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OREGON'S AGRICULTURAL

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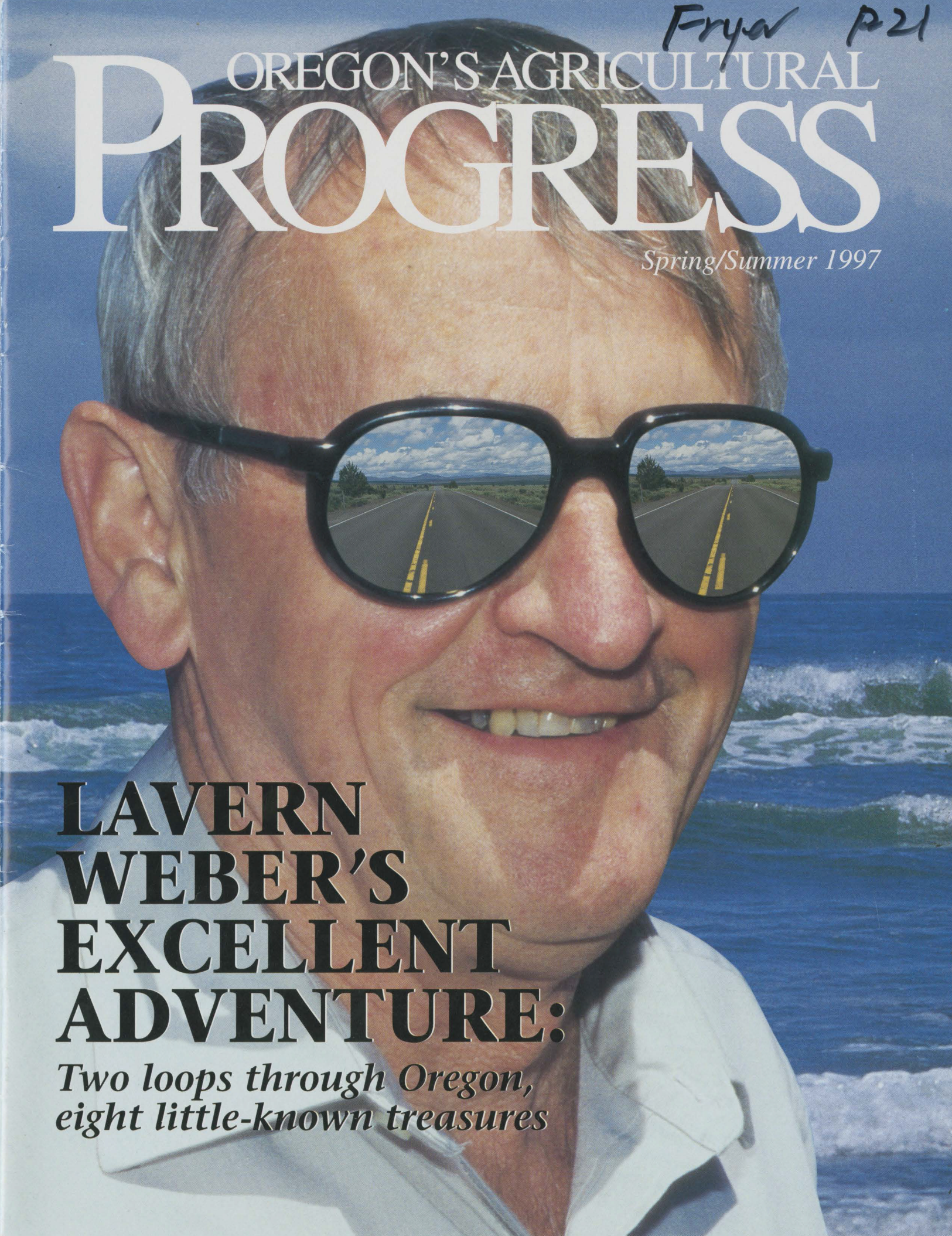

LAVERN WEBER'S EXCELLENT ADVENTURE:

Two loops through Oregon, eight little-known treasures

OREGON'S AGRICULTURAL
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Oregon State University

Cover: Lavern Weber, superintendent of OSU's Coastal Oregon Marine Experiment Station. Story on page 24. Photo illustration: Bob Rost, Tom Weeks.

Editor **Andy Duncan**

Designer **Tom Weeks**

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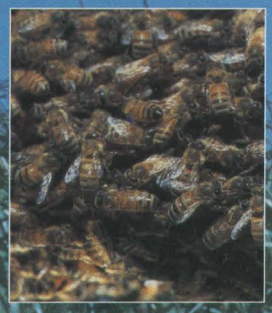

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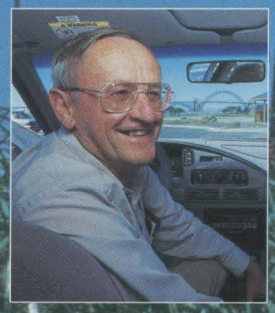

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EDITOR'S NOTE

Did you ever have a little accident that forced you to shift your mental gears?

This morning I was standing in a familiar spot on the campus, talking with the designer of this magazine, Tom Weeks. As I swung my hand making a point, my plastic OSU identification card fluttered out of it and, seemingly in slow motion, down to the sidewalk.

We looked at each other. The card had disappeared.

On closer inspection we saw it in a narrow crack between a cement wall and an equally solid sidewalk. Neither of us had noticed the tiny crevice before. There was no way any human finger could reach the card. I thought of using an ice pick. But who has one since block ice headed the direction of the dodo bird?

A little flustered, because you can't even check out a library book without one of those cards, I went in a nearby building looking for a very thin screwdriver. A good Samaritan gave me a big paper clip, suggesting I straighten it and use it to flip the card out. The paper clip didn't work, plus I lost it in the crack and the card slid deeper.

I went in another building looking for help (by now Weeks had abandoned me). A fellow behind a counter held up a svelte, 15-inch-long hacksaw blade, grinning confidently. My spirits soared. But that didn't work.

As I sat by the crevice pondering, a passerby, the same woman who gave me the paper clip, asked if I'd tried putting tape on the end of the hacksaw blade. A minute later the ID card was back where it belonged in my wallet. I felt like I'd put that little NASA rover on Mars—with an erector set and some household chemicals. Gradually, I came back to earth and realized the key had been the creative thinking of the passerby.

That brings me to the articles in this issue: We all have to look at situations from different angles, with fresh perspectives, to adjust to everyday life. It's a scientist's job to think that way.

In one article that follows, an entomologist is trying to figure out how to outmaneuver mites destroying wild honey bees. In another, a microbiologist describes the many dead ends and eventual triumph of her 16 years trying to figure out how an elusive parasite kills trout and salmon. You'll meet Portland high school students learning about life from the point of view of farmers. And you'll read about Oregon's network of branch agricultural experiment stations, where year after year researchers wrestle with natural puzzles to solve state problems and generate new opportunities.

Thanks to my colleagues Bob Rost, Rick Cooper and Rick Hansen, and others, if you don't want to read about all this the old fashioned way, on paper, you can shift gears and visit us online. Our address on the World Wide Web is: http://wwwagcomm.ads.orst.edu/. Once you're there, click on the *Oregon's Agricultural Progress* button.

Andy Duncan

UPDATE

RESEARCHERS STUDYING MALE-ORIENTED RAMS

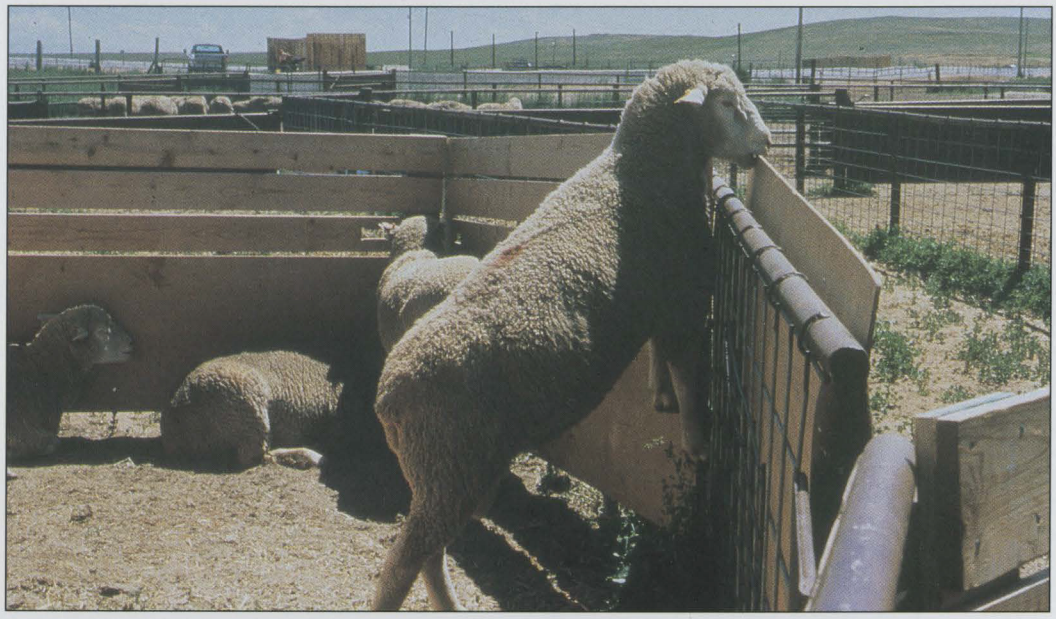
Scientists studying male-oriented mating behavior in some rams have found links between sexual preference and chemical activity in the brain.

A report on the work, co-authored by OSU animal scientist Fred Stormshak, was published in *Biology of Reproduction,* a scientific journal.

Stormshak and scientists from several other institutions investigated the sexual behavior of adult male sheep that prefer to copulate with males rather than females.

"This is a costly problem for sheep producers because breeding rams are worth $300 to $500 each," said Stormshak. "Outwardly, there is no way to tell whether a ram is male-oriented, so the producer runs the costly risk of buying an animal that will never produce any offspring."

Sheep producers lose thousands of dollars yearly from the purchase of breeding rams that turn out to be male-oriented, Stormshak added. About 8 to 10 percent of all rams are male-oriented, he said.



ANNE PERKINS

A male-oriented ram ignores nearby ewes in their mating cycle. He's looking at rams in a nearby pen.

The researchers focused on the part of the brain called the hypothalamus, a center for the formation of reproductive behaviors in most mammals.

"We concentrated on aromatase activity in the hypothalamus," said Stormshak. "Aromatase is an enzyme that converts testosterone into estrogen in the male."

In some species, he noted, the hormone estrogen brings about mating behavior in which males seek females for copulation. These data reflect the biology of sheep and are "not construed to be applicable across species," Stormshak pointed out.

After reaching 16–18 months of age, the rams in the study were given sexual behavior tests to determine their preference for either females or males.

"We found that in regard to mating behavior, the rams fell into three categories," Stormshak said. "One group mated with females again and again, a second group mated with females occasionally, and the third group did not mate with females at all."

Following further mating preference tests, tissue and blood samples were collected from selected rams. Analysis of those materials led to the general conclusions that male-oriented rams convert less testosterone to estrogen in the hypothalamus component of their brains, and that these rams have reduced capacity for production of testosterone, compared to female-oriented rams.

"These results raise the question of why the testes of some rams produce less testosterone than others," Stormshak said. "Unfortunately, there is no answer for that question now."

Stormshak and colleagues are following up with a project that will analyze the possibility of altering the male-oriented behavior of rams with an estrogen implant.

The initial research team included John Resko, Charles Roselli and Jerome Choate of the Oregon Health Sciences University, and Anne Perkins of Carroll College in Helena, Montana.

BORROWING MAY HELP LIVESTOCK INDUSTRY

By borrowing a strategy from Down Under, Pacific Northwest ranchers are going to be able to save on selenium treatments for their livestock, OSU researchers believe.

The strategy calls for applying selenium to pastures instead of giving selenium injections to cattle.

"Injections or oral treatments of selenium cost $3 to $10 per head. Applying selenium with fertilizer would cost about 33 cents a head," said Randy Dovel, a research agronomist at OSU's Klamath Experiment Station.

Dovel said the selenium formulation he uses is sold commercially in Australia and New Zealand. Like the Pacific Northwest, those countries have selenium-deficient soils that produce selenium-deficient forage.

Selenium deficiency causes white muscle disease of cattle and sheep, which affects animal reproduction, weight gain and general health.

Studies by Dovel and Ron Hathaway, a Klamath County extension livestock agent, showed that about one-half ounce of selenium per acre applied to the soil is enough to produce forage without deficiency.

"We found that just one pound per acre of the commercial material is all we need," Dovel said. "We mix it with a nitrogen-based fertilizer and apply it at the same time we fertilize."

INSECTS CAN HELP US MANAGE THE FORESTS

It took decades to give Smokey the Bear a decent burial and bring fire back into the forest ecosystem. It might take even longer to enhance the image of bugs, experts say.

Even in an age of enlightened forest management, it's tough to find the word "insect" used without "pest" attached. But new studies at OSU have concluded that a variety of insects can play major roles in forest ecology—many positive.

Research has already shown that insects are a key in cycling nutrients, speeding decomposition and building soil fertility," said Tim Schowalter, an OSU Agricultural Experiment Station entomologist. "It now appears they do far more than that.

"In Oregon we've viewed the major insect epidemics as disasters," Schowalter said. "Those destructive outbreaks are having an effect that's roughly comparable to fire. In some ways they're doing the forest underthinning that fire would have done and we should have done."

If nothing else, the insects are a clear indicator of forest health, according to Schowalter.

"What they're telling us is that fire exclusion allowed a huge invasion of understory shrub and tree species that don't belong there," he said.

OSU scientists examine a forest altered by the spruce budworm.

The insects have already taken the liberty of killing many of those plant species, he added. Now, if catastrophic fires don't first burn everything up, the insects may help create openings in the forest, improve water availability and give a major nutrient pulse to surviving trees.

In other words, they could work in concert with fire to restore forest health to eastern Oregon. Some areas, Schowalter said, are already healthier than they have been in half a century.

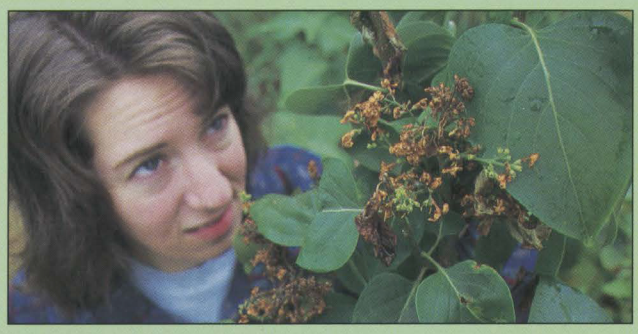
In pioneering research, much of it done at the H.J. Andrews Experimental Forest near Blue River, OSU scientists have learned about roles insects play in forest ecosystem processes.

Defoliating and sap-sucking insects affect nutrient turnover. Wood-boring insects penetrate bark and provide access for decomposers and water, accelerating decomposition. Insect outbreaks can open holes in the forest canopy. Trees that survive get a burst of nutrients that improves their growth and health.

