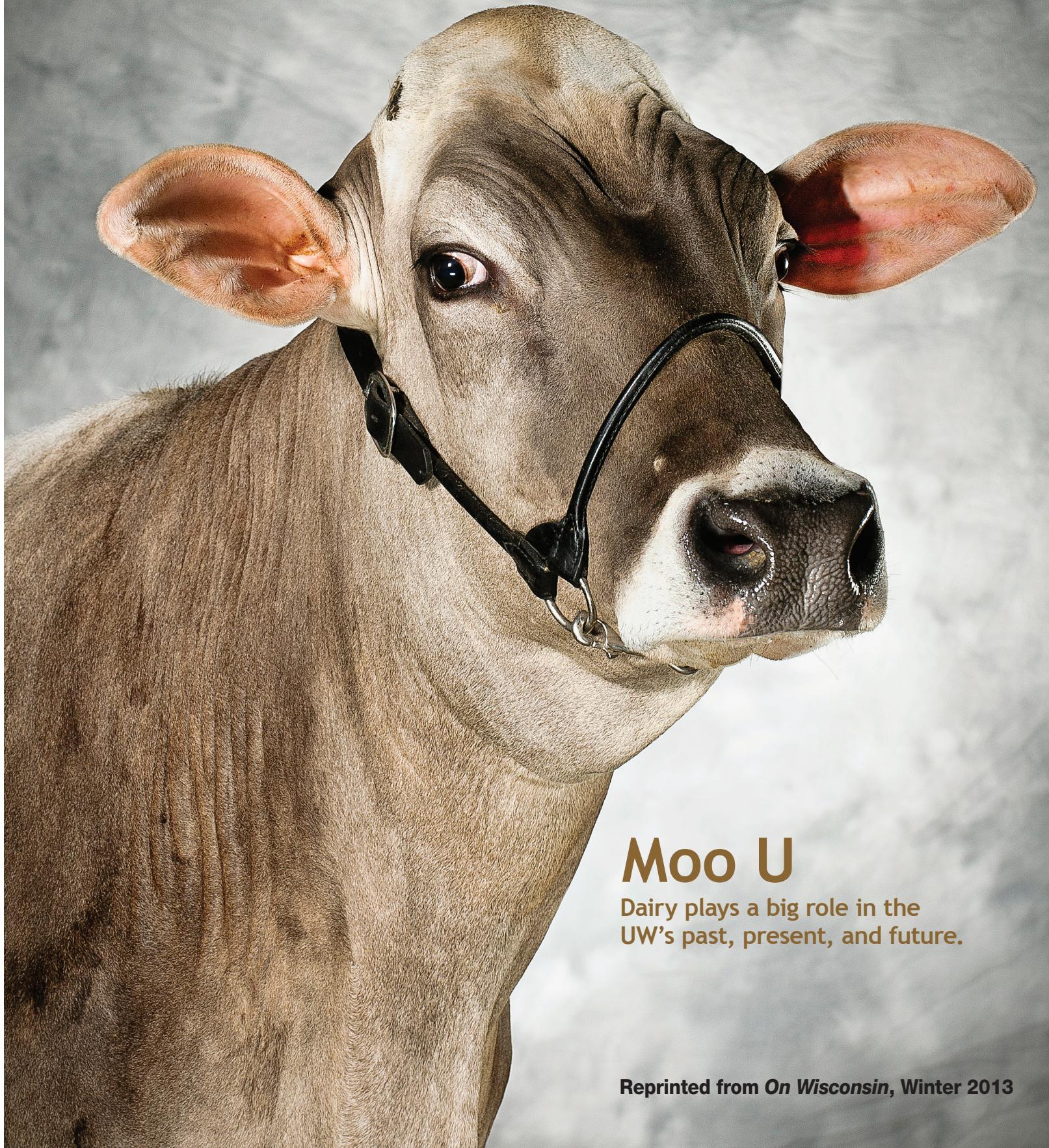


On Wisconsin

For University of Wisconsin-Madison Alumni and Friends



Moo U

Dairy plays a big role in the UW's past, present, and future.

