OREGON'S AGRICULTURAL
PROGRESS
Winter/Spring 1994

TROUBLED WATERS

The problems of the Tualatin River near Portland foreshadow the future for other Oregon streams, researchers say

THE EDITOR'S NOTE

I've been thumbing through a little paperback I read 20 years ago and rediscovered recently in the garage. It was written by Farley Mowat, a Canadian who's done several books about his earlier days.

At the beginning of *The Dog That Wouldn't Be*, during a 1929 duststorm in the outpost of Saskatoon on southern Canada's central prairie, a boy knocks on the Mowats' front door. Young Farley is at school; his father at work. The caller is selling ducklings for 10 cents apiece. It's the Depression so Mowat's mother passes. But then, impulsively, she scoops a lone puppy from the lad's basket. He finalizes a sale for 4 cents.

"What dog would insist on wearing motoring goggles?

What follows are Farley's rememberances of his childhood with Mutt, a companion inclined toward the absurd. As the book's back cover asks, "What dog would climb ladders and walk the top of fences like a cat? Insist on wearing motoring goggles in the car? Dive for crayfish or hobnob with skunks?" Mutt reminds me of Ring, an odd-shaped, uninhibited canine my siblings and I accompanied on quite a few adventures long ago.

I think Mowat does a wonderful job of capturing the spirit of that period of childhood when many of us are unaware that we're changing, and that we're surrounded by a changing world.

I see similarities between the book and this issue of *Oregon's Agricultural Progress*. Several of our articles deal with how Oregon has changed, and is changing, often in ways we didn't anticipate. These articles are about our streams; our crops; animals; food preservation; how scientific research will be done in the future.

For Farley Mowat, and me, Mutt is a touchstone to "the good old days." I hope the research described in the articles that follow is helping create good new days for our children, and their children, and generations of Oregonians who follow them.

Andy Duncan

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For 15 years two OSU researchers have studied an eastern Oregon stream, testing how to raise cattle without hurting fish.

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Mary Powelson is helping farmers find different ways to control diseases. But then she's used to breaking new ground.

Cover: A blue heron. Shrinking wetlands, sinking water quality and other factors have eroded the complex web of life that once existed in western Oregon's Tualatin watershed. Story on page 22. Photo: Tom and Pat Leeson. Back cover photo: Bob Rost.

UPDATE

ALFALFA DISCARDS

Researchers at OSU's Malheur Agricultural Experiment Station near Ontario are helping farmers *and* bulging landfills by finding uses for roughly 12 million pounds of alfalfa screenings generated annually in four western states.

Alfalfa, a forage, is planted for use as animal food, both as hay and in pellets. Screenings are what remains after alfalfa seeds have been removed at seed cleaning houses. Screenings include alfalfa leaves, stems and immature and damaged seeds, plus stems, leaves and seeds of weeds.

Traditionally, screenings were used as by-product additives for livestock feed. That changed when the alfalfa seed industry elected to have alfalfa seed designated as a non-food crop to ease federal and state pesticide registration requirements. Because the screenings contain a percentage of viable alfalfa and weed seed, and traces of pesticides that are not registered for food use, burying the screenings became the only legal option.

"Until last year we were charging growers about 2 cents a pound to dispose of their screenings at the dump," said John Stubstad, president of Andrews Seed of Ontario.

But two OSU researchers at the Malheur station, Mike Barnum and Clint Shock, worked with mushroom companies in the Ontario area to develop a method of using alfalfa screenings in the compost mix used to grow mushrooms. Bacteria in the compost eliminate more than 99 percent of alfalfa and weed seed germination in the screenings and break down pesticide residues.

"Now, instead of hauling a million pounds of screenings to the dump, ours go to the mushroom plant and growers don't have to pay for disposal," said Stubstad. Mushroom companies don't pay for the material, but they haul if off at no charge.

OSU researchers also are experimenting with composts containing alfalfa screenings that farmers can use in their fields. On-farm trials Barnum and Shock conducted in Oregon and Idaho show that a combination of alfalfa screenings, wheat straw and culled onions is a "marvelous" compost, said Shock.

Barnum notes that several states are considering regulations that would makes it illegal to put organic material in landfills.

TOM GENTILE

Mike Barnum with compost made of alfalfa screenings and straw.

BOB ROST

Left: Bananas and filberts are good sources of Vitamin B-6, says researcher Jim Leklem.

VITAMIN SHORTAGE A PAIN IN THE HAND

A study by researchers at OSU and a hand surgery center in Portland, Oregon, suggests a link between vitamin B-6 deficiency and certain symptoms of carpal tunnel syndrome.

Though the researchers stop short of saying a lack of vitamin B-6 is a contributing cause of carpal tunnel, they strongly endorse further studies of nutritional links to the syndrome.

Carpal tunnel syndrome is a condition characterized by numbness, pain or tingling in the hands and awakening at night. Historically, it's been associated with repetitive motions. Many office workers, industrial employees, computer operators and store clerks suffer from carpal tunnel syndrome or its symptoms.

The study at OSU looked at 294 persons who were at high risk for carpal tunnel syndrome. The researchers found that a significant number of the test subjects who had symptoms characteristic of the syndrome also had low levels of vitamin B-6 in their blood.

"We think there may be a nutritional link," said Jim Leklem, an OSU professor of nutrition and food management and principal investigator in the study. "Vitamin B-6 is directly associated with the neural system, including messages to the brain about pain cessation. That function may play a role with carpal tunnel syndrome."

Leklem, who has studied B-6 for some 20 years, said the vitamin also has a potential use in reducing edema, or swelling. One hypothesis is that swelling along nerve passages in the arm, exacerbated by lack of vitamin B-6, may either cause the pain and tightness associated with carpal tunnel syndrome, or impede "pain cessation messages" heading toward the brain.

"We're still trying to sort out the variables," he said.