In a normal forest ecosystem with a diversity of insects and the natural presence of fire, Schowalter said, tree species that are appropriate for that terrain grow and thrive. Inappropriate species are weeded out. If drought or wet cycles tend to push the ecosystem out of its usual balance, fires and insect attacks help bring it back.

At this point, Schowalter said, concessions may have to be made to decades of fire exclusion and insect suppression. As a member of Governor Kitzhaber's task force to study eastern Oregon forests, he agreed with recommendations for low-elevation salvage logging and more use of controlled fire to improve forest health.

NURSERY DISEASE HARDER TO CONTROL



LYNN KETCHUM

OSU graduate student Heather Scheck eyes a lilac plant damaged by bacterial blight.

A disease that causes problems for Oregon's $400 million-a-year-plus nursery industry has developed resistance to both the chemicals used to control it, an OSU study shows.

Pseudomonas syringae bacteria, which cause a disease commonly known as bacterial blight, are already responsible for more than $8 million in annual losses to the nursery industry.

As chemical resistance spreads it's believed the problem will worsen. A survey of 44 Willamette Valley nurseries showed the bacteria at all the nurseries, with 467 strains isolated from 25 plant species.

The bacterium "produces a toxin that kills flowers and new growth, and causes cankers on more than 160 green and woody plants," said Heather Scheck, a doctoral candidate in OSU's Department of Botany and Plant Pathology.

In recent years growers have complained that the chemicals they use most often to control bacterial blight—copper and streptomycin—seem to be losing their effectiveness. And the disease often makes plants appear at their worst during spring, the prime sales season.

"We discovered that different phenotypes of *Pseudomonas syringae* have rapidly evolved in the past 10 years with resistance to either copper, streptomycin or both," said Scheck, who works with OSU Extension plant pathologist Jay Pscheidt.

The OSU researchers have found some approaches that help address this problem.

Studies show that streptomycin resistance means the bacteria is virtually invulnerable to that chemical. But it appears that copper formulations with a higher concentration of "free ions," in a wettable powder form, still provide some control.

Brand names of chemical products that meet that criteria and are available in most garden stores include Microcop, C-O-C-S, and Kocide 101 in its wettable powder form.

Other non-chemical measures that can help include allowing more space between plants and pruning to maintain air flow within the canopy. Cover from rain is also very helpful, and growth of more plants either under cover or in greenhouses may be one solution available to the nursery industry.

Continued research at OSU will work to find other types of treatments that can address this problem, Scheck said. So far, there has been little success in finding genetic resistance among plant species susceptible to the bacteria, she added.

A LITT
IN BIG

We've learned how to protect commercial hives, but mites are wiping out Oregon's wild honey bees

BY DAVE STAUTH

Think back, for a moment, to your childhood. To a warm spring day. A nice day, of course. Not the time you got in trouble and lost your allowance. Forget about that.

Think about the smell of fresh-cut grass, hamburgers grilling on the barbecue. Butterflies wafting in the breeze. Playing catch with your dad or hopscotch on the front sidewalk. Honey bees bouncing from flower to flower.

Those were the golden days. The sun was still up past bedtime. Pleasures were simple. The ice cream

LE CRITTER
G TROUBLE

was so cold it hurt the roof of your mouth, and memories were forged to give your life a foundation.

Now adjust the image to the present.

You can still grill a hamburger. You can still play catch or hopscotch, and if you plant the right flowers a few butterflies might even come.

But the honey bees? Forget about it.

Maybe it doesn't seem like a big deal. But a little piece of our world has rapidly disappeared almost without notice.

The spotted owls are called the endangered species. AIDS, crime and budget battles fill the headlines. And hardly anyone notices that the wild honey bee, that simple little fixture of our spring and summer days, has quietly gone away. And it may be a long, long time before it comes back.

This isn't a story about losing a species. Honey bees are not extinct. And it isn't even a story about huge economic losses or disrupted agricultural systems. You can still find honey bee colonies in commercial

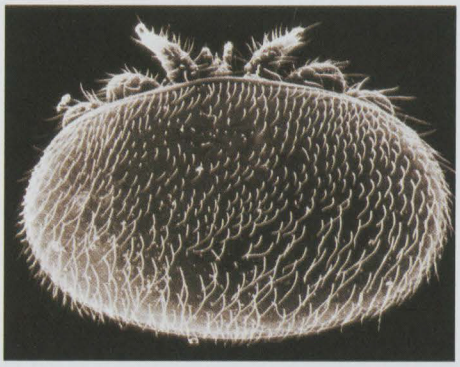
orchards, managed by expert apiculturists. And some other ratty little bee that lives in the dirt will probably pollinate your cherry tree or vegetable garden. In fact, if you don't want to you don't have to notice that almost all the wild honey bees are gone.

But they are, and some people don't like it.

"I know of a man who wanted to rent a commercial beehive so he could have the sight and sound of honey bees back in his garden," said Michael Burgett, a professor of entomology at Oregon State University. "Hardly a week goes by that someone doesn't ask me what happened to the honey bees."

Burgett, internationally recognized as an expert on honey bees, saw it all coming, about as early as anyone in the world. The demise of our wild honey bees may be a surprise to most of us, but he's been warning about the looming crisis for almost a quarter of a century.

To Burgett, it was an expected but unwelcomed event when he got a call late one night in 1984 from a colleague, an apiculturist at the University of California. The call was part of an early warning system entomologists had set up to spread the word quickly in the event of a disaster. It was the only time Burgett can recall the warning system being used.



Deadly honey bee enemies: Photos, taken with an electron microscope, of the trachael mite, above, and the varroa mite, below.

"Hardly a week goes by that someone doesn't ask me what happened to the honey bees."

"Mike, they've found tracheal mites in Louisiana," said the voice on the other end of the phone.

Most people would have no idea what that meant. Burgett did, and it made him a little numb. An integral part of America's heritage was on the way out, even if it would take another decade for the rest of the nation to realize it.

"Wow," Burgett thought at the time. "Here we go."

The caller was talking about parasitic tracheal mites, which entomologists know to be a deadly parasite of the

LYNN KETCHUM

OSU entomologist Mike Burgett with a swarm of wild honey bees in a Willamette Valley peach orchard. Eventually parasitic mites may kill up to 99 percent of the state's wild honey bees, Burgett fears. Photo, pages 6,7: Lynn Ketchum.

Wild honey bees in Malaysia. In his research overseas, OSU's Burgett often comes home with information about potential threats to Oregon. The varroa mites threatening Oregon honey bees came from Asia.

European honey bee, *Apis mellifera*. It wasn't news that they could be devastating to this species of honey bee, because the first big losses had happened on the Isle of Wight in the English Channel around 1920.

"We knew all about this parasite," Burgett said, "and had for some time. In fact, a law was passed in 1922 in the United States banning all honey bee imports, specifically to exclude the tracheal mite. Even back then we knew it would be a disaster."

That law, Burgett said, actually did its job pretty well for more than half a century. But then tracheal mites started showing up in Mexico and, finally, in the United States in 1984. Then, with shocking speed, the highly mobile commercial honey bee industry spread them all over the nation—within two years.

The worst was still to come.

In 1975, on a trip to Thailand—one of many he's made to various parts of the world studying bees—Burgett wrote one of the first professional descriptions of *Varroa jacobsoni*, more commonly known as the varroa mite. The article, titled "A Prospective Pest of Honey Bees in Many Parts of the World," was about one and a half pages long and was published in the journal *Bee World*.

Looking back, the article was a classic understatement.

"Professional people saw the paper, they read it, they said, 'gee, how interesting,' and then they forgot about it," Burgett said. "But I knew 20 years ago that the damage from varroa mites could make tracheal mites look like a Sunday ice cream party."

Tracheal mites can infect honey bees, but at least they're a native parasite for European honey bees and don't always kill a bee colony. Varroa mites are native to Asian honey bees, which have some different types of defense mechanisms. Our honey bee species does not, and a colony infected with varroa mites inevitably will die within a year or two.

In 1987, the news came in. Varroa mites had been found in Wisconsin.

"People, including me, were shocked how fast the tracheal and varroa mites spread," Burgett said. "I don't know why we should have been. The United States beekeeping industry is one of the most mobile, fluid industries in the world. Beekeepers often congregate in the South during the winter, in the Dakotas during the summer, and in between they go all over the country."

At first, under the naive assumption it could still do something, the U.S. Department of Agriculture's Animal and Plant Health Inspection Service fought back. It tried to identify infected bee colonies and destroy them. Organizations such as the Oregon Department of Agriculture joined in, killing 1,500 honey bee colonies in southern Oregon in 1986.

Such efforts accomplished nothing other than to infuriate and impoverish a number of commercial beekeepers. By the late 1980s the genie was very much out of the bottle, and the futile hive eradication programs soon ended.

"It took us a little while to realize the obvious," Burgett said. "The parasitic mites were everywhere."

Commercial beekeepers, and to a far lesser extent, "hobbyist" beekeepers, were soon anxiously seeking help against the mites. In 1986 Burgett faced an overflow crowd at one meeting in southern Oregon's Jackson County. Its participants urged the university to begin research programs that would develop effective mite controls.

"People were shocked how fast the tracheal and varroa mites spread."

OSU's research program, and others like it, soon succeeded in developing chemicals and control regimens that commercial beekeepers could use to protect their colonies. These miticides are reasonably effective if conscientiously applied.

But this is easier said than done. "Even with the best commercial beekeepers, who really know what they're doing, the mites have doubled the usual amount of dead colonies during the winter," Burgett said. "And hobbyist beekeepers without the knowledge or patience to use these chemicals have been leaving the field in droves."

The commercial impact of these parasitic mites, Burgett said, has not been trivial. Pollination fees have doubled in the past 10 years, and wholesale honey prices are up 90 percent in the past two years. If there is a silver lining to any of this, it's that the commercial beekeepers who are really at the top of their game are having banner years—honey is bringing top dollar, and for pollination that depends on honey bees, commercial beekeepers are now the only game in town.

"It's not easy," Burgett said. "I know one beekeeper near Molalla who really knows his business and runs about 1,000 hives. He didn't think he had any mite infestation yet. But he saw a few crawling around, did a sampling of 100 hives and found mite infestation in 95 of them."

There's still a real concern, Burgett said, about the mites developing resistance to the chemicals available to control them. And honey bees are not a big-ticket item like corn, wheat or cattle—for the giant agro-chemical companies, so there's not a lot of money to be made in parasitic mite research and

developing new chemical controls. But all things considered, the commercial beekeepers and their bees will survive.

The wild hives are not so lucky.

"We'd like to be able to offer more hope," Burgett said, "but the reality is that in the United States today, most honey bee colonies without chemical treatments will soon become infected with parasitic mites and soon after that they will die."

LYNN KETCHUM

Miticides are helping commercial beekeepers control deadly trachael and varroa mites. But who looks out for wild honey bees?

Will every last one of the wild colonies die? Probably not, but the limited research done so far indicates that at least 80 to 90 percent will, and the numbers may soon approach 95 to 99 percent.

"Probably 90 percent of the nation's wild honey bees are already dead."

Will natural resistance develop? Yes, it might, Burgett said. But because there's a constant intermingling of wild bees and commercially kept bees, any resistance that does develop will automatically get watered down, in a genetic sense, by the infected commercial hives.

"In theory, we might identify bees with mite resistance more quickly if we allowed almost all the honey bee colonies to die," Burgett said. "What we're doing now is literally encouraging survival of the weakest, and that's not great. But the alternative is just too Draconian."

For the wild bees it's almost over. In the past, a healthy natural colony might have persisted for up to 50 years. Today, because it will be infected with parasitic mites, it will be lucky to reach age two.

"Probably 90 percent or more of the nation's wild honey bees are already dead," Burgett said. "The harsh winter of 1995–96 helped finish them off. Pretty soon the only wild hives left will be colonies that have swarmed and escaped from human-kept hives."

Honey bees managed by humans pollinate hundreds of millions of dollars worth of Oregon crops each year, like these pear trees.

Just how many wild bees have died? Frankly, nobody knows. Honey bees were brought to America from Europe in the 1620s, and the North American climate was honey bee heaven for them. They thrived.

"We still don't have a good database on wild honey bees because it just never seemed an important thing to study," Burgett said. "Common sense told you there were a lot of hives, but exactly how many? No one seemed to know or care."

A survey once done in New York indicated, for that ecosystem, that there were about 10 wild honey bee colonies per square mile. A study done in the Sonoran Desert of the American Southwest, which doesn't exactly sound like prime bee country, found as many as 20 colonies per square mile. Suffice it to say there used to be several million wild honey bee colonies, and probably a lot more than that.

Early settlers prized honey bees for their honey (used as a natural sweetener), for their honeycombs (for their wax) and for their role in pollination of crops. As the nation grew, settlers in covered wagons literally carried the bees across the prairies. In the America of the mid-1800s, a nation of small farms, practically every farm kept a hive or two for personal uses.

"Honey bees are part of our heritage," Burgett said. "When most people think of a bee, they think of a honey bee."

You see them in advertising, in your garden, on your trees, in children's storybooks, and in movies. Remember the "bee tree" scene in the movie "Fried Green Tomatoes?" And to help explain the wonders of the insect world, honey bees are the bug of choice. Almost every young student learns about queen bees, drones, the intricacies of bee communication, the essential role each bee plays in supporting survival of the colony. Life lessons intermingle with entomology.

"I've never seen a child yet who wasn't fascinated by a honey bee colony," Burgett said. "More than 20 years ago I started a college course that was focused on honey bee biology, and a prime motivation for that course was the demand by K–12 teachers."

And the honey bee-human connection goes back a lot further than the European settlement of America.

"The most credible studies suggest that *Apis mellifera*, our European honey bee, actually evolved in Africa about 2.5 million years ago," Burgett said. "That parallels the age of the genus Homo, which of course later came to include *Homo sapiens*. *Apis mellifera* eventually

became most dominant in Europe, became our modern honey bee and evolved along with humans themselves and the human use of agriculture."

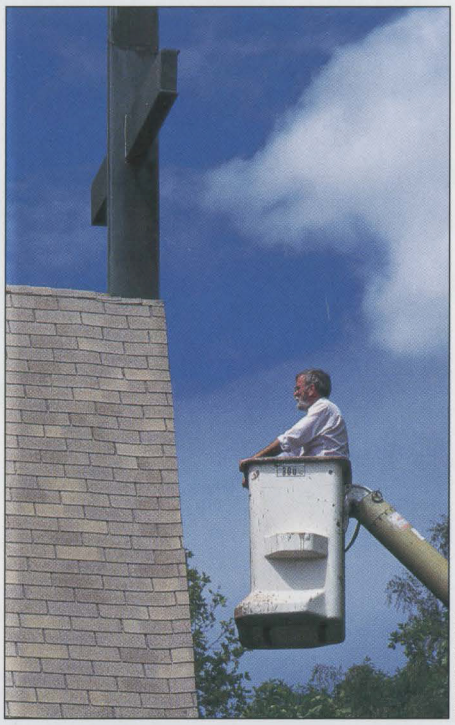
Honey bees were considered sacred in pre-Christian and Egyptian societies. The Bible suggests Jesus Christ was weaned on butter and honey and was offered a piece of honeycomb to eat just before his ascent to heaven. Islamic prophet Mohammed cited honey as a remedy for every illness of the body, and the Koran cites it as a remedy for mental illnesses.

