decisions and for ensuring that policy makers and the public were informed about and invested in natural resource management. A talented and devoted teacher, McNeil earned the SUNY Chancellor's Award for Excellence in Teaching in 1994 and the CALS Edgerton Career Teaching Award in 1996.

JOSEPH SIECZKA, M.S. '73

(b. 1939)

Professor emeritus of horticulture and coordinator of Cornell's Long Island Horticultural Research and Extension Center

Sieczka dedicated his career to vegetable research, with a special focus on potatoes. He served as coordinator of Cornell's Long Island Horticultural Research and Extension Center for more than 20 years, where he developed myriad strategies to help growers with concerns including weed control; optimization of fertilizer application to reduce costs and minimize nitrate pollution in groundwater; and development of new, pest-resistant potato varieties. Sieczka was elected president and honorary life member of the Potato Association of America, among other roles, and he coauthored two editions of the association's handbook, *Commercial Potato Production in North America*.

MY CORNELL STORY: CHRISTIAN YUNKER '02

I'm the third generation of my family to farm the land my grandfather bought in New York in 1951. Farming has always been heavily dependent on the weather, but every year, there seems to be more weather extremes—greater temperature variations, more periods without rain and, when it does fall, more extreme deluges. Wet conditions increase plant diseases and fungi that can hurt crops. Corn and green peas suffer, for example, from soilborne, moisture-loving pathogens *Pythium* and *Phytophthora*. When there are long periods with no rain, that's problematic, too; this year brought these little pests, thrips, that thrive in dry heat and feed on plants. Thrips attack many vegetables, but they can destroy an onion crop. Other pests that previously would have been killed off over the winter are now surviving the milder winters.

Our operation, CY Farms in Elba, New York, is trying to tackle the problem of weather extremes from many directions. For one, we are highly diversified. We farm 6,000 acres of crops including fresh market onions, processing peas, snap beans, spinach, corn, wheat and soybeans. We also grow alfalfa for our 3,500 dairy heifer replacement facility, and we have 300 acres of commercial turf grass.

A wide variety of digital agriculture technologies is used on the farm to solve challenges. These techniques are helping us respond to problems and weather events in real time in ways that were unimaginable even a decade ago. For example, GPS-based soil samples in the fields are overlaid with historical yield maps and soils maps. Then we can program our equipment to vary our fertilizer and seed application. The equipment actually does the work by changing application rates as the machine moves across the field, with accuracy to a degree of less than an inch. The ability to make these changes allows us to increase productivity on optimal sections of our fields and limit our

fertilizer use on the less productive soils. This saves us money and makes us better stewards of the environment: Less fertilizer runoff protects water quality.

Teams of researchers at Cornell CALS and Cornell Cooperative Extension are instrumental in helping our farm succeed. Expertise means boots in the field: Cornell scientists are doing the research, looking ahead at problems and working with us to find solutions.

The Cornell Initiative for Digital Agriculture is exciting for farmers like me. As problems grow every year, we need folks who are going to stay in front of these challenges and help us solve them. It's a perfect fit for Cornell to take on this challenge. Biological systems, plant genetics, information science, robotics—all of these disciplines can be brought together in one place to create the knowledge that agriculture needs to respond. It's very exciting to be a New York state grower and know that your Land-Grant university is leading change in the agriculture industry.

Farming is all about overcoming obstacles. The more we improve—whether it's putting in irrigation systems, increasing the accuracy of weather forecasts or implementing digital agriculture technologies—the more we can get ahead of extreme conditions. I'm optimistic about the future. People around the world are recognizing the importance of our industry and the opportunities that lie ahead. Now is our time to seize the challenge.



Christian Yunker '02 with his daughter, Maisie, at CY Farms in Elba, New York.

Christian Yunker '02 is a third-generation farmer and Cornellian. The family-owned CY Farms is located in western New York between Buffalo and Rochester. Christian returned to the farm in 2008 and became a partner in the business in 2010.

Photo: provided



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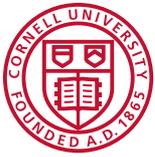
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