Vitamin B-6 can be found in significant quantities in soybeans, most nuts, red meats, chicken and turkey, salmon, tuna, bananas, avocados, most legumes and wheat germ. The body uses vitamin B-6 to break down amino acids that come from protein, to break down glycogen, a storage form of glucose (or sugar), stored in the muscles, and to help the formation of red blood cells.

Other functions of the vitamin include formation of neurotransmitters which carry signals to the brain, and maintaining the proper function of the immune system.

A lack of vitamin B-6 can lead to anemia; changes in brain patterns that lead to irritability, depression and neurological disorders; and a change in metabolism among the elderly.

Conversely, an excess of vitamin B-6 can also cause problems, Leklem pointed out. "It fries your nerves," he said. "Excess B-6 is associated with peripheral neuropathy, which causes a loss of sensation in the nerves of the hands and feet."

Leklem said it would be hard to take too much B-6 from

natural sources, such as chicken or avocados. But vitamin supplements or health "remedies" should be monitored.

"Women who have taken certain remedies for PMS (premenstrual syndrome) on occasion take more vitamin B-6 than is advisable," he said.

The OSU research was done in conjunction with the Portland Hand Surgery and Rehabilitation Center. It is directed by Dr. Peter Nathan, whose research suggests high body weight or mass, age, genetics and a lack of exercise are other factors that may be associated with the syndrome.

"Any relationship between repetitive motions and CTS (carpal tunnel syndrome) is tenuous at best," said Dr. Richard Keniston, an MD and senior research associate working with Dr. Nathan. "The most repetitive job we have studied, keyboard data entry, is actually at significantly reduced risk for CTS relative to the general population of over 2,600 subjects we have studied."

Leklem hopes to secure funding to conduct a second round of tests to see if increasing vitamin B-6 intake in carpal tunnel sufferers, or subjects with similar symptoms, helps reduce those symptoms.

RED WINE: THE SUNNY DELIGHT?

Ever hear of "The French Paradox?" It refers to the people of that country eating foods high in saturated fats but having a lower-than-average rate of heart disease. It's been suggested that drinking red wine is helping French hearts.

Now OSU scientists have discovered that the amount of sun hitting grape bunches influences the grapes' content of quercetin, one of the compounds thought to make a moderate amount of red wine good for you.

Quercetin is a type of flavonol, part of a group of phenolic compounds that give red wine some of its characteristics, explained Steve Price, who studies viticulture (grape growing) in OSU's Department of Horticulture.

Quercetin is found mostly in grape skins. Red wines are crushed and fermented with their skins, explained Barney Watson, a wine chemist in OSU's Department of Food Science and Technology. Red wines contain a lot more quercetin than white wines, made without grape skins.

Price and Watson studied Pinot Noir grapes produced by many Oregon vineyards. They collected


TOM WEEKS

grapes with various degrees of sun exposure—those grown in the open sun, part sun and shaded areas. They analyzed each category for phenolic compounds, including the amount of quercetin. Then they analyzed wine made with grapes from each category.

Pinot Noir grapes exposed to a high level of sunlight contained up to 20 times as much quercetin as those grown in the shade. Wine made from those grapes contained up to eight times as much quercetin as wines made from grapes grown in the shade.

"This is a really dramatic response," said Price. "I can't think of any other component in grapes and wine where you could go out in the vineyard and cause a 100 percent difference. And here you can cause an 800 percent difference."

Scientists suspect that flavonols, including quercetin, have beneficial effects on blood-borne cholesterol, hardening of the arteries and blood clotting in humans.

However, medical research has not pinpointed specific beneficial mechanisms and linked them to the quercetin in red wine. Quercetin is found in most other fruits and some vegetables, including onions, garlic and green leafy vegetables. The fact that the French eat less red meat and more fresh fruits and vegetables than many may be a factor in their lower-than-average rate of heart disease, said Price.

But if medical researchers do link the quercetin in red wine to positive effects on human health, vintners might try to make high-quercetin wines. For that reason, Watson and Price plan to look at the chemical interactions of high quercetin levels in wine processing.

Mina McDaniel, another food scientist at OSU, and master's student Renee Vaia plan to investigate how different amounts of quercetin affects the taste, mouth-feel and astringency of wine.

"Now, we really don't know from a wine quality standpoint, what this all means," Price said.

NEW GRAIN HAS SUPERIOR WEIGHT

A winter triticale called "Celia" is available to growers in the Pacific Northwest. The Oregon Agricultural Experiment Station, University of Idaho Agricultural Experiment Station and Washington State University Agricultural Research Center are releasing the new variety.