Burgett succumbed later in life to fascination with the honey bee.

"I've always loved biology and entomology, but I just kind of happened into a career studying honey bees," he said. "A research assistant job was open in that area when I began graduate school. So you could say my love affair with honey bees was sort of an arranged marriage. It took me about a year to realize this was the most marvelous creature on the face of the Earth."

Burgett said he hopes the demise of the wild honey bee is a temporary phenomenon. Mite-tolerant bees may develop, he said. Maybe. Someday.

"Mite tolerance could develop through genetic diversity," he said, "but right now the only restocking of wild bees is being done by swarms escaping from our commercial beekeepers. And in that commercial industry, literally thousands of genetically similar queens are being produced by just a few queens. That won't yield much diversity."

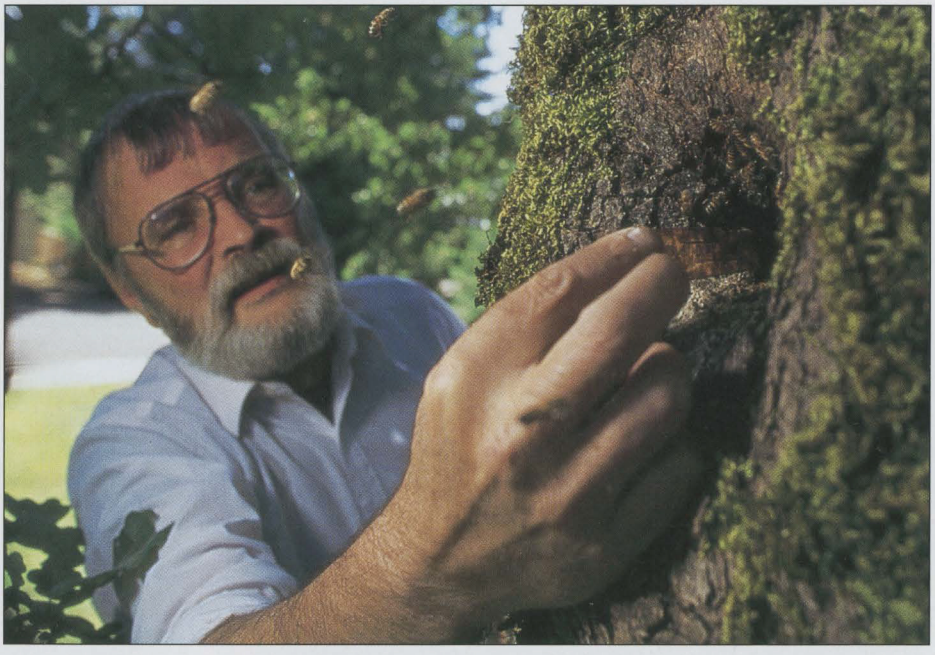


LYNN KETCHUM

The Episcopal Church of the Good Samaritan in Corvallis called Burgett to remove a hive under its cross. The congregation decided to "adopt" the wild bees. Later Burgett treated the hive for mites.

Burgett's efforts will continue. On various research projects he's already been to Thailand (17 times), China, Indonesia, Australia, Belize, Uruguay, Argentina, Russia, Egypt and Turkey. Other problems continue to occupy his attention too, not the least of which is the continued spread of Africanized bees in the American South and Southwest.

Lest home gardeners panic about the demise of wild honey bees, he notes that other bees will pick up the pollination slack.



LYNN KETCHUM

Burgett puts a chemical strip in a bee tree. When wild honey bees return to the tree they'll walk on the sticky chemical, which controls parasitic mites that could kill them.

The bee is an insect that's been with humans since we left the Neanderthals.

There are 3,500 species of bees in the United States, many of which will pollinate one or many plant species. Soon your cherries, apple trees, flowers and fruit gardens may owe their pollination to bumblebees, mason bees, sweat bees or even the "mining mud bee." These insects are often tiny, live in holes in the ground or elsewhere, and go about their work sight unseen. People can and will learn to live without the honey bee.

It's been sad but interesting, Burgett said, to see how this mite epidemic evolved. He used to get several dozen calls a year from Corvallis-area residents who wanted him to come pick up wild honey bees swarming near their homes.

"I was able to track the intensity of the mite epidemic simply as the phone stopped ringing in the mid 1990s," he said.

Right now, Burgett said, there's some refill of wild colonies by commercial swarms. For climatic reasons, 1997 in Oregon seems to be an unusually good year for bees to swarm (take off from their human keepers and form new colonies). What those bees don't know is that without the supportive chemicals provided by beekeepers, they're doomed. It's a tough time for an insect that has been so naturally successful, and revered, through thousands of years.

The wild honey bee is nothing more, or less, than an insect that's been with human beings since we left the Neanderthals behind and tried to start farms, get our crops pollinated, produce wax candles and enjoy foods that tasted a little sweeter.

Through countless generations they've been around, along with flowers, butterflies and cool winds, as we enjoyed warm spring days. But many of us took them for granted. We still have most of it. But not all, and the spring is a little more silent for the loss.

Dave Stauth is a science writer in OSU's Office of News and Communication Services.


CRAZY

Urban youngsters are out of touch with the good earth, some people say. But students at James Madison High School saw farm life up close and personal on a recent trip

FROM PORTLAND TO PERRYDALE

BY BOB ROST

I'm going up the country,
Tell me do you want to go,
I'm going someplace I've never been before
—Canned Heat, American rock band, 1968

The high school field-trippers who rushed past me onto the charter bus probably never heard that wonderful little chunk of rock music's psychedelic era, but it's a perfect theme song for these city kids from Portland headed out on a tour of several Willamette Valley farms.

The song is an upbeat, optimistic tune about leaving the city to discover new

Freshmen Heather Keel, center, and Miranda Ricketts of Portland's Madison High School on a field trip to a Willamette Valley hog farm. Photo illustration: Tom Weeks, Bob Rost.

experiences in the countryside. Although it was recorded long before any of these teens were born, it seemed to fit their mood perfectly as they chattered excitedly and appeared playfully impatient to begin their rural outing.

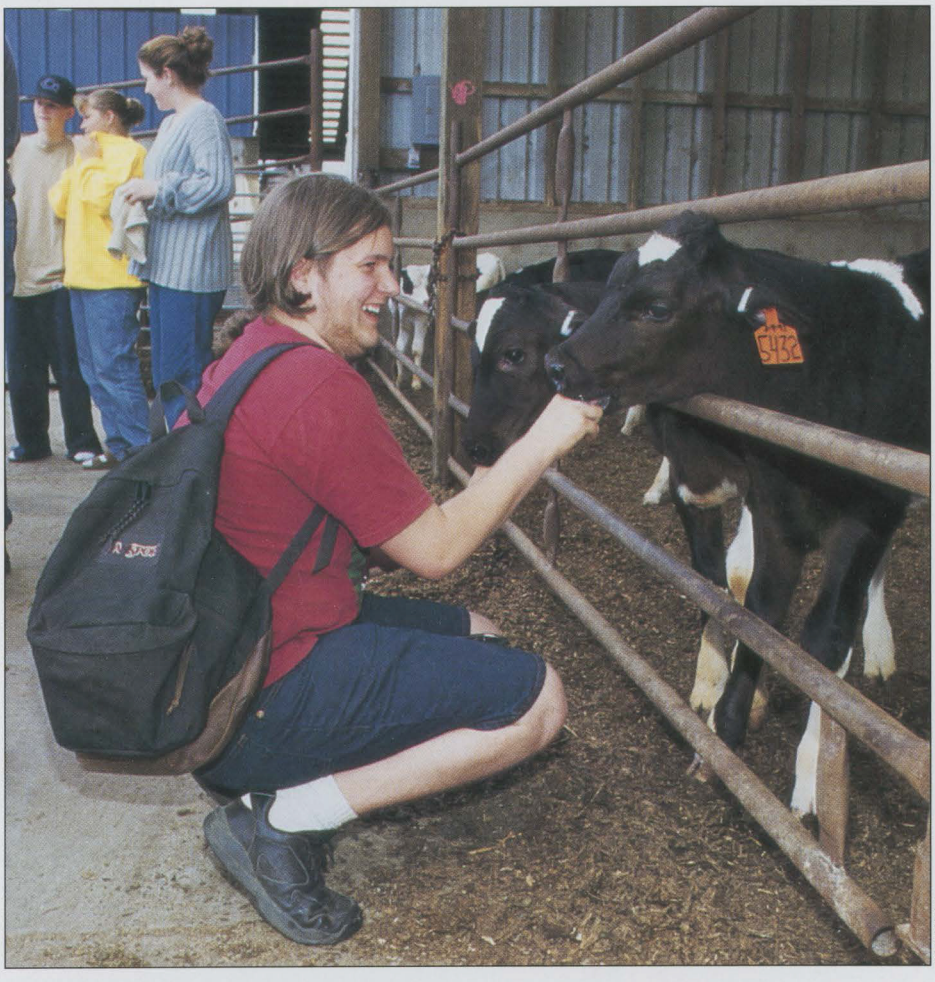
The students, from Portland's James Madison High School, were participating in an ongoing series of "agriculture tours" made possible through the efforts of the school's principal, Ron Hudson, and a partnership of Oregon agricultural organizations and institutions, including the College of Agricultural Sciences at Oregon State University.

I accompanied the students on a recent foray from the heart of the Portland metropolitan area to the small-town country charm of Perrydale, Oregon.

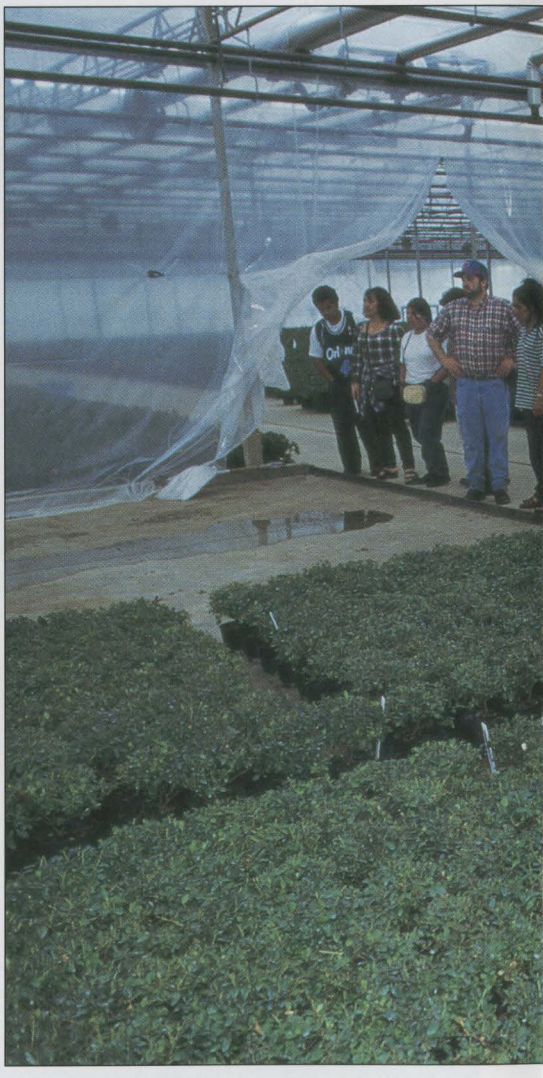
It's both a curious and humorous thing to watch a bunch of city kids troop around down on the farm, their teacher-chaperones urging on the stragglers. The kids reacted with comical disgust at the odor of the hog pen, throwing their arms over their faces and emitting a loud

BOB ROST

Tom Crawford, who grows grass seed near Perrydale, Oregon, about 45 miles south of Portland, tells Madison High students how a swather works.



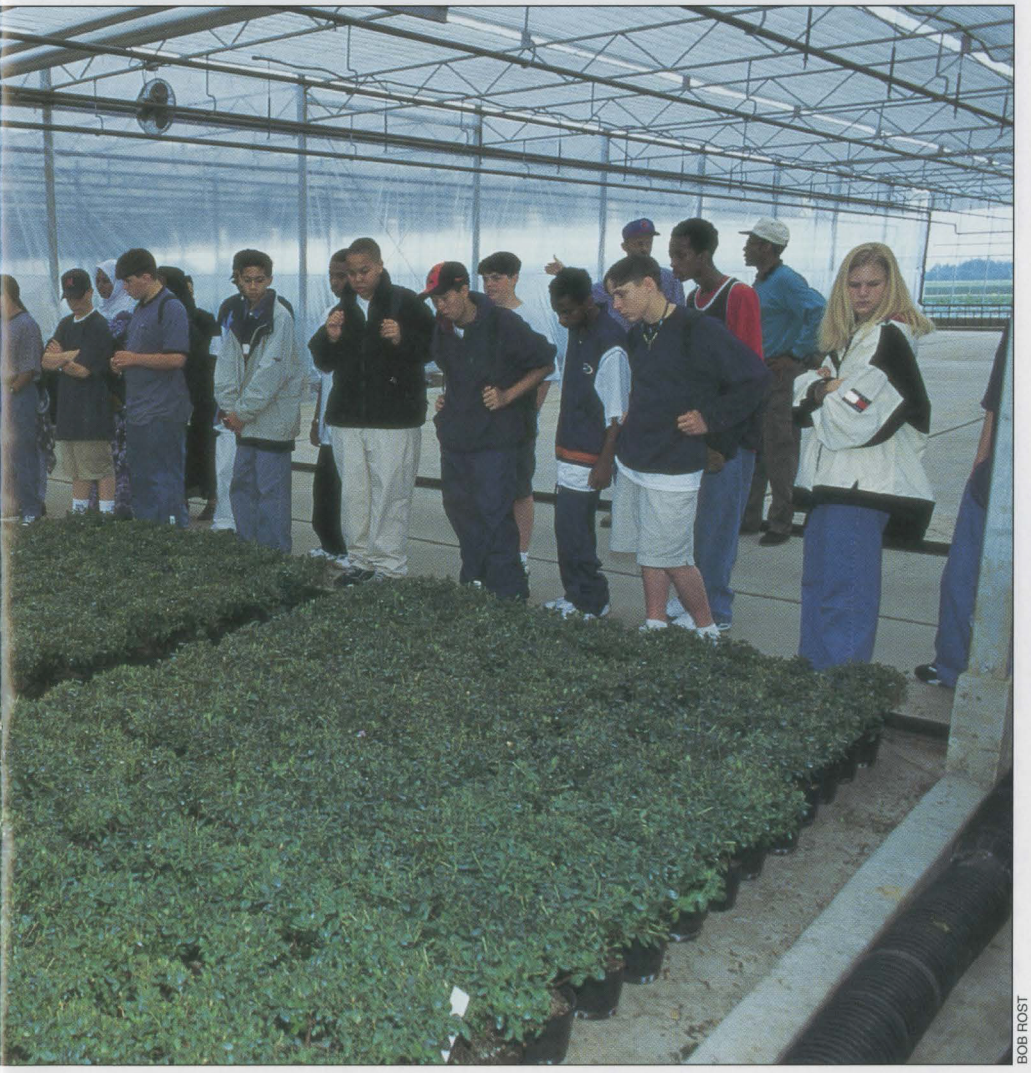
BOB ROST



Above: Madison sophomore Andrew Henderson meets some other newcomers at Rickreall Dairy. Right: Where do those plants city dwellers grow in their windows and yards come from? Madison students tour Woodburn Nursery and Azaleas, which produces container plants.