Reprinted from *On Wisconsin*, Winter 2013

Milk Matters

Dairy science is no longer the field of straw hats and bib overalls. The UW's future is as thoroughly milk-soaked as its past.

BY JOHN ALLEN

ILLUSTRATIONS BY JOYCE HESSELBERTH

Last March, the UW's dairy science department held an open house for the grand re-opening of one of its newest facilities — the Dairy Cattle Center.

Don't feel bad if you missed it. A lot of people did. Although the College of Agricultural & Life Sciences sent out a press release, only local media picked it up — the *Daily Cardinal* had a brief story, for instance, as did a local TV station.

But then the Dairy Cattle Center isn't entirely new. It was originally built in 1954, replacing the function of the old Dairy Barn, which had opened in 1898. To refurbish the six-decade-old Linden Drive structure, the UW spent ten months and \$3.5 million, which aren't huge numbers nowadays. More surprising was that the university bothered to refurbish it at all. The UW is the school of stem cells and satellite imaging, the institution that harnessed the computer power to help find the Higgs boson. And yet it still keeps eighty-four cows on campus — which isn't even its largest herd. The UW has another 550 or so cattle at a farm in Arlington, Wisconsin, and 530 heifers in Marshfield.

The UW is the flagship university for America's Dairyland, but somehow

dairy science seems like a relic of its nineteenth-century heritage. Agriculture is deeply traditional, and milk seldom produces the sexy headlines that medicine and engineering create. Very few of UW-Madison's students have spent enough time on a farm to learn how to tell a Jersey from a Brown Swiss.

"Today, only a small number of the university's students have any experience in farming or agriculture," says Kent Weigel, chair of the dairy science department. By contrast, the majority of students in his department — typically up to eighty-five undergraduates and some forty-five grad students — grew up on farms. "The only opportunity [their classmates may have] to see an operating dairy farm is to visit one on our campus."

But Wisconsin is still heavily invested in dairy, an industry worth \$26 billion a year to the state. And that means that milk matters to the UW, where dairy draws large grants from government and industry and researchers have patented inventions worth millions in revenues.

Preparing for her close-up: a member of the UW's dairy herd poses in the Stock Pavilion. The UW's cows are star performers for both research and education.

BRYCE RICHTER PHOTO ILLUSTRATION EARL MADDEN





The field is far less traditional and far more scientific than you might think.

"It's a very information-intensive field," Weigel says. "We're using modern technology to monitor diet and activity and rumination and the composition of milk. We're learning how to do what we do better and more usefully, and that requires more understanding of DNA and management of big data. Using information is the future of dairy farming. It's not a straw-hats-and-bib-overalls thing anymore."

The UW's dairy science department is perhaps the best in the nation — in 2012, the firm Academic Analytics ranked it first among all animal science departments at American universities, based on the number of faculty publications, awards, patents, grants, and outreach efforts.

And that's just one department. The UW also dips into moo juice in the food science department, which operates the Babcock Hall Dairy Store. Biological systems engineering (ag engineers) covers dairy housing, forage harvesting equipment, and manure management, among other topics. Agronomy focuses heavily on dairy feed and forage crops, and soil science studies how to keep manure out of streams and groundwater. UW-Extension and UW-Madison experts offer dairy short courses and field days on campus and around the state (eighteen next year on dairy foods alone) for Wisconsin farmers and firms. And there are units conducting studies and outreach, such as the Center for Dairy Research and the Center for Dairy Profitability.

"If you're going to do dairy," says Lou Armentano, a professor of dairy nutrition who studied at Cornell, North Carolina State, and Iowa State, "this is the place you'd most like to be."

UW-Madison milks dairy for all it's worth, and for the university's past, present, and future, milk is worth a lot. Within the following pages, you'll see snapshots of some of the many ways that the university is making the most of milk.



UW-MAMMARY

There's no other way to look at it:

Laura Hernandez is obsessed with udders.