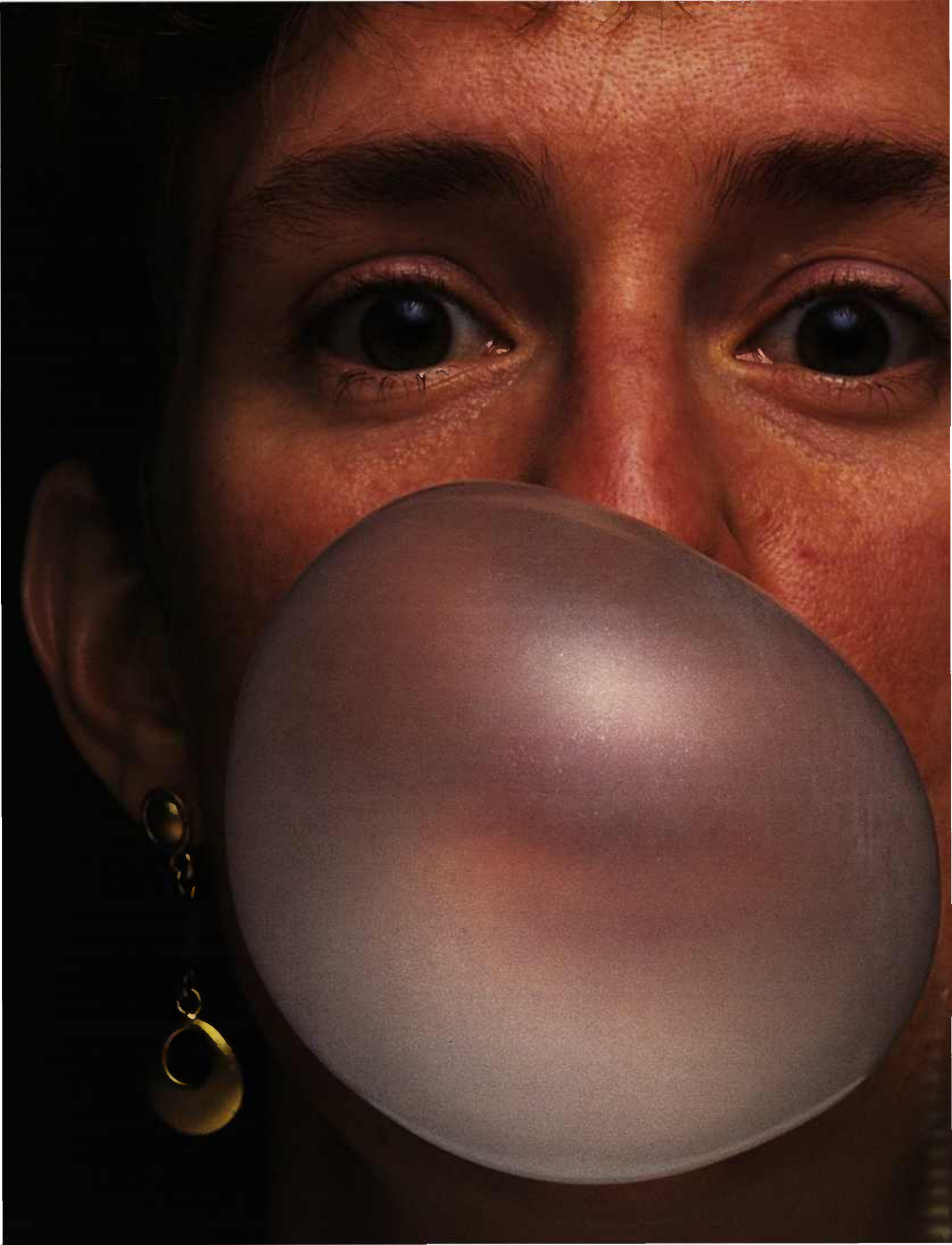
Celia came from a cross made by Robert Metzger, a retired U.S. Department of Agriculture geneticist who was stationed at OSU. Selection work was done by Mat Kolding, retired feed grains breeder stationed at OSU's Hermiston Agricultural Research and Extension Center.

The new winter triticale is named in memory of Celia Davis, who as a student worked on the feed grains project with Kolding. She died while working toward her doctorate at North Dakota State University.

Triticale is a cross of wheat and rye, explained Russ Karow, OSU agronomist. Triticales tend to have rye's adaptability to poor soils and resistance to diseases and cold while having kernel characteristics more similar to those of wheat.

Some experimental triticales even have milling and baking qualities like wheat, explained Karow. Triticales have a high food and feed value. In recent variety tests in Oregon, both winter and spring triticales have had yields similar to or better than those of wheats or barleys. As farmers search for crops that can be grown with fewer inputs while maintaining yield levels, triticales may find greater acceptance, he said.

Celia is offered as a replacement for the winter triticale Flora, primarily because of its superior test weights.



LYNN KETCHUM

THE SCENT OF MINT

Oregon is the country's top producer of peppermint oil; OSU researchers are studying diseases and pests to help growers keep it that way

BY JOAN DRAKE

Thick fog blankets the Shumaker farm on the outskirts of the little town of Crabtree in western Oregon's Willamette Valley. The scent of mint, accentuated by the cool, moist air, perks up the noses of visitors as they climb from the car.

A stone's throw away, shrouded in the mist, are some of the 250 acres Bob Shumaker and his partner and cousin, Lynn Shumaker, plant in peppermint. Candies, chewing gum, and the toothpaste we had better use after indulging in them, are flavored with oil this family and other Oregon growers distill from the herb.

LYNN KETCHUM

Left: Oregon-grown peppermint flavors gum, candy, medicines and other products.

The 2,592,000 pounds produced in 1993 placed the state first in the nation in peppermint oil production. Add to that another 144,000 pounds of spearmint oil and let's see. . . if one pound (about a pint) of the oil is so concentrated it can flavor 40,000 sticks of chewing gum or between 900 and 1,600 medium tubes of toothpaste, that amounts to. . . well, you get the idea.

Sales from oil last year contributed about $38 million to Oregon's economy. Foods, medicine, mouthwash and other products also are flavored with the oil.

The Shumakers began raising mint in 1977. (They had been dairy farmers for 40 years, but sold the cows about five years ago.) Rich soil, along with favorable weather conditions, makes this part of theWillamette Valley a suitable location for raising numerous crops, including mint.

Jefferson County, approximately 100 miles east as the crow flies, is another major mint growing area in the state. It also is where scientists at Oregon State University's Central Oregon Agricultural Research Center are conducting experimental work on the herb.

"Mint is a very old crop, but compared to other crops not much research has been done on growing it," said Fred Crowe, a pathologist and superintendent of the center. "It's so understudied that we don't know a lot about it. We don't know how to grow it optimally.

"Each farmer has his own theory about how to do it best. There are old timers who say mint doesn't grow as vigorously as it did in the old days," continued Crowe. But few records were kept, so it's impossible for him to know for certain whether that's true.

Sales from oil last year contributed $38 million to Oregon's economy.

One thing he does know, however, is that mint plants are very susceptible to verticillium wilt, caused by a fungus that lives in the soil and in diseased plants. Because it now exists in almost every Oregon field with suitable soil and climate for mint, growers no longer have the option of relocating to a "wilt-free" area.

"Right now," said Crowe, "they are planting into badly infested soils and some of them aren't able to keep their stands even two or three years. And that's not good; they can't live with that."