BOB ROST

Perrydale High School agriculture instructor Kirk Hutchinson, in hard hat, discusses lambing with Madison students Crystal Pounds, left, K'lynn Gifford, second from left, and Travis Jacobs.



BOB ROST

"eeewwwwww." One of them wanted to know if a female hog with piglets is called a cow or a sow.

Another student reacted with a broad grin and hearty laugh at a calf's willingness to suck his finger as though it were a cow's teat.

The students looked on with awe and revulsion as they watched a newborn calf struggle to stand up, the afterbirth from the calving lying just a few feet away in a corner of the pen. They stared at the unfamiliar shapes and dimensions of combines, tractors and other farm equipment as farm owners explained what the contraptions are used for.

Beyond their entertainment value (which, judging from the students' reactions, is substantial), these agriculture tours offer some very important opportunities to students.

"They get to see where food comes from," said Hudson. "That's important because many young people who have lived all their lives in the city often think food just comes from the supermarket."

Also, the field trips are valuable because any out-of-class school experience has the potential to reach or move a student in a special way.

"The students looked on with awe and revulsion."

"I happen to believe that most students will remember what they did in a special project or field trip long after they forget the names of most of their teachers," said Hudson.

The seed of the idea for agricultural field trips at Madison High School was planted when Hudson saw a 1995 newspaper story about OSU's desire to have a greater presence in the Portland area and to find opportunities to inform city residents about the university's agricultural programs and the value of agriculture to the state of Oregon and the city of Portland.

"That story got me thinking about establishing some kind of connection between our school and OSU that would help us with a school-to-career initiative we were starting at our high school at that time," Hudson said.

He began making phone calls and contacts that led to new partnerships and opportunities for Madison High students.

"We started with Oregon State University and the Oregon Agri-Business

Council, and later the Oregon Farm Bureau and several Future Farmers of America chapters in the area around Portland also got involved," Hudson said.

The agriculture tours began a short time later.

"OSU doesn't provide funding for the tours, but the College of Agricultural Sciences' Ambassadors for Agriculture, Forestry and Natural Resources do a wonderful job of preparing the kids for what they will see on the tours," said Hudson.

"It's important they understand food doesn't magically appear."

The Ambassadors for Agriculture, Forestry and Natural Resources are 10 students who travel to high schools throughout the state making presentations about agriculture and forestry and career opportunities in agriculture, agribusiness and the forestry industry. During a trip to Madison High earlier this year, the ambassadors visited 36 classrooms in one day.

OSU's College of Agricultural Sciences has created other opportunities for Madison High School faculty and students. Small groups of Madison High students have visited the OSU campus for day-long agribusiness and forestry careers workshops. Students have visited OSU's North Willamette Research and Extension Center near Aurora, where scientists explained agricultural research projects and led tours. And Madison teachers, along with school teachers throughout Oregon, have been invited to the OSU campus to participate in the Summer Agriculture Institute, a week-long course they can take for graduate credit. The summer institute offers teachers the opportunity to visit working farms and agricultural industry facilities. In addition, teachers and administrators from Madison High and other schools have participated in annual summer tours to OSU branch agricultural experiment stations around Oregon.

"These programs are an important part of our job," said Kelvin Koong, an associate dean of the OSU College of Agricultural Sciences. "The staff and administration in our college feel strongly that we at OSU, as a statewide educational institution, have an obligation to inform all citizens, including school-age children, about agriculture, the food system and the environment."

Right: Madison chemistry instructor Dave Conine, left, helps students Seng Saechao, right, and Geniece Battle with quantitative analysis. The Portland School District has designated Madison as a school that will put special emphasis on the study of environmental sciences and natural resources.

Beyond introducing students to career opportunities in agriculture, agri-business and forestry, the activities dovetail with the emphasis on natural resources and environmental issues in the Madison High School curriculum.

"Our school has been designated as an academy within the Portland School District and offers an emphasis in natural resource and environmental studies," said Hudson. "Students from throughout the district can enroll here, if they choose, to take those courses. Some of the faculty here have found the agriculture tours to be a great way to help students connect the real world with natural resource and environmental topics they talk about in class."

Chris Breil, who teaches literature of the Pacific Northwest at Madison High, said the tours have been springboards to lively classroom discussions about how natural resources are used and managed by society, and about the ethics of animal use.

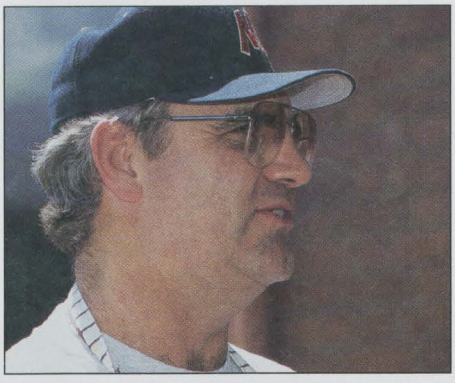
"The tours enable the kids to get a closer look at issues covered in class," said Breil. "After the tour, students have a better idea of the tradeoffs between how society chooses to manage a resource and how that affects the environment."

Like Hudson, Breil says some students have become so disconnected from the natural cycle that they don't have any idea where food comes from and have little knowledge of rural lifestyle and culture.

"It's really important for urban kids to start re-establishing that connection," said Breil. "It's important that they understand food doesn't magically appear in supermarkets, that there are real people who are engaged in providing those commodities, and that these rural people are very much like urban people, with similar concerns."

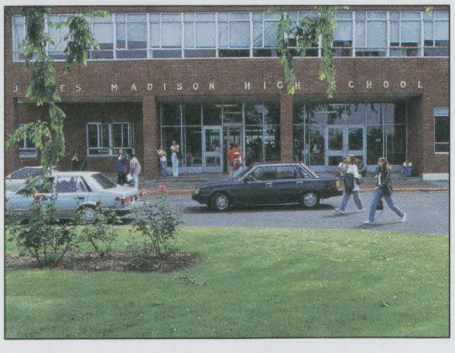
For biology teacher Winnie Yan, the value is that her students get hands-on experience.

"The most important part of the tours for my students is that they get to go out and see the things we talk about in class," she said. "It's one thing to read books, listen to lectures and take notes, but the



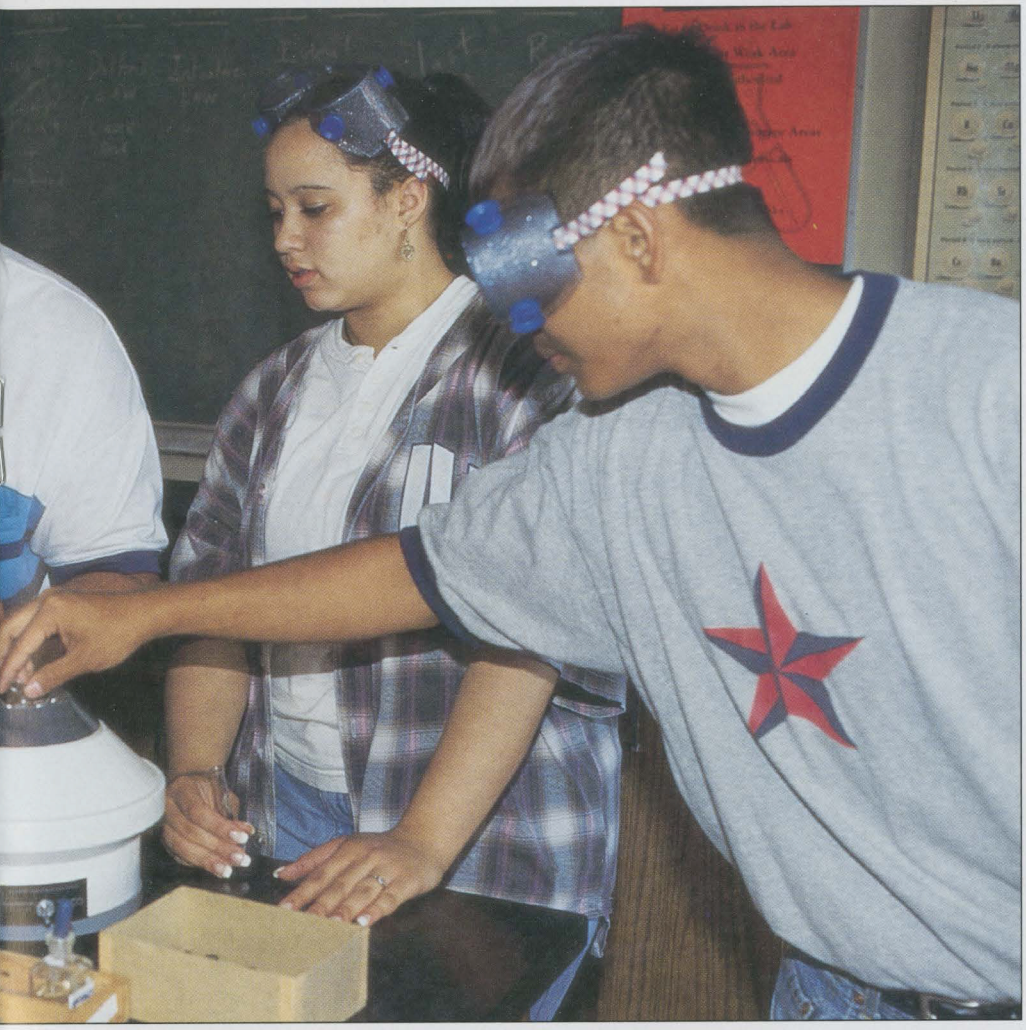
BOB ROST

Madison High principal Ron Hudson



BOB ROST

James Madison High School



BOB ROST

BETH BUGLIONE, CAPITAL PRESS

OSU's student Ambassadors for Agriculture, Forestry and Natural Resources give a presentation to Madison High students. The presenters are Carina Chapin, left, Elizabeth Howard, center, and Amy Poole.

opportunity to reach out and touch something we talk about in class is really meaningful."

In her biology course, Yan covers a broad range of topics from plant anatomy to the characteristics of vertebrates and the gestation periods of mammals. The agriculture tours complement all these areas of study, said Yan, because students get the chance to see all kinds of crops growing in the field, get to see and touch many kinds of farm animals, and sometimes get to watch animals being born.

"The tours also help students understand food processing and why it's important," said Yan. "Students get the idea of how a crop is taken out of the field and ends up as cereal in a bowl on the kitchen table."

"Students get the idea of how a crop ... ends up as cereal in a bowl."

Many students who go on the agriculture tours seem to react strongest to animals they see on the farm. Jennifer Ashkins, now graduated from Madison High, liked the large dairy farm she visited best. Ashkins went on tours in her junior and senior years.

"It was really neat to see all the animals and how they (the managers) ran the place," she said. "I really liked the baby calves."

Palestine Fox, a sophomore, especially liked the horses she saw and noted that the tours made her think about how pollution in the environment is everyone's responsibility.

Although she plans to be a dental hygienist, Fox said, "the tours made me think about becoming a veterinarian."

Charles Leggett, a sophomore, participated in the tour to Perrydale in part because his father and uncle lived there as teenagers.

"It's neat to come here and see what they probably saw when they were around here," Leggett said. "It's kind of dusty here but a lot of fun otherwise."

Speaking from the other end of the spectrum, Travis Hayes sees a lot of value in the tours, too.

A senior at Perrydale High School and one of the Future Farmers of America (FFA) members who helped host tours from Madison High School, Hayes likes the opportunity to show off a little.

We can show them something they haven't seen before; show them where things like Wheaties come from," said Hayes. "They [Madison High students] don't have FFA in their school or agriculture around where they live," he added. "We can show them something they don't have."

Is the Madison High School program going to have long-term influence on its graduates? Too early to tell. When I asked them about a tour they went on, most students just said "neat" or "great." But if Ron Hudson is right, going up the country is an experience many will remember for a while.

Bob Rost is a writer and photographer in OSU's Department of Extension and Experiment Station Communications.

A FISH MYSTERY

BY CAROL SAVONEN

OSU scientists knew the parasite was deadly. Where did it come from? How did it spread?

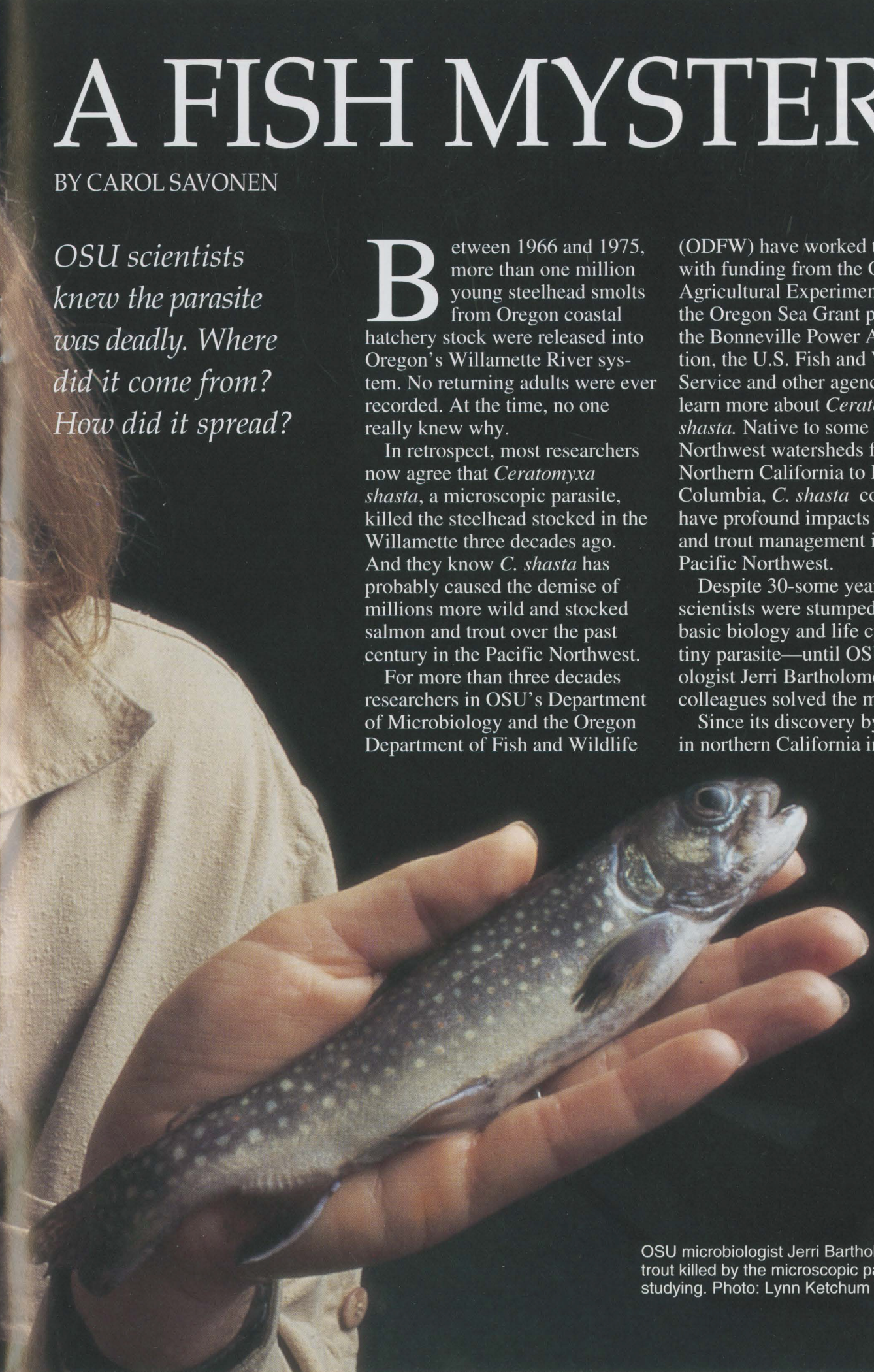
Between 1966 and 1975, more than one million young steelhead smolts from Oregon coastal hatchery stock were released into Oregon's Willamette River system. No returning adults were ever recorded. At the time, no one really knew why.