"I've always found mammary glands to be fascinating," says the assistant professor. "Ever since I was an eight-year-old kid, I was intrigued by this organ. It's what defines mammals. Physiologically, it's amazing — that it's evolved to make milk and devote so much energy to producing food for another creature."

Hernandez isn't a traditional faculty member in the UW's dairy science department. For one thing, she didn't grow up on a dairy farm. A native of El Paso, Texas, she had little connection with dairying, other than the milk she put on her morning cereal. And while she finds milk scientifically interesting, she's not fond of it as a food.

But more unusual still, she's a she. Though the university has offered classes in dairy science for 120 years, it had, until recently, hired almost no women to teach them. The first female dairy professor, Margaret Dentine, joined the faculty in the 1980s and left in the 1990s. The second, Pam Ruegg, joined in 1998. Hernandez is the third. She was hired in 2010, the first of a series of women who now account for nearly a third of the department's faculty.

"Actually," says her department chair, Kent Weigel, "more than half of our undergraduates are female now. It's a good thing to have the faculty look a bit

more like the student body."

Hernandez is a lactation specialist, and her research focuses on the role of the chemical serotonin. Animals need calcium in their blood to make a variety of cellular processes work properly, but this can be a problem for dairy cattle, due to the high volumes of milk they produce. Cows move a lot of calcium into milk — much more than they take in. This leads to a condition called hypocalcemia, or "milk fever." To overcome milk fever, cows must increase calcium mobilization — that is, free up calcium ions from their bones into their blood. Serotonin seems to help speed this process. Hernandez has filed for two patents for serotonin-based drugs to help dairy farmers prevent milk fever in their herds by shortening the time it takes for a cow to transition from "milking state" to "dry state," giving the cow's body time to recover.

If anything, lactation has become only more interesting to Hernandez since she joined the UW's faculty, and not just because of her research. She's also the first woman to give birth while on the dairy science faculty, meaning she's the department's first professor to experience the phenomenon they all study firsthand.

"Dairy has traditionally been a male field," Hernandez says. "But that's changing. Overall, animal science students are nearly 90 percent women. Dairy science is something like 65 percent women in undergraduate courses. It's not just old white men anymore."

THE ROAD TO BABCOCK HALL

The milk from the UW's herd

doesn't go directly from the Dairy Cattle Center to Babcock Hall to be made into ice cream and cheese — though some of it (as much as 3,000 pounds a day) does get there eventually. It's first shipped off to Foremost Farms, a local cooperative. Why? Chiefly because the herd's production is fairly constant, but the Dairy Store's demand fluctuates. Here's how the Dairy Store's milk use breaks down:

- 2 million: pounds of milk that Babcock Hall requires a year
- 10,000 to 15,000: pounds of milk needed every day when the plant is running
- 60 percent: amount of milk that is bottled for drinking
- 35,000 to 40,000: pounds of cheese made each year
- 21: varieties of cheese (six Cheddars alone)
- 75,000: gallons of ice cream made each year



THE CENTER OF THE MILKY WAY

Eau Claire, Wisconsin, is the center of the milk universe.

Everyone in the dairy industry knows this, but then everyone, dairy economist Mark Stephenson contends, is wrong.

"We have urban myths, and we have rural myths," he says. "Eau Claire is a rural myth."

The myth goes like this: when the U.S. Department of Agriculture (USDA) sets its target price for milk, it does so for milk produced in Eau Claire. Every

other dairy in the country then calculates its mileage from Eau Claire, puts that number into an equation, and comes up with the price it should charge, the price rising the farther away the dairy.

"It's like people think there's some big obelisk up there, and a tape measure," Stephenson says. But "you will never find anything in the USDA's federal [milk] order language that says Eau Claire."

The myth is probably the result of a couple of factors. First, in the 1920s, agricultural economists did a study on the cost of milk, and discovered that the lowest prices were generally in America's

upper Midwest and higher on the coasts. "They decided to put a pin in the map in the center of the low-price region," Stephenson says, "and Eau Claire is where they decided to stick that pin."