Crowe and his colleagues have researched ways growers can deal with the fungus in the future. "What we were trying to figure out was how to anticipate what the population level (amount of fungus) was and give them (the growers) an indicator of what their stand life is, to help them plan ahead," said Crowe. "This aspect of the research has been useful, although measuring soil populations has proven difficult. No soil test currently is adequate for routine usage."

Mint is a perennial plant. Because of its hybrid background, and a lack of resistant breeding stock, it is harder to breed mint for resistance to verticillium wilt than it is most other crops, explained Crowe. Also, he added, the industry is bound to a traditional oil character, which is very difficult to duplicate.

The standard variety, Black Mitchum, is hundreds of years old and very susceptible to verticillium wilt, said Crowe. The newest varieties, Todds and Murray, were released in the 1960's. Scientists scrambled genes of Black Mitchum peppermint with gamma radiation to make these varieties more resistant to wilt, but in doing so, they developed plants that were a little less vigorous, explained Crowe. In the last few years the industry has accelerated testing of promising new breeding lines, including studying how to use biotechnology to improve mint varieties.


LYNN KETCHUM

Peppermint harvest at Shumaker Farms near Crabtree, Oregon. After it's cut and dried, mint "hay" is chopped, put in a trailer and hauled to an on-farm distillery.


LYNN KETCHUM


LYNN KETCHUM

Above: Steam from a boiler in this building "cooks" mint hay. Right: Incredibly pungent pure oil collects in this condenser and is funneled into barrels.

In addition, new plants of the Black Mitchum variety were regenerated with a technique called meristem tip culture. From a few cells near the growing tips (meristems), new plants can be produced that have the same genetic identity, but are free of viruses or other systemic pathogens. When Starkle Farms in Montana propagated meristem plants and

REMAINS OF THE HAY

Quality and quantity of mint oil is highest when the herb is harvested before the plants are in full bloom. Most years that's in July or August, but due to the slow 1993 growing season, the Shumakers, like many growers, were still gathering their crop in early September.

A windrower (the same type used for ryegrass) cuts wide sections of the mint close to the ground and mounds it in narrow rows. The herb is then left to dry, or cure, for three to five days.

When most of the moisture in the plants has evaporated, a chopper picks them up, chops and blows the "mint hay" into a large tub or trailer. Once filled and closed, a tractor is attached and the trailer is pulled to a distillery, where it becomes a giant cooking pot.

Steam generated by the distillery boiler is then pumped through pipes in the trailer bed. "It takes 30 minutes to an hour for the steam to get through the hay," explained Bob Shumaker. "Then the hay must 'cook' another 1 1/2 hours."

During this period the steam rises through the mint, rupturing the small oil sacs on the back of the leaves. The steam and mint vapor exit the trailer through a pipe leading to a condenser, which converts them to a mixture of water and mint oil.

This liquid flows into a separator where gravity causes the oil to rise and float on top of the water. It can then be collected in 55-gallon galvanized drums, each holding 400 pounds of oil (the yield from about 5 1/2 acres).

The Shumaker distillery equipment was built in Washington. "It's probably the only one like it in the Willamette Valley," said Shumaker.

In addition to the traditional equipment, their operation includes a $10,000 gas separator. This was added because water leftover after the initial distilling process was contaminated with mint oil and couldn't be disposed of without polluting the environment. The additional separator removes 99 percent of the oil and the water can be recycled back to the boiler.

"I'm kind of proud of that because it's a step in the right direction," said Shumaker. Also the quality of the secondary oil is excellent because it has been vaporized rather than boiled.

"One rule when working in a peppermint still - you don't rub your eyes, ever," warned Shumaker. The oil is so strong, he compared it to mace.

The leftover cooked hay makes a good compost for other crops and home gardens. "You just have to make sure you don't use too much," warned Shumaker. One enterprising grower brings cooked hay to a corner lot near Corvallis and sells it by the pickup load.

Shumaker estimates cost of setting up a mint growing operation today—including the distilling equipment, trucks, trailers and choppers—at $300,000, if you're careful. Rather than building their own distillery, some mint growers opt to contract with a neighboring grower.

"It's a problem though, because the farmer takes care of his first and you're last," said Shumaker. "That's the reason we put a still in. We sat and watched fields get rained on for two weeks."

Companies contract with the growers for their oil. The barrels are stored in warehouses for up to seven years. If the grower chooses not to sell during that period, the contractor will use the oil, but trade the grower a new barrel. The Shumakers are using the system to build a reserve for when they retire.

LYNN KETCHUM

Left: The peppermint oil in each of these 55-gallon drums is worth about $6,000. Grower Bob Shumaker can store his oil up to seven years, waiting for a favorable price.

claimed they were more vigorous, the Oregon Mint Commission asked scientists at the central Oregon research center to grow some of the plants at the research center to determine whether they are superior to what is currently being used.

For comparison in the field trials, rsearchers also obtained root cuttings of the same plants from which the meristems were taken. Because of this, both types of the experimental plants were placed in soil that had never been used for mint, then raised as identically as possible.

Last year, the meristem plants were clearly more vigorous, said Crowe. They were 15 to 20 percent taller, had more upright stems and larger leaves. However, vigor didn't equate to a better harvest. Plants in the meristem plots failed to lodge (fall over) later in the

LYNN KETCHUM

Right: Oregon farmers grew 43,200 acres of peppermint and 1,800 acres of spearmint in 1993. Some probably ended up on your teeth.

season, had less secondary growth, and yielded 20 to 25 percent less leaves and oil than the non-meristem plants.

"It doesn't mean we're going to give up on it (the meristem variety). It just means that when we handled them identically, they didn't perform as well," said Crowe. "Maybe with different management they would." Further trials are also needed to determine whether the plants will retain their vigor and to verify the involvement of viruses.

Verticillium wilt fungus is even more destructive in mint when the soil contains the type of nematodes, or roundworms, that feed on plants. OSU Agricultural Experiment Station plant pathologist Russ Ingham researches ways to control these crop plant parasites in mint fields.