In retrospect, most researchers now agree that *Ceratomyxa shasta*, a microscopic parasite, killed the steelhead stocked in the Willamette three decades ago. And they know *C. shasta* has probably caused the demise of millions more wild and stocked salmon and trout over the past century in the Pacific Northwest.

For more than three decades researchers in OSU's Department of Microbiology and the Oregon Department of Fish and Wildlife (ODFW) have worked together, with funding from the OSU Agricultural Experiment Station, the Oregon Sea Grant program, the Bonneville Power Administration, the U.S. Fish and Wildlife Service and other agencies, to learn more about *Ceratomyxa shasta.* Native to some Pacific Northwest watersheds from Northern California to British Columbia, *C. shasta* continues to have profound impacts on salmon and trout management in the Pacific Northwest.

Despite 30-some years of study, scientists were stumped about the basic biology and life cycle of the tiny parasite—until OSU microbiologist Jerri Bartholomew and her colleagues solved the mystery.

Since its discovery by scientists in northern California in 1948,

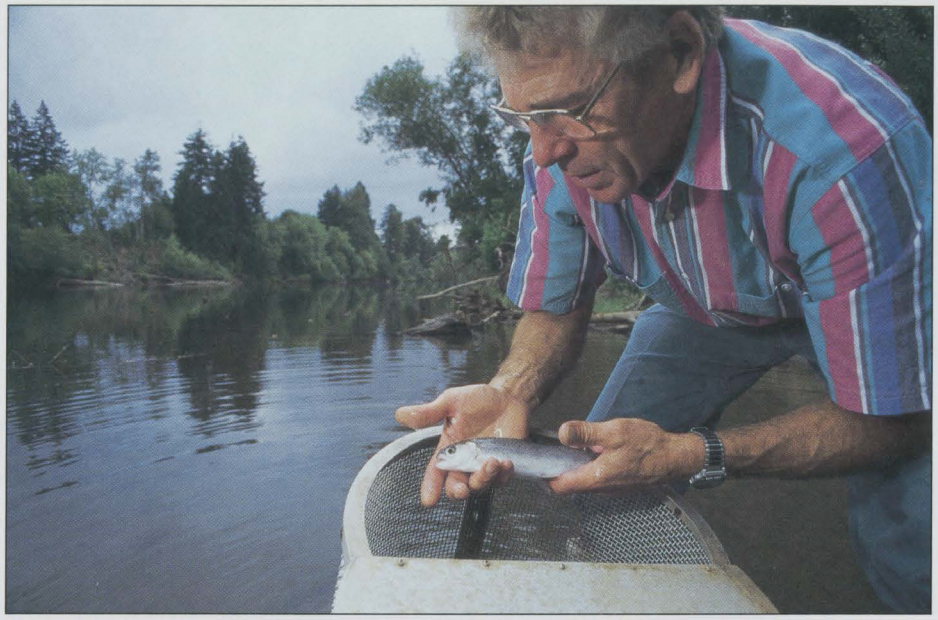


OSU microbiologist Jerri Bartholomew with a trout killed by the microscopic parasite she's studying. Photo: Lynn Ketchum

certain basic questions about *C. shasta* lay largely unanswered for many years. Where did the organism reside when it wasn't living in salmon and trout? Why did it fail to spread from fish to fish or drainage to drainage as do other diseases? Why was it found in certain rivers such as the Willamette and Deschutes, but not the Siletz? Why was it only in some areas within a river? Why were some fish stocks from certain areas more susceptible to infection than others? Was the resistance of fish to *C. shasta* due to genetics or acquired immunity, or both?

C. shasta has a strangely complicated life cycle. No one has yet been able to raise it through its complete life cycle in the laboratory. And until the life cycle of an organism can be completed in the lab, it's almost impossible to develop control strategies or to predict where the parasite may exist or spread.

The key piece of the life cycle puzzle lay on the river bottom. It resided in a



LYNN KETCHUM

Research assistant Don Stevens gets ready to immerse a trout in the Willamette River. The fish will be kept at OSU's Salmon Disease Laboratory to see if it's infected by *Ceratomyxa shasta*, a microscopic parasite. This is one way to learn if the parasite is in a stream.

THE KOREAN WAR CHANGED HIS CAREER PATH

Imagine, if you will, a human under the control of microscopic organisms.

In a way that's John Fryer, who more than 30 years ago initiated OSU's research with diseases of Pacific salmon, including the parasite *Ceratomyxa shasta.*

"I don't play golf. I don't play tennis. I'm not big on travel—I've seen the inside of enough airplanes. I really don't want to do anything else but what I'm doing," says the 68-year-old microbiologist.

When he retired in 1994, Fryer went right on with his job as chair of OSU's Department of Microbiology for a year and a half, until OSU could hire a new chair.

Then he moved his day-to-day work from campus to the OSU Salmon Disease Laboratory, which he helped build. It's just off Highway 34 a couple of miles east of Corvallis.

"His main nod to retirement since he came out here, that I can see, has been to stop wearing a tie and buy some cotton slacks," says Don Stevens, a research technician at the laboratory. "He's here every day."

But "I'm not that unusual if you look around the campus," Fryer contends, noting that a lot of professors continue doing research after they retire because the work is important.

Fryer followed a curious path to his position as a "distinguished professor emeritus," respected internationally for his research with fish diseases.

After graduating from high school in Washougal, Washington, in 1948, he joined the Marines, intending to make the military a career. When war broke out he was shipped to Korea. On a cold, rainy afternoon in 1951, as the sun set over a place called "The Punch Bowl," an enemy artillery shell changed everything.

"It was kind of a bad situation. We were about 2,000 yards past the main line of resistance," Fryer remembers. He lost his right leg. Six Marines carried him to safety. "Those guys were pretty amazing," he says. "It was slick as glass and they kept falling coming down the mountain with me."

After 10 months in a hospital, he got a job as a summer aid with California's fish and wildlife department. That experience, plus government testing, convinced him he'd like to work with fish.

He wrote colleges and universities, and the most favorable reply came from Roland Dimmick, former head of OSU's Department of Fisheries and Wildlife and a World War I veteran.

Fryer got bachelor's and master's degrees in the OSU department. One summer, while he was working with a former state agency called the Oregon Fish Commission, he saw a die-off of fish with white lesions on the kidney and liver. "No one knew much about the organism that was causing the problem," he remembers. "And I soon realized that if I was going to do research on this disease I'd need a different kind of training."

By 1964 he had a Ph.D. in microbiology from OSU and had isolated IHN, the virus that killed the fish with the white lesions. Later one of his OSU microbiology colleagues, Jo-Ann Leong, developed a vaccine that protects salmon in hatcheries from the virus.

Asked to list some highlights of his long, still-in-progress career, Fryer says:

—Isolating the IHN virus.

—Developing, in the late 1950s, the first "salmon cell lines." These cells are grown in laboratory culture tubes. Scientists can subject them to various conditions and organisms. They're used in labs around the world.

—In the mid-1960s, "me and a whole lot of students" developed a vaccine for *Vibrio*, an economically important bacterial disease. "Without the vaccine, there would be no pen culture of salmon anywhere in the world," Fryer notes. Many say this was the birth of the fish vaccine industry.

bed of freshwater mussels. On the algae that grows on mussels and rocks lives a tiny wormlike organism called a polychaete. In only one of every hundred polychaetes is found a tiny microorganism that unlocked the half-century-long mystery. No wonder it took almost five decades to find it.

This is the story of how OSU microbiologists and their colleagues at ODFW solved a difficult biological mystery. They used old-fashioned patience, perseverance and teamwork, combined with new tools in immunobiology and molecular genetics.

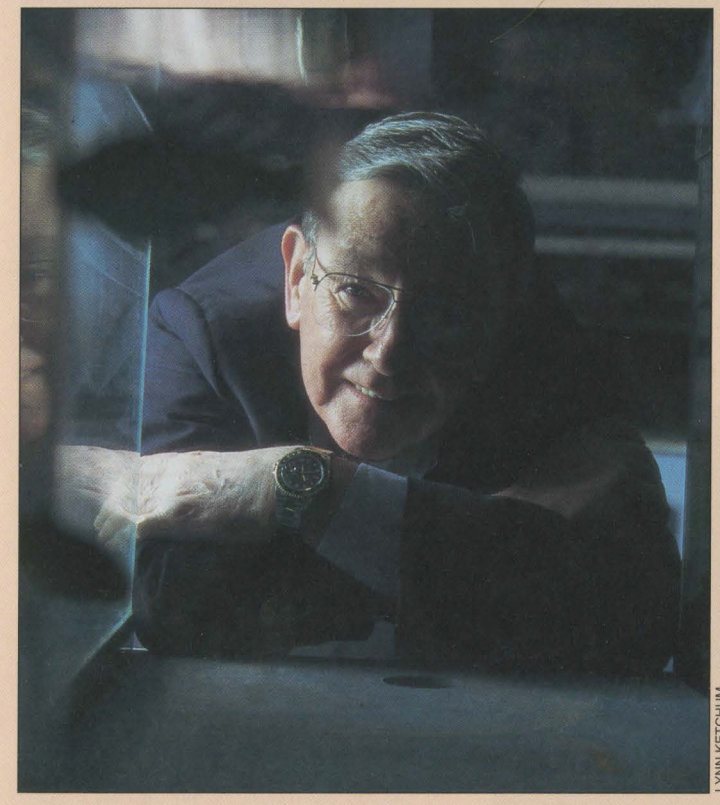
The story begins in 1948, when *Ceratomyxa shasta* was discovered when massive numbers of trout died at a newly completed fish hatchery near Mt. Shasta in northern California. This "new" organism infected the intestine of the fish and was released from the fish as a spore. Scientists assumed, based on its spore structure, that *C. shasta* belonged to the "myxosporean parasites," which include the organism that causes whirling disease in salmon and trout. Myxosporeans are now thought to fit somewhere between the jellyfish and primitive worms in the evolutionary scheme of things.

The story begins in 1948, when massive numbers of trout died.

By the 1960s, researchers detected *Ceratomyxa shasta* in Oregon. Juvenile coho salmon at the Bonneville Hatchery on the Columbia River, as well as juvenile chinook and steelhead at Pelton Dam on the Deschutes River and returning adult spring chinook at Dexter Dam on the Middle Fork of the Willamette River, were succumbing to *C. shasta.* Eventually *C. shasta* was discovered in parts of Washington, Idaho and British Columbia as well as northern California and Oregon, in both adult and young fish, and in both hatchery and wild trout and salmon.

"What was intriguing is that *C. shasta* was found only in certain areas of the Pacific Northwest, including parts of the Klamath, Rogue, Columbia and Fraser River drainages," explained Bartholomew, who has studied *C. shasta* for the past 16 years. She earned master's and doctoral degrees working on the parasite with John Fryer, former chair of OSU's Department of Microbiology, now a professor emeritus in the department.

"*C. shasta* does not spread easily outside its geographic range," said Bartholomew. "Within this region, the areas where fish actually became infected were limited. And we believe the range of the parasite hasn't changed much with time. *C. shasta* has probably always been



LYNN KETCHUM

OSU's John Fryer eyes fish in a laboratory aquarium.

—The research with *Ceratomyxa shasta.* He says credit for advances with this fish disease should go to former OSU microbiology colleague Jim Sanders; many other students, professors and technicians; Rich Holt of the Oregon Department of Fish and Wildlife; and, especially, OSU microbiologist Jerri Bartholomew, one of his former graduate students.

—In 1989 figuring out, with collaborators in Chile, that a bacterium called *Piscirickettsia salmonis* was responsible for massive kills of coho salmon off the country's shores.

—The role he and OSU students and technicians have been able to play in developing the taxonomy (scientific classification) of many fish pathogens.

—Great pride in his association with the many OSU microbiology students who have gone on to have an impact at the state, national or international level.

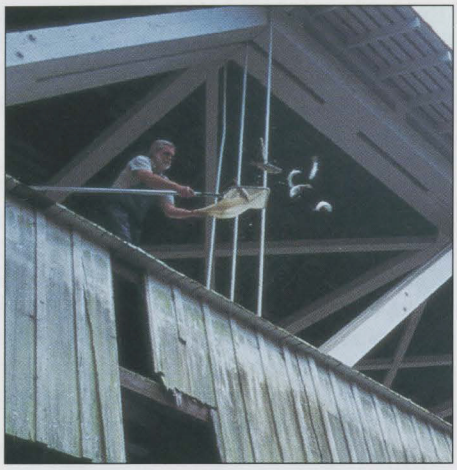
"We're like a family," says Fryer. "Those people (students) have turned out to be my best friends." He runs into some of them at almost every professional meeting he attends.

And he gets around, having done research important to the fish industry not only in this country but in many other parts of the world, especially Asia. His 1994 "retirement" party was an international affair. Colleagues flew in from Japan, Thailand, Taiwan, Korea and elsewhere to honor him.

When's he going to get away from the Salmon Disease Laboratory and relax?

"I'm really excited about a trip to Chile in November," he says. "My collaborator down there, Pedro Smith, and I are going to see if we can figure out the vector for this organism that kills the coho salmon. We know it's out there in that salt water somewhere."