Second, in the 1930s, when the federal government created Milk Marketing Orders to regulate the quality and price of milk, it called its basic formula price "the Minnesota-Wisconsin price." This was a number based on a survey of milk prices at dairies in the two most productive dairy states, Wisconsin and Minnesota. The USDA dropped the Minnesota-Wisconsin price system in 2000.



FEED THE FUTURE

Lou Armentano looks the part.

With a barrel chest and large, calloused hands that seem genetically designed for the pulling of teats, his appearance says he should have spent his entire life on a dairy farm.

You'd never guess he was born and raised in Brooklyn, New York.

"I suppose it has as many dairy cows as anywhere else in New York City," he says. But that's only supposition. He didn't spend much time seeking dairy in his youth. In many ways, Armentano isn't really a milk guy. "I'm lactose intolerant," he admits.

But if milk isn't a big part of his own diet, he's deeply interested in what makes a good diet for milk producers. Armentano is a dairy nutritionist, and he serves as the principal investigator on one of the UW's bigger milk research projects, a multi-million-dollar, multi-disciplinary, multi-university, multi-national inquiry into whether a cow's genetic makeup plays a significant role in what's called *feed efficiency* — its ability to turn a significant amount of the food it eats into milk.

"Feed is one of the largest costs a dairy has," Armentano says. "And as the

cost of feed goes up, dairy farmers are increasingly interested in finding ways to make sure that they get the most for their investment."

Improving dairy output is one of the UW's oldest concerns. In the early twentieth century, Stephen Babcock — he for whom the dairy store is named — designed the "single-grain experiment" to determine, in part, what diet to feed dairy cattle to produce the best results. (See "The Birth of Vitamin A" in the Fall 2013 issue.) Over five years, researchers took four groups of heifers, three of which received a diet consisting of a single type of feed: corn, wheat, or bran. The fourth ate a mixture. The results proved not only applicable to cattle, but to humans as well, ushering in the modern study of nutrition.

Armentano's study leaps beyond the record-keeping of Babcock's time. Using today's vastly expanded knowledge of bovine genetics — the cow's genome was sequenced in 2009 — Armentano and his colleagues are looking into whether one or more of a cow's roughly 22,000 genes governs feed efficiency.

What's meant by *feed efficiency*? A cow needs a certain amount of food just to maintain its size and health. Pretty

much everything it eats beyond that goes into the production of milk — up to a certain point, after which it's just processed out as waste. The higher that point is, the more feed-efficient the cow.

But what governs that limit of feed efficiency? Is it genes? Environment? Some quality of the food?

"We know that inheritance accounts for about 50 percent of size in cows," Armentano says, "and that genes account for about 28 percent of milk production. We don't know about feed efficiency. We think [genetics] accounts for something, but we really don't know what."

Armentano's group is in the third year of a five-year study, and the answers so far are unclear. But irrespective of the result, the study itself indicates that the future of dairy management lies in an increasing understanding of data and science.

"Kids come in here [to the UW] at eighteen, nineteen years old," Armentano says. "Their goal is to do as well as the best people in the business right now. And we tell them no — you've got to be as good as the best in this business will be in twenty years. This is a very technological industry, and we've got to prepare students for that world."

MILK MONEY

Mark Stephenson's breaking point came in the ice cream aisle.

He's a big fan of ice cream (his favorite flavor is peppermint stick). In winter 2012, he was shopping for a half-gallon. He looked at how much the price had risen, and how the size of containers had begun to shrink, and his mind screamed in protest.

"I thought, 'I'm going off the grid,'" he says. And so he went out and bought his own ice cream maker.

Stephenson is more attuned to the price of dairy than the average shopper. He's the director of the UW's Center for Dairy Profitability, and he's perhaps the nation's leading authority on the wholesale and retail prices for milk and milk products.