By testing the amount of nematodes present at different times during the growing season, Ingham has been able to recommend the best time for growers to take soil samples to determine the level that exist in their fields. He has also been relating the number of nematodes to the amount of yield loss in order to establish damage thresholds.

"It's sort of male confusion, but they call it mating disruption."

Field trials are being conducted to test new nematicides and determine the optimum levels of existing nematicides to use on the crop. The economic benefit of soil fumigation is also being examined.

LYNN KETCHUM

After the oil is removed, cooked mint hay is recycled, fertilizing wheat and other crops.

LYNN KETCHUM (NEMATODE SLIDE: RANDY GAUGLER)

OSU entomologist Ralph Berry, right, and researcher Jie Liu from China are studying microscopic nematodes mint growers can put on their fields to destroy insect pests. Projected on the wall is *Steinernema carpocapsac*, a beneficial nematode.

Other species of nematodes—those that prey on insects—are beneficial to mint. They represent one type of biological pest management Ralph Berry, an OSU entomologist, is researching as an alternative to the use of non-selective pesticides.

Berry and graduate student Joyce Takeyasu are studying how the beneficial nematodes can be used to control soil pests such as mint root borer, strawberry root weevil and mint flea beetle. When billions of the tiny worms are injected into each acre of mint through irrigation, they infect and destroy the insect larvae.

Jie Liu, a post-doctorate student from China that is working with Berry while at OSU for one year, is trying to identify pathogenic nematodes native to Oregon soil. "At first I thought that was like looking for a needle in a haystack," said Berry. "But he's found a large number of beneficial nematodes."

Liu has identified nematodes in soil samples primarily from along the coast, but also from fields in the Willamette Valley and central Oregon. In the future, it may be possible to manage and enhance what is already here rather than using the commercial nematodes that growers are currently buying, explained Berry.

The scientists hope to begin using mint root borer sex pheromone to disrupt mating behavior of these insects. The idea is to put lots of the chemical female sex attractant in the field so when the males come into that high concentration, they can't find the female and become disorientated.

"It's sort of male confusion, but they call it mating disruption," said Berry. "So you don't get mating, you don't get viable eggs, and therefore you don't get larval infestations."

Still another study by Ph.D. student Mark Morris is on management of spider mites by predator mites. The predator mites have always been present, but in the past they have been killed by insecticides used to control the spider mites. The three-year project has shown that predator mites keep the spider mites in check, reducing the need for insecticides.

"Growers will still have to use insecticides from time to time," said Berry. "But if they don't use them unnecessarily, then the predators are not disrupted and will eat the spider mites."

"We're going to have to be more and more careful about how we use the pesticides we have. And if we can use

TOM GENTLE

Fred Crowe, left, superintendent of OSU's Central Oregon Agricultural Research Center at Madras, tells growers at a Mint Field Day about studies of a fungus that attacks their crop.

those wisely and employ some of these other naturally occurring techniques, then I think we'll be far, far ahead," said Berry.

Since the mid-1960's, mint growers in the Willamette Valley have been controlling verticillium wilt by flaming their fields after harvest and not tilling the plants back into the soil. The elimination of tillage, however, has caused an increased problem with insects formerly controlled by this cultivation procedure.

In other areas of the western United States, tillage is still used to control insects and protect the mint plants from winter damage. Other management practices used in central Oregon to minimize the effect of verticillium wilt include avoiding fields with a known history of excessive wilt, shortening the time mint is raised in the same place, and not planting rotation crops believed to increase the fungus levels.

Researchers at the Central Oregon center have been conducting field trials to determine the benefits of tillage/no-flaming versus flaming/no-tillage on the fungus at their facility in Powell Butte.

As expected, each year more plants have been destroyed by wilt in the plots that were tilled. So far, however, the scientists haven't been able to come up with definitive answers on what is happening in the soil.

They are also finding differences in the disease from one end of the field to the other. Crowe suspects it may relate to soil type and water infiltration. The researchers may be able to design future trials that will examine these things and help them learn to better manage the disease.

"There are fields 20 years old that have never succumbed to bad wilt. And there's wilt in some of those. So we think there are things farmers do that we don't understand very well that are keeping the disease from overwhelming the crop," said Crowe.

TOM GENTLE

At the same field day, OSU soil scientist Alan Mitchell reports on research with "good" and "bad" mites that live on mint.

"My personal opinion is that the growers who are able to grow mint without ever putting it under any stress will have the least problems with verticillium wilt."

Grower Bob Shumaker agrees. "If it never is allowed to get stressesd—you give it plenty of water—and insects are kept in check, I think it almost controls it as well as burning."

But while lack of stress lessens problems with wilt, Alan Mitchell, another scientist at the Central Oregon center, is finding that stressed mint plants have higher concentrations of oil. "So some people think it's good to have mild stress," said Mitchell. "We're not ready to go that far yet because of other things stress can do to plants."

He and other researchers have been conducting trials for two years, studying the interaction between nitrogen-stressed and water-stressed mint. They are determining how much nitrogen should be used for a certain rate of water.

"The plants respond well to nitrogen, so farmers tend to use a lot," said Mitchell. "But it can leach into and contaminate the groundwater."

Plots that received the equivalent of 250 pounds of nitrogen per acre were judged optimum. Since only 150 pounds can be accounted for by the above-ground plants, the remainder could be lost below the root zone if excessive irrigation is used.

In addition to answering questions on the yield and quality of mint under stress, the scientists are testing instruments that measure the nitrogen level of mint right in the growing field. (Formerly this testing had to be done in a laboratory and took days.) If a dependable, relatively inexpensive method can be perfected, a grower will be able to quickly determine exactly when to add nitrate.

Oil quality has very little to do with plant variety and a lot to do with climate.

By adjusting the amount of stress, growers may be able to control the quality of oil they distill from the herb. The oil comes from glands on back of the leaves, which glisten in sunlight. It has many components, some favorable and others that are undesirable.