—Andy Duncan



LYNN KETCHUM

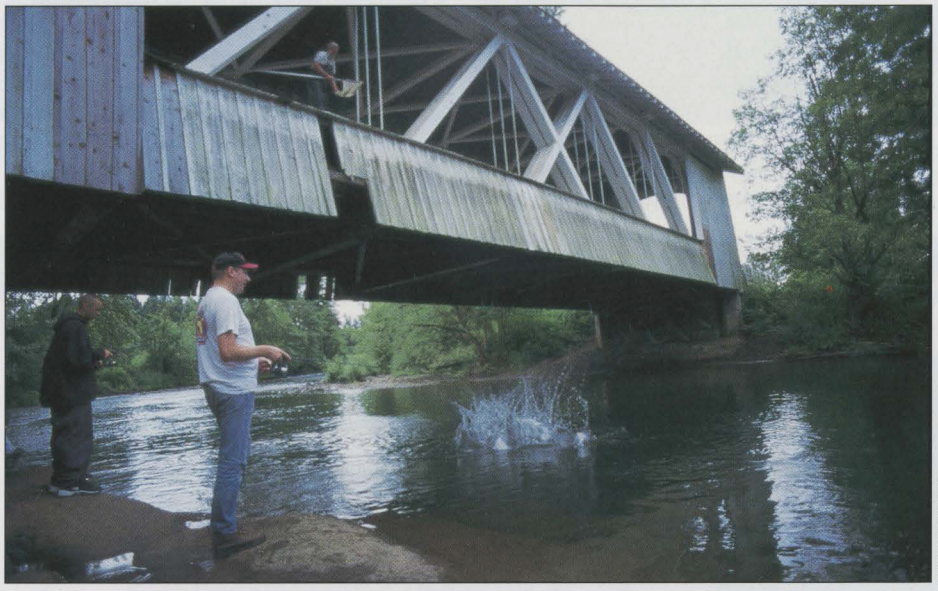
here, but we only recognized it when we started moving fish between watersheds."

Nor does the disease spread from fish to fish.

"Each fish is an individual target—each has to come in contact with the parasite," she continued. "They can't catch it from each other like in an infectious disease such as the flu or a cold."

This lack of mobility also became an important clue. By the late 1960s, scientists began to suspect that something else must be involved in the life cycle of *C. shasta,* something that was relatively immobile in the rivers where fish were getting sick. Researchers suspected an "intermediate host"—that there was another yet unknown organism or stage to *C. shasta's* life cycle.

"Originally, we thought maybe the parasite might have to 'age' in the mud on river bottoms for a while before it would infect trout or salmon," recalled Fryer. "We'd bring in mud, add spores and allow them to 'age' before exposing fish to them. But we couldn't infect fish. However, when sediments were brought from a lake where the parasite existed, fish became infected. We started looking around for a second living or intermediate host."



LYNN KETCHUM

Watch out for flying fish: Bob Dahlberg of the Oregon Department of Fish and Wildlife's Roaring River Fish Hatchery near Scio stocks trout in Roaring River. The *Ceratomyxa shasta* parasite causes more problems for non-native, than native, fish. Some Oregon streams contain the parasite. Others don't. And only certain stretches of some rivers have the parasite. For decades researchers at OSU and elsewhere couldn't figure out why.

Researchers suspected there was yet another unknown organism.

In 1984, another big clue came along. Another research group, working on whirling disease, had found an intermediate host—an aquatic "oligochaete" worm that hosted another, previously unknown stage in the life cycle of whirling disease. This parasite lived part of its life in fish and another part in an oligochaete worm. It needed to go through all stages to complete a generation before it could infect another fish.

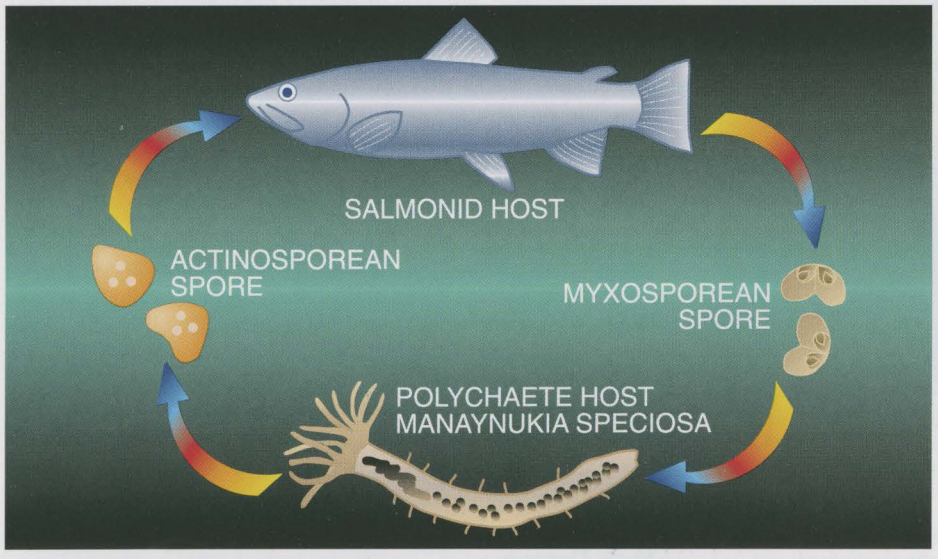
The OSU researchers thought *C. shasta* might have a similar life history, going through a second spore stage in an intermediate host. Don Stevens, a research assistant in OSU's Department of Microbiology, brought items such as mud, rocks and fresh water mussels—basically any substrate that might support aquatic worms—into the lab. He exposed fish in tanks to these materials.

Eureka! When researchers incubated fish in tanks containing mussels, the fish became infected with *C. shasta.*

"We knew the other previously unknown stage of *C. shasta* was present," said Bartholomew. "But we didn't know what the other life stage looked like or what organism it lived in.

"We set up a tank with live mussels and filtered the water to search for the infectious stage of *C. shasta,*" she recalled. "We saw parts of oligochaetes. So, for 12 months we looked at oligochaetes, searching for possible life stages of *C. shasta.*"

Bartholomew and her colleagues hit a dead end. They had no luck infecting fish using oligochaetes as intermediate hosts.



The cycle of *Ceratomyxa shasta.* The parasite spends part of its life in a wormlike organism called a polychaete and another part in a trout or salmon.

LYNN KETCHUM

OSU's Don Stevens gathers mussels and other river bottom materials from a stretch of the Willamette River that contains the *Ceratomyxa shasta* parasite.

So they began to search again, this time for something that might be smaller.

They broadened their search to other invertebrates. And finally, they observed a tiny polychaete worm infected with spores similar to those seen in other myxosporean life cycles. As these tiny spores were released from the worm, they collected them and fed them directly to a fish.

For about three months they waited anxiously, checking daily to see if the test fish were still alive. One deserted day in the lab over Christmas break, Bartholomew and technician Margo Whipple found the fish dead.

"I never thought I could be excited by a fish dying," Bartholomew recalled. "We examined the fish and the intestine was full of *C. shasta* spores. After 16 years of looking for the alternate host of *C. shasta*, I was really thrilled! We celebrated over champagne."

LYNN KETCHUM

After decades, OSU researchers discovered that algae, which grows on mussels like this, and on rocks and other river-bed materials, was home for a tiny wormlike organism that's an "intermediate host" for *Ceratomyxa shasta*.

The final proof that the polychaete was the intermediate host for *C. shasta* came by using genetic probes on the tiny spores the polychaete contained.

"The only way we could be sure the parasite in the fish and in the polychaete were the same was to compare their DNA," said Bartholomew.

She and her colleagues sequenced a gene from both spore stages. Indeed, they were one and the same species—*Ceratomyxa shasta*.

"This long search is a good example of how much work it sometimes takes to make scientific breakthroughs," she said. "It is not always easy or quick."

Bartholomew and her colleagues are anxious to put their knowledge of *C. shasta's* life cycle to work. They are learning to raise the polychaete in the lab and are trying to develop ways of treating the disease in salmon and trout.

"Knowing the complete life cycle may offer insights into ways of controlling *C. shasta*, and understanding the biology of the polychaete may help us predict where the parasite may exist or spread," she said.

After 16 years of frustrating study, Bartholomew is still captivated.

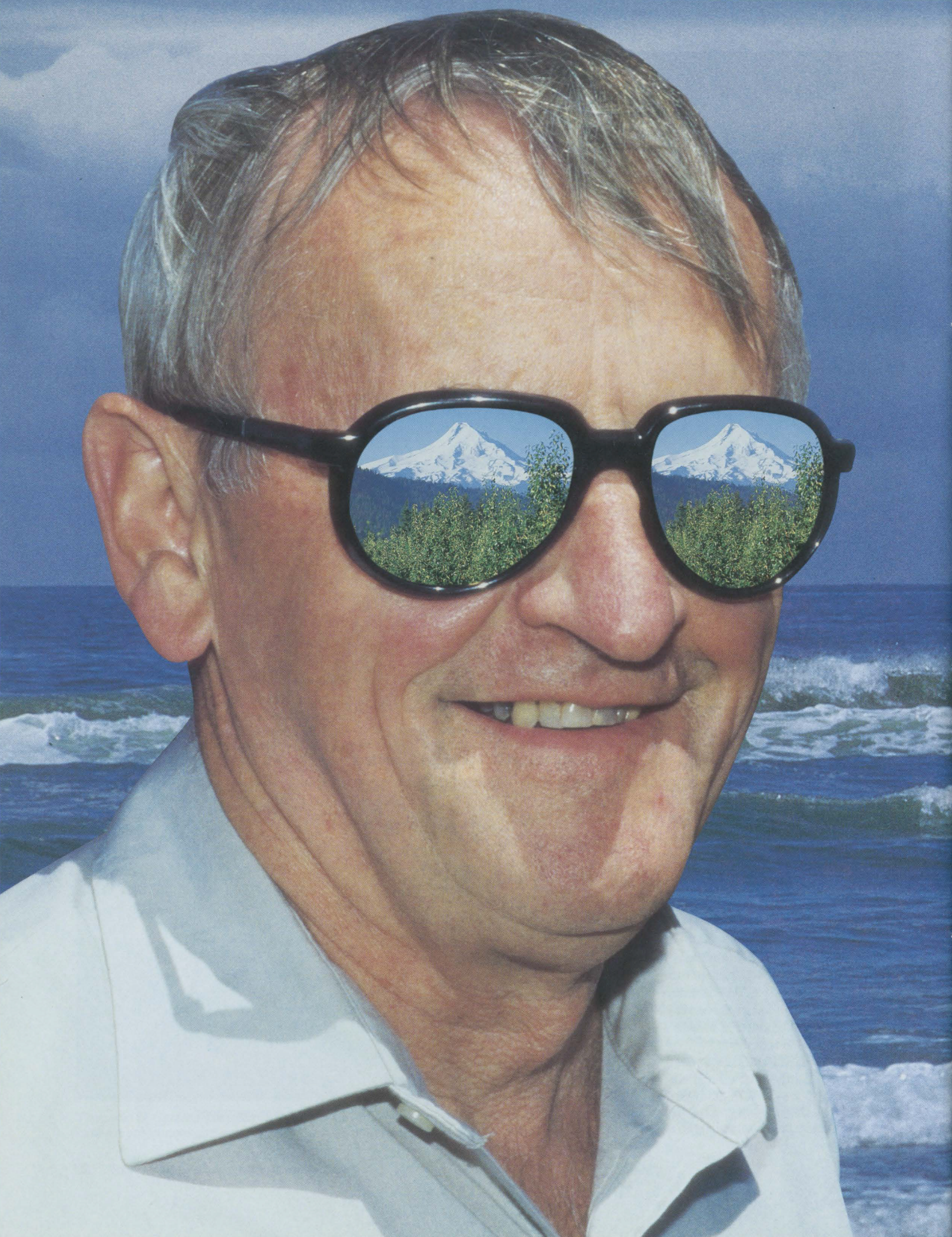
"This organism is exquisitely adapted to both its hosts, the salmonid fish and the polychaete worm," she said, excitedly. "No one knows how these life cycles evolved, but I find it really intriguing."

The work on *Ceratomyxa* by OSU and ODFW researchers is helping fish biologists make better decisions when stocking hatchery fish in Oregon streams and rivers.

"Back in the good old days, we used to move fish from outside a river drainage all around through our hatchery programs," said ODFW research biologist Dave Buchanan. "It was a classic case of naiveté. We didn't consider the life history and evolutionary biology of local stocks. *Ceratomyxa* is a good example of why local stocks are important. You can't just introduce any old stock from one stream into another and expect good results. Once you lose your local stocks, you lose your evolutionary history, including resistance to things such as *Ceratomyxa*."

Although there is still no "cure" for the disease, fisheries biologists in the Pacific Northwest are learning to manage around it. They now consider whether salmon or trout are resistant or susceptible to *C. shasta* before they introduce them into a river or stream where the parasite lives.

Carol Savonen is a science writer in OSU's Department of Extension and Experiment Station Communications.



LAVERN WEBER'S EXCELLENT ADVENTURE

From its briny beginning, his 1,900-mile Oregon trail led to eight state treasures

BY ANDY DUNCAN

Ahoy mateys. All ashore who're going ashore. Damn the jackrabbits and tumbleweeds, full speed ahead.

Well, O.K., those weren't Lavern Weber's exact words when he set off recently on a voyage to destinations a lot of Oregonians probably don't even know exist. But this is as true as the trade winds, as trustworthy as the lights of the Southern Cross: Weber is the skipper—well, O.K., the superintendent—of the only branch of the Oregon Agricultural Experiment Station where you can hear waves and sea lions, sniff salty air and seaweed.

On the April morning he revved up his Ford Taurus, pulled onto Highway 20 and headed inland from Oregon State University's Coastal Oregon Marine Experiment Station at Newport he was sailing, figuratively speaking, into unfamiliar waters.

It wasn't golden doubloons but a siren of another sort—information—luring him away from the blue Pacific.

"The dean of the College of Agricultural Sciences had asked me to serve on his advisory council, and the Oregon Agricultural Experiment Station is headquartered in the college," recalls Weber. "The marine branch experiment station where I work is a little different from the other branch stations. So to serve on the advisory council, I felt I needed to know more about the other stations."

Road trip.

Actually, his plan to visit the superintendents of all the other branches of the Oregon Agricultural Experiment Station "on their turf" turned into two road trips.

It wasn't golden doubloons luring him away from the Pacific.

"First I took the northern loop. Then, the next week, a southern and central loop," he explains. "If you want to know how far it is I can tell you—1,900 miles the way I went."

• • •

You can trace the ancestry of Oregon's branch experiment stations back 110 years. President Grover Cleveland signed the Hatch Act in 1887. It provided annual funds to establish agricultural research facilities in every state. The facilities were to be headquartered at the country's land-grant colleges, set up during Abraham Lincoln's presidency to make sure "common" Americans had access to higher education. The Oregon Agricultural Experiment Station was created in 1888 at Oregon Agricultural College in Corvallis (now OSU).

Today professors on the OSU campus, in many disciplines, conduct research funded through the Agricultural Experiment Station. They also teach undergraduate and graduate students to help develop a new generation to keep us fed and clothed.