The center has been part of campus since the 1987–88 academic year, at a time when the state had 42,000 dairy farms, 325 cheese plants, 36 butter plants, and 40 ice cream manufacturers. Dairy was then a \$10 billion industry in the state, and the legislature worried about its future, much as it does today. "Well-managed competition from California, New York, Arizona, and Texas is increasing rapidly," reads the state budget bill from 1987.

And that's why the legislature ordered the creation of the center as part of UW-Extension, the arm of the university tasked with using educational and research assets to help citizens — especially farmers — improve their daily lives.

"The thing that I really appreciate and enjoy about Wisconsin," Stephenson says, "is that you're completely unconflicted about whether you're interested in dairy. Biofuels and other [new technologies] may look a lot more interesting than traditional agriculture to the general public, but traditional agriculture is still of great importance."



Trained as an agricultural economist, Stephenson started getting familiar with the arcane process of forecasting milk prices when he was on the faculty at Cornell. He built a mathematical model to predict the price that milk would fetch at market. It takes into account the number of cows in the country, the production per cow, the costs of feed and fuel, and the demand overseas. Stephenson then fine-tunes his prediction with judgments about the potential impact of drought and guesses about rises and falls in consumer demand.

"Like any good economist, I sat down and I built the best milk-price forecasting model that had ever been created," he says. "And for the very first month, I was right on the penny. That was probably the last time [the model] was right. There's about this much science to it," he says, holding his fingers

an inch apart; then he spreads his hands wide, "and this much art."

Twenty years since creating that model, Stephenson continues to refine it. There's high demand for his forecasts, which dairy farms and plants consider when they make their business decisions. The center also works with farmers to provide management tools, analysis, and advice to help them navigate what can be a difficult business. Farmers have a hard time making their milk stand out from the competition. The product is bulky and perishable, and farmers can't easily increase or slow production to match the variations in market demand — cows produce what they produce, irrespective of business plans.

"It's a very competitive industry," Stephenson says, "and economics will punish anybody who tries to do what the market doesn't want."

DAIRY DOLLARS

How big is milk for Wisconsin?

In 2012, dairy accounted for \$26.5 billion, about a tenth of the state's gross domestic product.

Here's how that breaks down:

- 11,490 dairy cow farms
- 1.27 million cows (an average of 111 per farm)
- 27.2 billion pounds of milk
- 21,436 pounds of milk per cow
- 90 percent of the state's milk is made into cheese
- 26 percent of America's cheese comes from Wisconsin
- And dairy's favorite vitamin, vitamin D, has been worth approximately \$20 million in patent funds for UW-Madison — thanks to the licensing fees from Stephen Babcock's process for irradiating foods.

WARM MILK?

Cows don't actually belch much carbon dioxide.

Rather, the gas they produce includes a lot of methane — which, from a greenhouse perspective, is worse. According to Matt Ruark, methane has about seventy-two times the greenhouse potency of carbon dioxide, meaning that an ounce of methane is worth four and a half pounds of CO₂. CO₂-equivalent is the scale that scientists use to measure greenhouse gases. Using that standard, a gallon of milk produces about 17.38 pounds of CO₂-equivalent. Here's how that breaks down:

- 4.42 enteric gases (that's cows belching and breaking wind)
- 4.02 manure management
- 3.33 fuel
- 3.15 electricity
- 1.38 feed production
- 0.67 refrigerant
- 0.41 packaging



COWS OR CATTLE?

The plural term for cow is a complicated issue. The word *cow* comes from Old English: *cu*. The word *cattle* comes originally from Latin, *caput*, meaning head. Through a similar process to the word *capital*, meaning property, cattle came to mean livestock. So the traditional plural of *cow* is *cows*, and the traditional singular of *cattle* doesn't exist. And yet many elementary school teachers across the land insist that the plural of cow is cattle.

Here are some other bovine terms that are helpful to know:

- *Cow* refers to an adult female bovine; *bull* is male.
- A *steer* is a castrated bull. If kept as a draft animal, we Americans call it an *ox*. If not, we call it beef or leather.
- An *intact* bull hasn't been castrated. Its job prospects are much brighter.
- A *heifer* is a cow that hasn't yet had a calf, and so doesn't yet produce milk.
- And *calves* are young bovines of either sex that haven't yet been weaned off of milk.