According to Mitchell, oil quality has very little to do with plant variety and a lot to do with climate. Warm days and cool nights are the best combination.

Time of harvest is also very important to oil quality. Harvesting too soon produces immature oil; but harvest too late and the result is an over-mature product.

"Every year quality is a little different. Also it's a little different between growing regions," said Mitchell. (In addition to the Willamette Valley and central Oregon, the Ontario area is a major growing area and small amounts of mint are grown in Christmas Valley and along the Columbia River in the upper northwest corner of the state.)

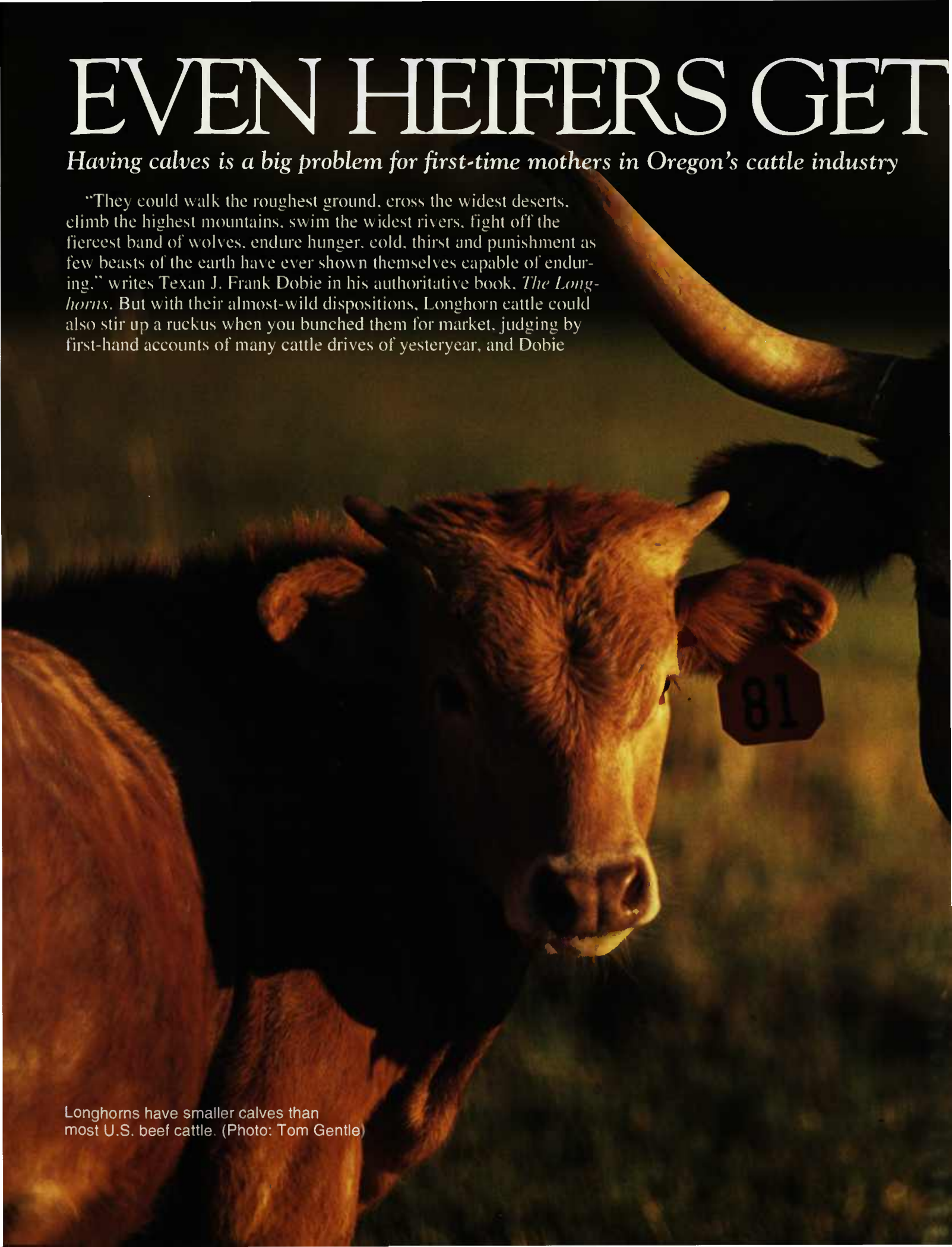
"It's a fascinating thing to raise," said Shumaker. "Very unpredictable. You think you've figured something out, then something else happens."

Joan Drake is a McMinnville, Oregon, writer.

EVEN HEIFERS GET

Having calves is a big problem for first-time mothers in Oregon's cattle industry

"They could walk the roughest ground, cross the widest deserts, climb the highest mountains, swim the widest rivers, fight off the fiercest band of wolves, endure hunger, cold, thirst and punishment as few beasts of the earth have ever shown themselves capable of enduring," writes Texan J. Frank Dobie in his authoritative book, *The Longhorns*. But with their almost-wild dispositions, Longhorn cattle could also stir up a ruckus when you bunched them for market, judging by first-hand accounts of many cattle drives of yesteryear, and Dobie



Longhorns have smaller calves than most U.S. beef cattle. (Photo: Tom Gentle)

THE BLUES

BY ANDY DUNCAN

admits the creatures were "tall, bony, coarse-headed, coarse-haired, flat-sided, thin-flanked, some of them grotesquely narrow-hipped ...."

So why is Harley Turner telling Oregon ranchers they should introduce Longhorn blood into their sleek modern herds?

"I'm not," says the OSU animal scientist, who works at the Eastern Oregon Agricultural Research Center at Burns. "I didn't intend for our study to be a comparison of Longhorns and Angus or any other breed. But immediately when we present the findings people start thinking we're advocating Longhorns."

Today's beef cattle look like bovine Arnold Schwarzeneggers.