But through the decades Oregon, like other states, has developed a network of branch experiment stations around the state (some are called research and extension centers). Scientists permanently assigned to these facilities do on-the-spot studies tied to the soils, climates, economies and other characteristics of various regions. Campus-based scientists also do experiments at branch stations.

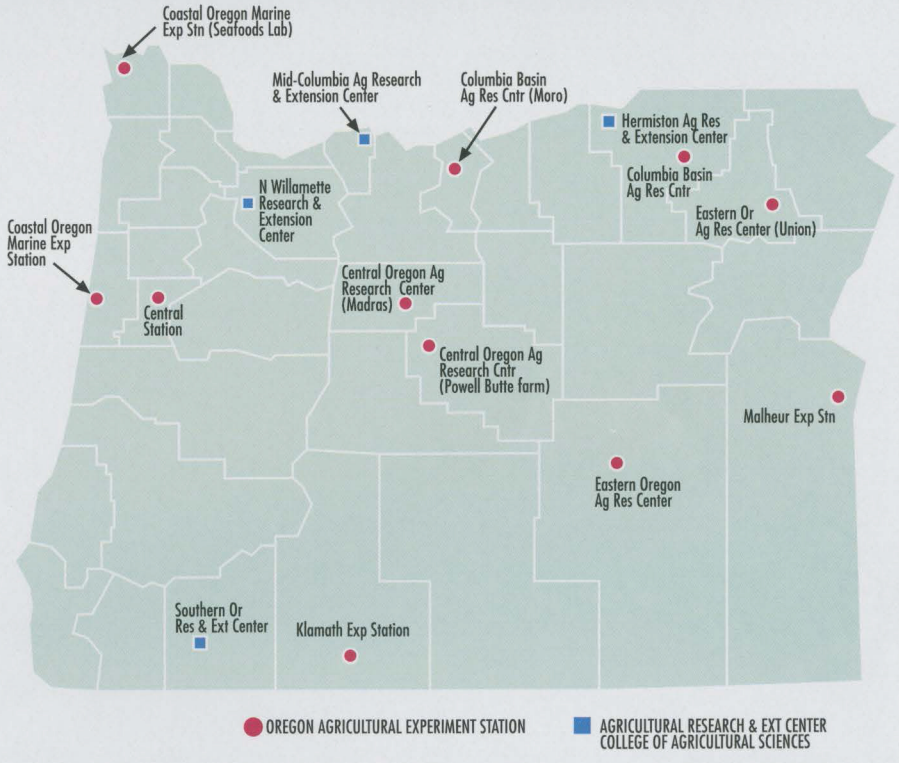
• • •

"I left on the northern loop on a Wednesday evening," Weber recalls, adding that his spouse, Pat Lewis, a zoologist, took some vacation time so she could go with him and see parts of Oregon not on her usual pathways.

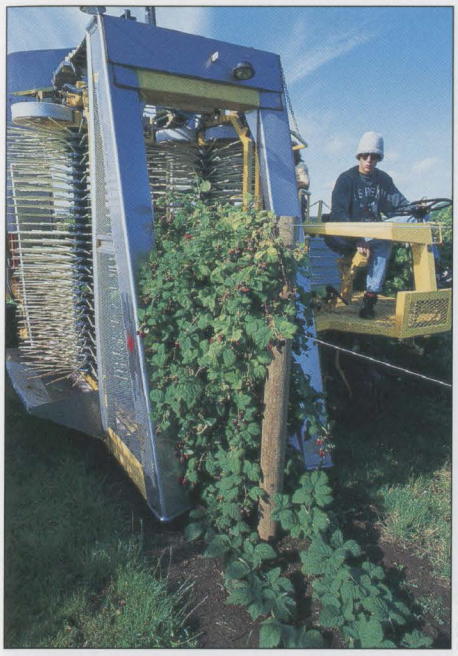
The first port of call was the North Willamette Agricultural Research and Extension Center near Aurora, 25 minutes south down Interstate 5 from the heart of Portland. But, shiver me timbers, nature scuttled the plan. The center's superintendent, Ron Mobley, was stuck in dry dock (home sick). The determined Weber set up a rendezvous with Mobley later, on the OSU campus, and got the information he wanted.

BOB ROST

Lavern Weber at OSU's Coastal Oregon Marine Experiment Station at Newport, where he's superintendent. In April, Weber set out to learn more about OSU's other branch experiment stations. First he traveled a "northern loop" east through the Columbia Gorge to the Idaho border and back west through Burns. Then he took a "southern and central loop" through Medford, Klamath Falls and Madras.



Many branches of the Oregon Agricultural Experiment Station, which is headquartered on the OSU campus, are called "research and extension centers."



BOB ROST

Blackberry harvest in test plots at OSU's North Willamette Research and Extension Center at Aurora, south of Portland.

The staff at the North Willamette branch station, he learned, works on horticultural crops, including vegetables, strawberries, caneberries and one of Oregon's hottest industries—greenhouse and nursery crops worth about $420 million a year at the farm gate.

A lot of the center's work helps growers produce better quality crops, at lower costs, and with reduced environmental impact, explained Mobley. "Often the quality or form of a product must be changed to meet the demands of domestic or foreign customers," he noted.

Next, Weber's itinerary took him up Interstate 5 past Portland and through the Columbia Gorge.

"I didn't realize how large it was," he recalls of his arrival at OSU's fruit tree-covered Mid-Columbia Agricultural Research and Extension Center at Hood River. Scientists at the station search for better ways to grow pears, apples and cherries around Hood River and The Dalles. They also help orchardists in a high-stakes struggle with pests.

"I was impressed with their storage work, too," says Weber. "While I was there a worker came in with a pear to show Gene [Mielke, station superintendent] how long it was lasting." The station helped pioneer fruit storage rooms with finely controlled temperature and atmospheric conditions. These innovations are giving growers more marketing options and giving consumers better quality fruit over a longer period of time.

Back in his vessel (the Taurus), Weber continued east along the Columbia River on Interstate 84, sailing single-mindedly toward the Hermiston Agricultural Research and Extension Center. The station is in an arid region dominated by massive center pivot-irrigated circles of cropland.

"It was a beautiful day when I drove into the station. Gary [Reed, the superintendent] was out in a field digging a trench, planting bare-root trees," recalls Weber.

"The first time I was in Pendleton I was nine years old. B-17s were taking off."

The Hermiston center supports the region's irrigated farms. These farms generate about $160 million a year in farm-gate receipts, according to Reed, and "probably add another $160 million in income to our communities" through local processing of crops. The center concentrates on potatoes, vegetables, canola, alfalfa, wheat and grass production and pest control.

With Hermiston in his rear view mirror, Weber continued eastward to a place he'll never forget.

"The first time I was in Pendleton I was nine years old. It was 1942," he recalls. "My older brother was stationed in the military there, the Army engineers. Just as we got into town a bunch of B-17s were taking off, heading for the Pacific Theater. As a young boy, with my country tangled up in World War II, that image has really stuck in my mind."

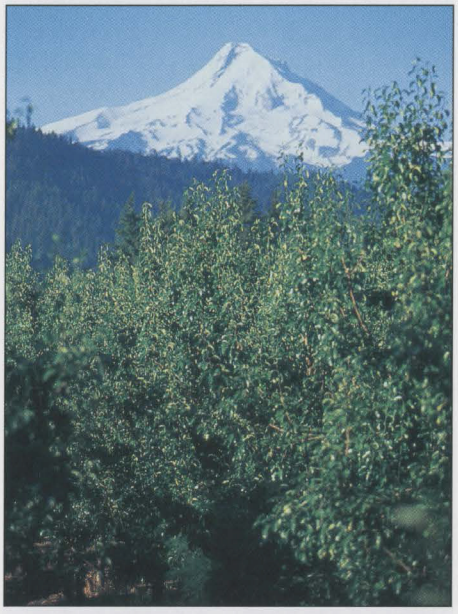
But this time he was going to Pendleton to visit fields chopped into small experimental plots—the Columbia Basin Agricultural Research Center. The center, headquartered a few miles east of the city, has a branch back to the west at Moro in Sherman County.

Lavern and Pat arrived in the evening. The next morning, while Pat visited the Pendleton Woolen Mills, Lavern met branch station superintendent Dick Smiley for breakfast.

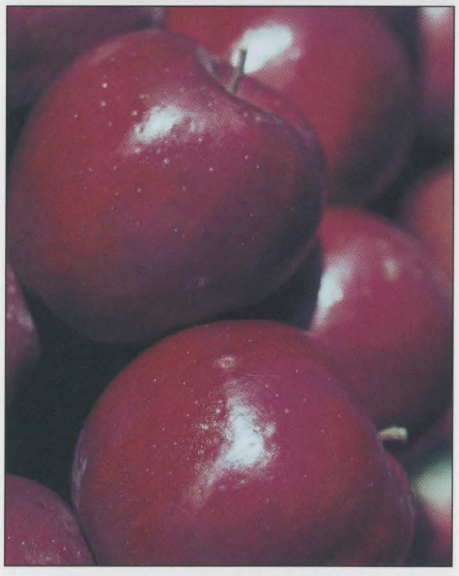
Hundreds of thousands of acres of wheat, barley, peas, grass seed and other crops paint the Columbia Basin's rolling hills green as a lawn in Portland's west hills in the spring, then golden in summer when the plants ripen. These crops provide nearly 15 percent of Oregon's agricultural cash receipts, Smiley explained.

Ten OSU and USDA researchers at the station study dryland and irrigated crops in an eight-county area, develop varieties with better yields and disease resistance, help farmers prevent erosion, deteriorating soil quality and other environmental problems, and try to figure out how to control new pests and weeds. Often partnering with extension agents, they experiment with other crops like mustard, canola and lupine that give the area's producers farming options.

From Pendleton, Weber continued along I-84, sailing east to La Grande and then south until he reached the Malheur Experiment Station between Ontario and Vale in the Treasure Valley on the Oregon-Idaho border. Though in dry



TOM GENTLE



At OSU's Mid-Columbia Research and Extension Center at Hood River, scientists search for better ways to grow and store fruits such as apples, pears and cherries.

country, this branch station is on a fertile plain near where the Malheur and Owyhee rivers run into the Snake River.

Weber asked a question about a composting experiment and, right away, was sucked into a whirlpool. "Clint [Shock, the station superintendent] got really excited," he remembers "and took me down to fields where they're doing things with onion wastes, and other research. Anytime I asked about anything we were off again to look at another experiment. His pride in the station's work was infectious."

The branch station raises onions, potatoes, wheat, barley, asparagus, soybeans, alfalfa, sugar beets and other crops, doing research that supports Malheur County's agriculture industry. The value of that industry is about $160 million a year at the farm gate, according to Shock, and $800 million including processing and other spin-offs.

BOB ROST

Clint Shock, the enthusiastic superintendent of the Malheur Experiment Station near Ontario, shows off sugar beet variety trials.

"I drove while Lavern was on his cell phone. I guess it was convenient."

"Our programs are related to irrigation and production efficiency, erosion control, surface and groundwater protection, and weed control," explains Shock. "Work here has contributed to lowering groundwater contamination through cooperative programs with growers. Much of the success of these programs depends on the support of many folks and networks of interdisciplinary cooperation among professionals."

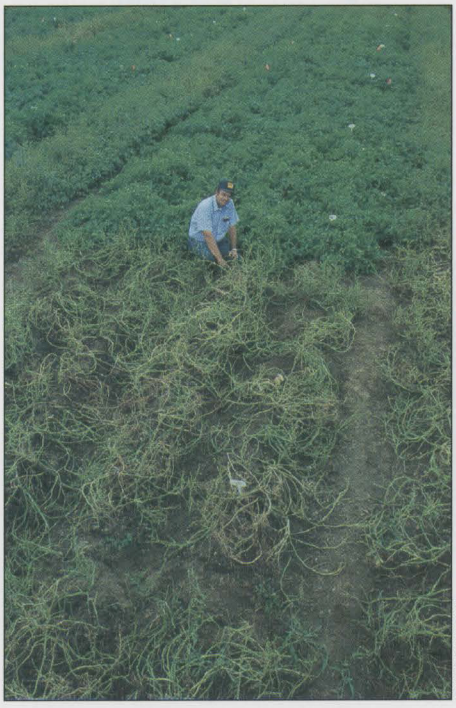
When they left the Treasure Valley, Lavern and Pat curved back to the west on Highway 20 toward the Eastern Oregon Agricultural Research Center. The center, last stop on Weber's "northern loop," is headquartered at Burns but also has facilities at Union near La Grande and about 40 miles (34.7 nautical miles) west of Burns.

"We got to Burns in the evening and met Marty [Vavra, station superintendent] for dinner," recalls Weber. "It was the peak of the snow geese migration and the next day, within a mile of the station [headquarters] the geese looked like white clover covering the pastures. There must have been tens of thousands. It was beautiful."

According to Vavra, OSU and USDA scientists who work at the station "search for strategies that will improve beef cattle production while maintaining or enhancing environmental quality. Ranchers and other land managers throughout eastern Oregon have adopted practices developed here.

"Ecological studies," he adds, "focus on sagebrush and juniper communities—how they are changing, their impacts on ecosystem health, and how they can be managed. Our scientists also are studying which native forage species cattle prefer at particular times of the year."

From Burns, Lavern and Pat made a dash for a brinier clime (Newport), enjoying beautiful spring sunshine along the way. "Actually, a lot of the time I drove while Lavern was on his cell phone working. I guess it was convenient to have me along," Pat recalls, chuckling.



ANDY DUNCAN

The next week Weber was back in the Taurus on his "southern and central loop" of branch stations, but this time he was by himself, battling a squall.

"I drove down to Medford on a Sunday afternoon," he recalls. "It was raining hard most of the way." Mike Howell, superintendent of the Southern Oregon Research and Extension Center, discussed his branch station over breakfast Monday morning.

Scientists at the center specialize in research important to fruit and field. Pears are an important commodity. Station studies have provided information on how to manage pests, control frost damage, improve irrigation and assure long-term pear storage crops, Howell pointed out.

ANDY DUNCAN

Left: Gary Reed, superintendent of the Hermiston Research and Extension Center, examines potatoes devastated by Colorado potato beetles (above). Healthy plants behind Reed contain a gene that resists the pests.

The station has developed many of the growing techniques and pear varieties used in the region. Studies of water and chemical movement through the soil aim to maintain profitable crop production while protecting and conserving water resources. And researchers at the station regularly identify new farming options for the area.

"It rained all the way from Medford to Klamath Falls," recalls Weber. There he met Ken Rykbost, superintendent of the Klamath Experiment Station.

Two scientists and the support staff at the station do research on cereal, forage, potato and sugar beet crops that account for more than 90 percent of the Klamath Basin's agricultural crop production, according to Rykbost. Crops account for almost 50 percent of the Basin's $200-million-a-year farm-gate agricultural production. Beef cattle generate just over 50 percent of the sales. The basin includes Klamath County, in Oregon, and a couple of counties in northern California.