GLASSES OF GASES

Pardon their rudeness, but cows burp — a lot.

It's the price of being ruminants. All that cud going up and down the esophagus results in the expulsion of a lot of gas right out of the mouth.

How much is a lot? According to assistant professor Matt Ruark, a dairy cow will belch out the equivalent of 4.42 pounds of carbon dioxide for every gallon of milk it produces.

This is important because the world is getting warmer, and all those burps aren't helping. Dairy farms contribute about 2 percent of U.S. greenhouse gas emissions. That's why Ruark is directing a research project — funded by a \$10 million grant from the U.S. Department of Agriculture

(USDA) — to investigate how dairies can help mitigate and adapt to climate change.

The five-year study was launched in spring 2013, and it includes contributions from a variety of different disciplines. (Ruark himself is a soil scientist, although he does describe himself as a big milk drinker.) Project participants include seven different universities, as well as several government facilities.

The study's funding comes from a USDA CAP grant — that's a Coordinated Agricultural Projects grant — a program that looks at farming as a unified process, rather than as a series of discrete activities.

"We're looking at the entire milk cycle — cows, manure, land, crops, and back," Ruark says.

He believes that one of the key reasons why his research project won its

CAP grant was because it will actively involve working farmers and has the support of the dairy industry.

"The USDA project not only includes research activities, but also funds education and outreach," Ruark says. "My Extension appointment puts me in a unique position to integrate all these activities."

The UW's relationship with the dairy industry dates at least back to 1886, when it began offering educational outreach programs called farmers' institutes. The Dairymen's Association sponsored the bill that created them.

More than a century later, the UW is still working to help the dairy industry deal with the leading problems of the era. These days, that's climate change. Dairy farms produce the equivalent of 49,000 teragrams — that's 49 million billion grams — of carbon dioxide every year, and yet dairy production shows no sign of decline.

"Milk is actually one of the few foods that nutritionists say we should consume more of," says Molly Jahn, the co-director of the climate project and former dean of the College of Agricultural & Life Sciences. But the dairy industry has signed a memorandum of understanding with the USDA, agreeing to reduce emissions 25 percent by 2020. That's why the industry — through its trade organization, Dairy Management Incorporated, and its scientific arm, the Innovation Center for U.S. Dairy — is so interested in this study. It needs Ruark, Jahn, and their team to help prepare dairy farmers for a changing world.

"Our main goal is to promote dairy sustainability," Ruark says, "which has both economic and environmental aspects. We want to work with the industry and provide them with tools to mitigate greenhouse gas emissions and adapt to future changes in climate."

A CASE FOR QUESO

"It's you people who are the mutants," says dairy science professor Lou Armentano, addressing all of the lactose-tolerant people of the world. "You know that, right?"

He's referring to the fact that most mammals are lactose intolerant. While they can digest milk in infancy, they are unable to as adults. About 10,000 years ago, some human populations developed a mutation (to the MCM6 gene, if you want to get specific) that allowed them to digest lactose throughout their lives.

As a lactose-intolerant person, Armentano knows that he will never comfortably enjoy a white Russian, or cream in his coffee, or genuine ice cream, or the snap, crackle and pop of Rice Krispies. But there's one dairy treat he

eats with gusto and generally without consequence: cheese.

"Lactose is in whey," Armentano says. "Almost all of it is removed in the cheese-making process. So lactose-intolerant people, in general, can eat cheese, without discomfort to themselves or those around them."

He notes that this is particularly true for the harder cheeses — the harder the cheese, the less whey remains, and so the less lactose.

"Most lactose-intolerant people think they have to avoid all dairy products, but that's not true," he says. "They can eat cheese. That's something to put in a magazine article." ■

John Allen is senior editor of On Wisconsin. He drinks two glasses of milk a day, and his bones are adamantine.