The goal of his study, Turner explains, was to find a way to prevent dystocia, which simply refers to any time a cow has to have help delivering its calf. Most dystocia occurs with what ranchers call first-calf heifers, female cattle bred so they have their first offspring when they're about two years old. You'll see the main cause of calving problems the next time you take a drive in the country. Thanks to selective breeding, today's beef cattle look like bovine Arnold Schwarzeneggers, and their offspring are chips off the old blocks.

"Mostly, dystocia is caused by a calf too large for the opening," says Turner, "although some are turned wrong or something like that. The average weight in Oregon for the calves of first-calf heifers is about 72 pounds. As the birth weight goes up so does the dystocia rate. A 50-pound calf, no problem. A 100-pound calf, they almost always have to be assisted."

Ranchers have moved steadily toward calves with high birth weights because, besides starting life big, those animals tend to grow faster, says Turner, and mature cows "can handle a calf with a high birth weight."

In Oregon these days the majority of beef cattle east of the Cascade Mountains are a combination of the Hereford and Angus breeds. Western Oregon has a high percentage of crosses of Herefords and what ranchers call "exotic" cattle, less widespread breeds with names like Simmental and Charolais.

JOHN COLWELL FROM GRANT HEILMAN

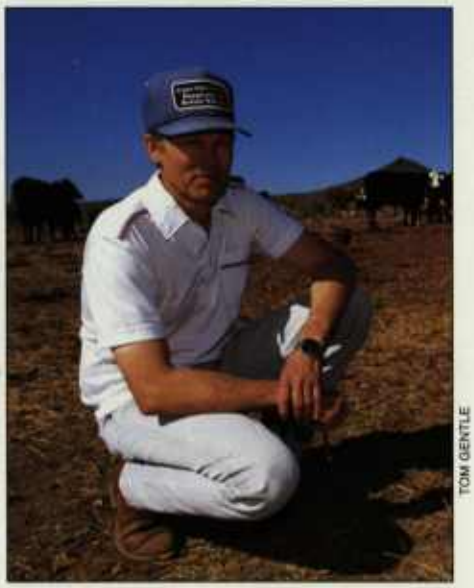
A Hereford cow and calf. Giving birth the first time, such cows often need help because their calves are so large. This causes problems for the animals and ranchers.

TOM GENTLE

Jordan Valley rancher Doug Burgess' Longhorn bull Vandal weighs 1,500 pounds. But Vandal's offspring are small at birth compared to the offspring of the bulls of breeds more common in Oregon's beef cattle industry.

Beef producers don't raise pure-blooded animals because cattle breeds are like cars with varying features. Cross-breeding gives ranchers customized "packages." For example, Hereford cattle graze well on sparsely vegetated land, and Angus are good milk producers. Crossbreeding also generates a hardiness animal scientists refer to as "hybrid vigor." About five years ago, Turner decided crossbreeding also might yield another quality, one that would be popular with ranchers and heifers having their first calves.

"I hadn't decided what I was going to use," he says, "I just knew I wanted to breed first-calf heifers to bulls that throw [produce] small calves, to try and do something about the calving problems. I'd thought of using Jersey bulls [small dairy cattle], or using bulls from the popular beef cattle breeds and selecting individuals known to throw small calves."


TOM GENTLE

Left: Studying calving problems, OSU animal scientist Harley Turner bred Longhorn bulls to cows giving birth the first time, called first-calf heifers.

But then Turner discussed his research plans at an Extension Service meeting in the little town of Jordan Valley in southeastern Oregon. A local rancher, Doug Burgess, approached him afterwards.

Burgess suggested he use Longhorns in his experiments and offered to donate semen from Longhorn bulls. "I told Doug I didn't want to use artificial insemination [although many ranchers do] because

THE CATTLE DRIVES OF DAVID SHIRK

Oregon's early cattle were all Longhorns.

The first arrived in the Willamette Valley in the 1830s, including an 1837 drive of about 800 head from Monterey, California, led by settler Ewing Young, often thought of as the "father" of the state's cattle industry.

In the 1840s, cattle began reaching the state via the Oregon Trail. Later, there were drives from Texas. Two are captured in *The Cattle Drives of David Shirk*. The book is the memories of an Indiana native who settled in southeastern Oregon's Catlow Valley and became an enemy of famed Oregon cattle baron Pete French (after marrying a young woman both he and French liked).

According to the late University of Oregon archivist Martin Schmitt, Shirk's recollections are "the only detailed account of the first beef cattle bonanza west of the Rocky Mountains."

In 1869, Shirk was on the receiving end of a drive from Texas that fed a booming beef cattle industry tied to silver mining in the Owyhee Country of southeastern Oregon, southwestern Idaho and northeastern Nevada. In 1871 and 1873 he drove cattle west himself.

Here is Shirk's description of an incident on May 9, 1871, during his first cattle drive from Texas to Oregon, with 1,500 head of Longhorns:

"After an hour ... the storm subsided in a measure, and the flashes were less frequent. We could see nothing, and only the breathing and puffing of the cattle told us where they were. All at once, my horse refused to go any further, but digging my spurs into his side, he plunged down a steep embankment, landing in water up to my stirrups. I instantly recognized that I must get out speedily as the cattle would be down on top of me, besides, I knew the water was rising rapidly. I then rode across the stream to the opposite bank and found a perpendicular bank as high as I could reach. Feeling my way, I ventured down the stream and reached what appeared to be an island. But the water was rising rapidly and I knew I would soon be driven from my temporary refuge. Thinking I possibly might be heard, I called loudly, but the only answer was the wind and rushing of the waters. ... In my extremity, I decided to stay where I was and my horse appeared to be in the same mind. Presently, I heard Mr. Miller calling, and to my great relief, the water appeared to be falling. After an interminable period of waiting, the clouds began to break away, and day soon began streaking the horizon, and it was with infinite relief that Mr. Miller appeared on the bank above the cattle."