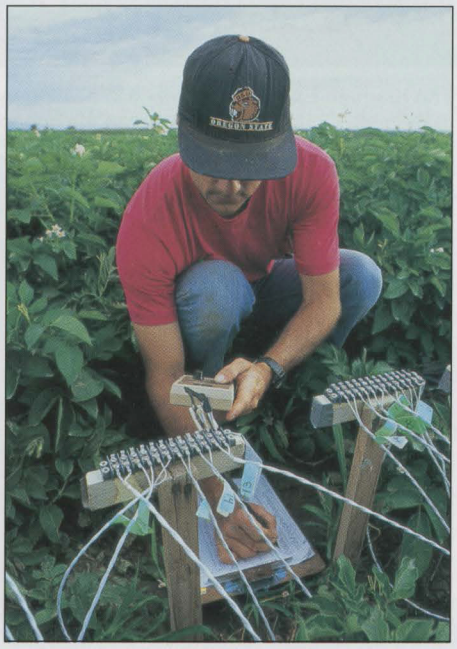
Rykbost noted that the station evaluates "cultivars"—potential new varieties—of sugar beets and potatoes, and does similar evaluations of potential new cereal and forage varieties.

From Klamath Falls Weber drove northwest along Highway 97, rain again lashing the Taurus, to Madras, headquarters for OSU's Central Oregon Research Center. He met superintendent Fred Crowe for breakfast.

In addition to the Madras site, the center has facilities at Powell Butte between Redmond and Prineville. The center continues to do research with long-standing crops in the area such as alfalfa, grass forages and cereals, Crowe explained. But in recent years a larger focus has been on specialty and seed crops. These include types of bluegrass seed, peppermint, vegetable seed crops

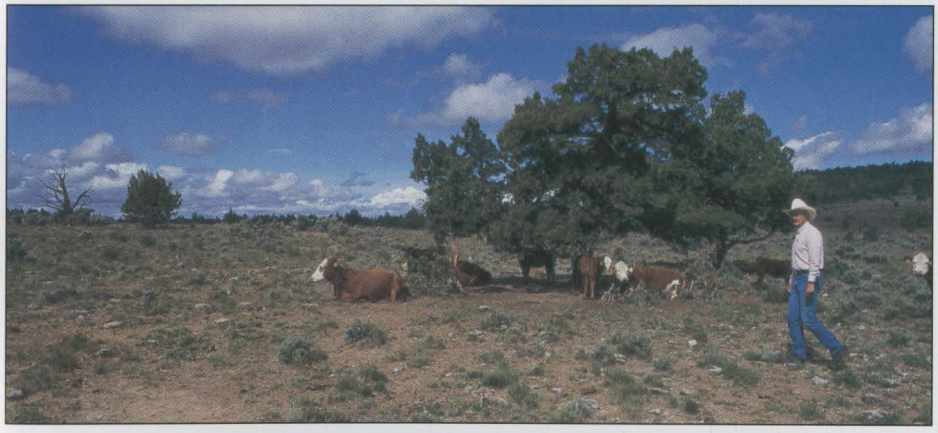
BOB ROST

The Columbia Basin Agricultural Research Center at Pendleton, where OSU and USDA scientists study wheat and other crops suited to the arid countryside.



TOM GENTLE

Erik Feibert, a research assistant at the Malheur branch station, adjusts computerized moisture sensors that can cut waste and groundwater pollution in irrigation.



BOB ROST

Marty Vavra is superintendent of the Eastern Oregon Agricultural Research Center, headquartered at Burns on Oregon's high desert. Ranchers around the state use practices developed at the branch station.

HOW'D OREGON GET A MARINE STATION?

It has a long name but a fairly short history.

The Coastal Oregon Marine Experiment Station was established in 1989 as a branch of the Oregon Agricultural Experiment Station, which is headquartered on the OSU campus.

The marine branch station's headquarters are at OSU's Hatfield Marine Science Center at Newport. The OSU Seafoods Laboratory at Astoria is part of the branch station.

"The idea originally came from George Keller [who recently retired as OSU's vice president for research]," says Lavern Weber, the marine branch station's superintendent. "He gave a talk to the public over on the coast and people started asking him questions about whether OSU could help them. He said maybe something like an experiment station would address their concerns."

Weber, also director of the Hatfield center, offers a list of individuals at OSU, in industry and in politics, who "ran with the branch station idea."

"We didn't want to duplicate administration," he says, "and it was about the same time the U.S. Department of Agriculture was getting into aquaculture.

"Our station may be the only marine branch station in the country that's part of an agricultural experiment station," says Weber. "I think Oregon is on the cutting edge, breaking ground, with that."

But fish, oysters, abalone and the like are commodities just like wheat, beets and sheep, he adds. "When I go to Pendleton and talk to farmers about protein and research in the ocean," Weber says, "they can relate."

TOM GENTLE

Horticulturist David Sugar of OSU's Southern Oregon Research and Extension Center checks an experimental red pear to find out if it's ready for harvest.

such as carrot, onion and garlic, radish and cilantro.

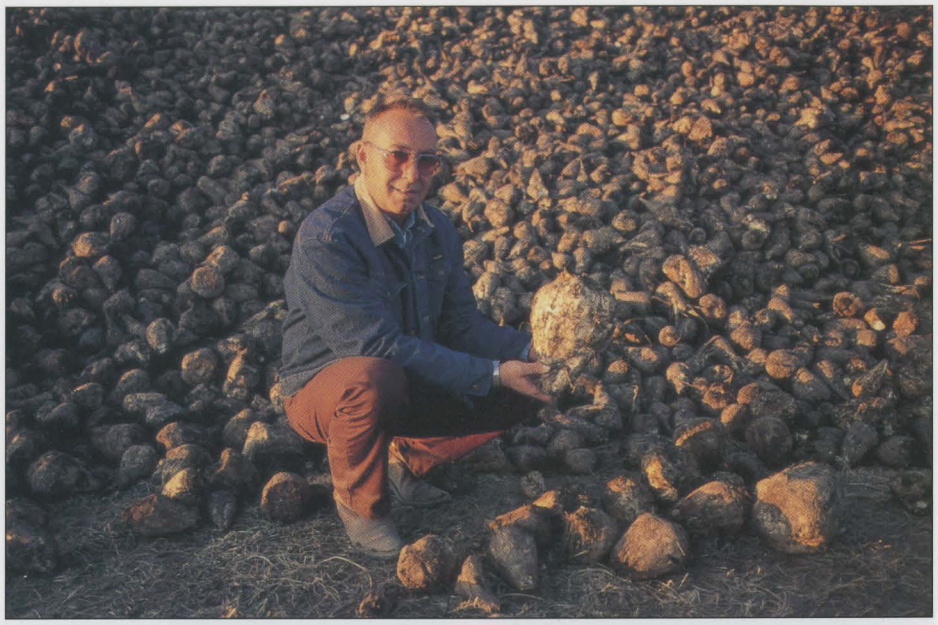
A new crop is sugar beets. And, as it has for years, the center provides seed potatoes for a large, multi-state potato variety improvement effort that takes advantage of classical plant breeding and genetic engineering techniques.

• • •

Like gophers in a field riddled with holes, branch stations have appeared and disappeared at various locations in Oregon through the years. Today, there's one just about everywhere people farm or ranch, and in a few other spots. Those stations support an agriculture industry that last year produced more than 200 crops worth almost $3.5 billion at the farm-gate—and worth much more after processing, including tens of thousands of jobs. Clearly, this is an industry that has major impact on the livelihoods of Oregonians in both rural and urban areas.

This has major impact on the livelihoods of Oregonians in rural and urban areas.

With hindsight you can find things to criticize in the work done at OSU's branch stations through the decades. But the experimentation, and county Extension Service efforts to deliver the findings to Oregonians, have yielded a steady stream of new and improved crops and farming methods, as well as information on nutrition, food safety, forestry, fisheries, the environment and other practical topics important to the quality of life in the state.



TOM GENTLE

The Klamath Experiment Station is helping farmers grow sugar beets, a crop relatively new in Klamath County but important to the economy, explains superintendent Ken Rykbost.

TOM GENTLE

One important effort at OSU's Central Oregon Research Center, headquartered at Madras, is developing disease-free seed for a regional program that yields improved potato varieties. That's Mount Jefferson in the background.

His trip in the Taurus wasn't the first time Lavern Weber had been to some of the branch stations. But it was the first time he'd visited them all with his own fact-finding agenda. Cruising from Madras to Newport, with his adventure drawing to a close, he thought about what he'd seen.

"My immediate reaction," he recalls, "was that they're doing really good research for the state, out there working not just to produce food but to help farmers do this in a way society will approve of. The branch stations I visited have problems. Most of them seemed similar to the problems we have at the marine station—ones tied to very limited resources. But overall, finding such excellence was a real treat for me."

FORGET TRAINS, PLANES AND AUTOMOBILES

You can take a cybertour of branch stations in several parts of the state.

The address for the Oregon Agricultural Experiment Station's home page on the World Wide Web is: http://wwwagcomm.ads.orst.edu/agcommwebfile/aes/

Once you're there, click on the "Branch Stations" button. There's a map of the state with branch station locations. Click on the blue names of branch stations. You'll be connected to their home pages.

HE THOUGHT HE'D RUN AN ICE CREAM STORE

To say that Floyd Bodyfelt and the Oregon dairy industry have had a long and tight relationship would be an understatement.

A revered professor, Extension Service specialist and Agricultural Experiment Station researcher in dairy science at OSU's Department of Food Science and Technology, Bodyfelt is retiring this summer after 33 years of service to the citizens, students and dairy industry of Oregon.

Born and raised on a family dairy farm in Tillamook County, Bodyfelt was the oldest of 5 brothers. He won his first Jersey calf in 4-H while in grade school. He raised and sold several calves and earned "milk money" through his childhood.

When it came time to leave home, he was torn between pursuing a degree in forestry or dairy technology.

"I almost flipped a quarter to help me decide," said Bodyfelt with a laugh. "What made a difference was a $1,000 scholarship from Tillamook Creamery for my freshman year."

Bodyfelt supported himself while he was studying at OSU by working in three cheese factories and the OSU creamery, by distributing mail and serving as a resident assistant in the dorms, and by refereeing intramural sports. His education was interrupted by military service. He spent three and a half years in the U.S. Army Medical Corps in Texas, working in the World Burn Treatment Center and in blood banks and teaching microbiology. His love for the dairy industry and Oregon drew him back to OSU to finish his bachelor's degree in dairy technology.

"I thought maybe I wanted to run an ice cream store when I got out or something like that," he said.

But Bodyfelt's talent for teaching others, trial-by-fire learning and trouble shooting helped him pursue a career in higher education. Finishing his undergraduate degree, he was offered a job as an instructor in food science at OSU. Simultaneously, he was earning a master's degree helping cheesemakers eliminate the "fruity flavor" defect in cheddar cheese. He also managed the OSU creamery for five years.

"There was poorer sanitation in those days," explained Bodyfelt. "Milk came from the dairies in metal cans. There was a lot greater chance then than today for poor batches of dairy product."

During this time, Bodyfelt coined the first rule of dairy quality assurance—"the final product is only as good as the raw materials going into it."

After completing his M.S. in dairy processing, Bodyfelt was appointed Oregon Extension dairy processing specialist for the state. He also taught courses in dairy processing, coached the OSU collegiate dairy products judging team, and conducted dairy products research.

Bodyfelt described this busy era in his life as his "Ph.D. equivalent."

"I was extending technical information to 45 dairy plants in Oregon, managing 15 people at the campus creamery and teaching," he recalled.

By the time the OSU creamery closed in 1969, primarily due to budget constraints, Bodyfelt had five children and was ready to spend fewer than 80 hours per week at work. Teaching, research and extension work was enough to keep him busy, without running the creamery.

Over the decades Bodyfelt has worked to solve many problems and develop innovations for the dairy industry including:

—Improving the shelf life and flavor stability of dairy products.

—Perfecting ice cream quality, especially the Oregon strawberry flavor.

—Developing methods to evaluate the quality of dairy products, including his classic textbook *Sensory Evaluation of Dairy Products.*

—Characterizing the problem of light-induced off-flavor in milk that is packaged in plastic bottles.

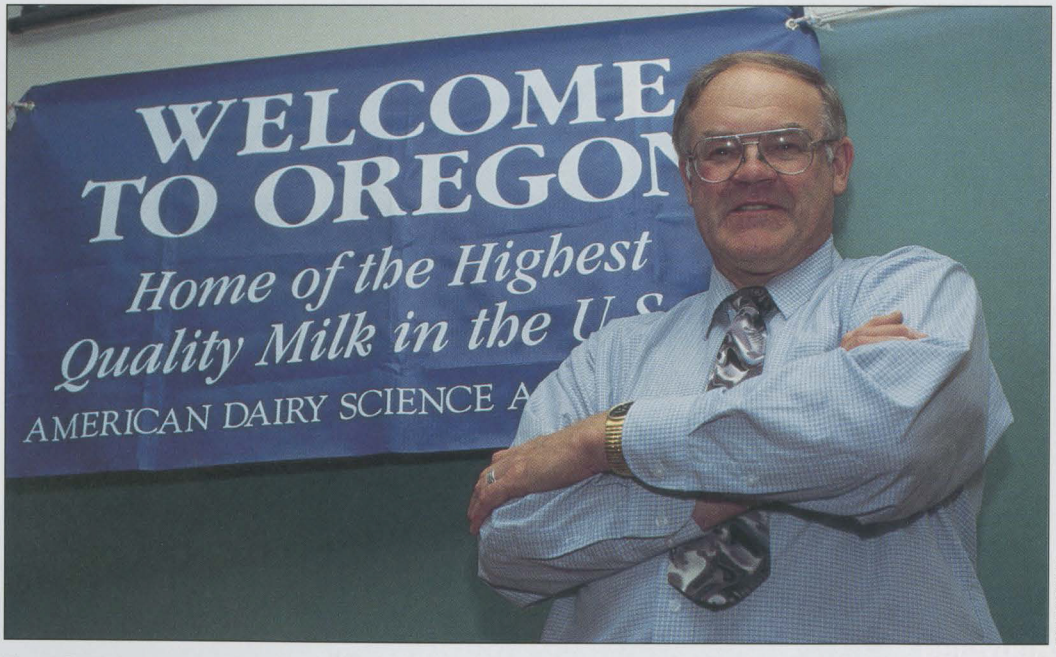
—Refining lactic cultures for cheese manufacture, which helped save the Tillamook-centered cheese industry more than $1 million per year in lost productivity.

—Teaching more than 600 students through the years.

"My biggest thrill is having so many students who are now leaders in the food industry," he said. "It is most rewarding to see former students who have far exceeded their own expectations."

In retirement, Bodyfelt said he wants to relax with all the good history books he never has had time to read, watch some travel videos and "go see places first hand." And he will not stray far from his roots. He is returning, part-time, to the Bodyfelt family farm in south Tillamook County to occasionally look after the neighbor's 70 Jersey heifers that are pastured on his home place.

—Carol Savonen



TOM GENTLE

Floyd Bodyfelt

Thayne R. Dutson, Director
Oregon's Agricultural Progress
Agricultural Experiment Station
Oregon State University
422 Kerr Administration Bldg.
Corvallis, OR 97331-2119

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