On Wisconsin

WINTER 2013

Publisher

Wisconsin Alumni Association
650 North Lake Street, Madison, WI 53706
Voice: (608) 262-2551 • Toll-free:
(888) WIS-ALUM • Fax: (608) 265-8771
Email: onwisconsin@uwalumni.com
Website: onwisconsin.uwalumni.com

Co-Editors

Niki Denison, Wisconsin Alumni Association
Cindy Foss, University Communications

Senior Editor

John Allen, Wisconsin Alumni Association

Senior Writer

Jenny Price '96, University Communications

Art Director

Earl J. Madden MFA'82, University Marketing

Production Editor

Eileen Fitzgerald '79, University Marketing

Class Notes Editor

Paula Apfelbach '83, Wisconsin Alumni Association

Editorial Intern:

Preston Schmitt x'14
Design, Layout, and Production
Barry Carlsen MFA'83; Toni Good '76, MA'89;
Kent Hamele '78, University Marketing

Campus Advisers

Paula Bonner MS'78, President and CEO,
and Mary DeNiro MBA'11, Executive Vice President and COO, Wisconsin Alumni Association • Amy E. Toburen '80, Executive Director, University Communications • Lynne Johnson, Senior Director of Communications, UW Foundation

Advertising Representatives

Madison Magazine: (608) 270-3600

Big Ten Alumni Alliance
National Accounts Manager
Susan Tauster: (630) 858-1558

Alumni Name, Address, Phone, and Email Changes • Death Notices

Madison area: (608) 262-9648
Toll-free: (888) 947-2586
Email: alumnichanges@uwalumni.com

Quarterly production of *On Wisconsin* is supported by financial gifts from alumni and friends. To make a gift to UW-Madison, please visit supportuw.org.

Printed on recycled paper.

Please remember to recycle this magazine.



Brown Swiss are divas.

They're lovely cows, but as dairy breeds go, they're high-maintenance and kind of temperamental.

"Brown Swiss do what they want, when they want," says Sarah Witt x'17, a member of the Badger Dairy Club who helped *On Wisconsin* stage its cover shoot for this issue. And we needed a lot of help.

Although the UW is the flagship university of America's Dairyland, we haven't covered milk studies in a feature-length article in many years, so we wanted to give cows their due. We held a cattle call to select the best cover girl, which led us to UW Wonderment Taylor, the 1,500-pound, three-year-old beauty you see here.

But choosing the right cow is the easy part. Getting her photo? Now, that's hard.

Ted Halbach, who teaches dairy cattle evaluation, was there to assist. Whenever UW cattle make a public appearance — which they were doing a bit of this week; it was World Dairy Expo — Halbach's the guy to see. He can get our mooing models ready for a runway show or photo shoot. And he assembled the entourage that prepped and managed Taylor.

First Witt and a few fellow students — Kathryn Ruh x'14, Elizabeth Binversie x'15, and Anuj Modi x'17 — had to get Taylor primped and polished. They washed her, brushed her coat, combed out her tail, and brightened up her hooves. Normally this last task is done with a product called Black Magic — or with shoe polish or even spray paint if Black Magic isn't available. On our day, the team had none of the above, so instead they shined up her tootsies with spray oil. Then they brought Taylor — a very skeptical Taylor — into the Stock Pavilion, where we'd set up a makeshift photo studio.

Ruh and Binversie coaxed her into position, while Witt convinced her to look in the right direction by hooting like a howler monkey. As for Modi, he was on bucket duty. Don't ask.

And Taylor? We eventually got her picture, but she made it clear that she didn't like clicking cameras. She liked popping flashes even less. She threw a tantrum, threatened to kick over a few thousand dollars' worth of lights, and generally huffed and sulked.

Diva.

John Allen



From left: Elizabeth Binversie, Anuj Modi, Taylor, Ted Halbach, Kathryn Ruh, Sarah Witt, and photographer Bryce Richter. Pity poor Modi.

JEFF MILLER