Shirk had arrived in Texas the previous March, 26 years old. On October 15, about seven months older and a *lot* wiser, he found himself back home in the Northwest with his share of the herd, "my own boss, void of all cares and responsibilities save those of my own making."

On July 2, 1928, David Lawson Shirk died at the age of 83. "I have lived a long and interesting life," he'd told his wife four days earlier.


TOM GENTLE

Driving beef cattle west of Burns, Oregon, circa 1994.

I wanted to see how the natural system worked," recalls Turner. "Then he said he'd loan me bulls. So later I went out to his ranch and picked out four and told him we'd give him the money we got for them when we sold them after the study was over."

Burgess had owned Longhorns since 1977, when he bought a few to use in roping practice and competition. Now he has about 60 purebred Longhorn cows and sells purebred Longhorn bulls to other ranchers for breeding, as well as operating an all-around beef cattle operation that includes selling animals whose mothers bred with Longhorn bulls.

"I've never pulled [helped with the birth of] a Longhorn or Longhorn cross that's presented right," he says. "They've domesticated cattle for years to be bigger and fatter. They've helped them calve, so that saved the problem calves that were too big. Longhorns evolved on their own, mostly."

The results of Turner's research seem to fit with the rancher's experiences. But Turner started studying dystocia long before he met Burgess.

About 10 years ago he and fellow researchers Dale Weber of OSU, Mike McInnis of Eastern Oregon State College and Ray Angell of the U.S. Department of Agriculture's Agricultural Research Service looked over data on almost 1,200 first-calf heifers from Oregon herds. Dystocia rates ranged from 11 to 69 percent, they found. The average was 34 percent. To Turner, it seemed like an expensive problem.

"I'd be hesitant to put a dollar figure on the cost," he says. "But you obviously have increased labor, getting them into the pen to assist with the calving. Calves' growth rates and health are hurt because nursing is delayed. That opens their systems up to diseases like scours, pneumonia and other respiratory problems, and diphtheria. Even an hour or two day delay in nursing opens them up to disease. A calf needs colostrum [mother's milk secreted the first few days after birth] right away."

TOM GENTLE

Calves with Longhorn blood are hardy, say Darrell and Charlotte Northrop, who own the Fields, Oregon, store and raise cattle.

As you'd suspect, with birthing problems more calves die at birth or in the first months afterwards, according to Turner, and calf weights at weaning time (8 to 10 months of age) are about 30 percent lower. Heifers that have problems delivering their first calves tend to go into heat and breed again later than those that don't, and many have fewer and lighter calves during the rest of their lives.

Turner conducted his experiments at Burns and Union (near LaGrande). At Burns he bred Longhorn bulls to Hereford-Angus heifers. At Union, he bred Longhorns to Hereford-Simmental heifers. The results from three years of breeding, involving about 450 first-calf heifers, surprised him.

The dystocia rate among the Longhorn/Hereford-Angus crosses at Burns was about 15 percent, compared to 38 percent among other first-calf heifers. At Union, the dystocia rate among the Longhorn/Hereford-Simmental crosses was 0, compared to 42 percent among other first-calf heifers.

"I went into the study fully expecting the weaning weights of the Longhorn crosses to be lighter. I'd always heard Longhorns didn't grow as fast," says Turner. "But they gained exactly the same as our other calves at Union and Burns. From weaning [at about 7 months] to long yearling [16 to 18 months] they were just slightly below in weight gain. But there was no difference in the rate of weight gain at the feedlot. After slaughter, the Longhorn crosses were rated as well as other breeds in cutability [the percent of edible cuts in the carcass] and the USDA quality grade.

"The other thing that surprised me is we didn't reduce the birth weights as much as I expected—only about six pounds a calf in each location. That indicates the [Longhorn] breed is changing."

If the birth weights of the Longhorn offspring weren't as low as expected, why did the dystocia rate go down as much as it did?

"Weight doesn't account for all the drop," Turner admits. "I think the other factor is the shape of the head and hips. The Longhorn has a longer, narrower

TOM GENTLE

A small herd of purebred Longhorns on the Burgess ranch near Jordan Valley. OSU's Harley Turner used bulls from this herd to reduce calving problems in first-calf heifers.

head and narrow hips. The calf that's really hard on a first-calf heifer has a wide, heavy head and wide hips."

Turner liked the way calves with Longhorn blood behaved.

"Those son of a guns. Even if it was 20 below zero they hit the ground running. A Hereford calf lays there a little bit if it's cold. A little's too long. The Longhorn flops around, jumps up and sucks [nurses]."

Still, despite the research findings, there haven't been any stampeding ranchers trying to buy Longhorn bulls, or Jerseys or other small bulls, so they can breed them with first-calf heifers. One reason is the experience some ranchers had with Longhorn crosses. Buyers pay less for beef cattle with Longhorn blood.

"We tried them a few years ago so we wouldn't have calving problems, and from that respect it worked real good," says Burns rancher Van Decker. "But it became standard practice that Longhorn crosses brought 10 cents a pound less, so selling them didn't work too well.

"The industry got into this in the middle 70s and the research might have been timely then. There's still a few guys who can't get the management done [assisting first-calf heifers with calving] where it's good [using Longhorn crosses]," adds Decker. "I guess if I had a continual scours [bovine diarrhea] problem I might need to calve on new ground and Longhorn crosses might be helpful, or if a person was [also] farming, like they do up around Pendleton, and needed to be working on equipment during calving season."

Bob Skinner of Jordan Valley, who ranches with his son and brother, tried Longhorn crosses, too. "The first calf I said, 'My Lord, that thing looks premature. It looks like a deer.' But they get up and run off like a deer, too," says Skinner. As with Decker, getting less from buyers ended the experiment. "Most breeds have something to offer," adds Skinner. "It's hard to cover all the bases."

Beef cattle with Longhorn blood may have fewer birth problems, says Burns rancher Van Decker, but buyers pay less for them.

Darrell Northup, who runs the Fields store and motel at the base of Steens Mountain with his wife Charlotte, and raises a few cattle, likes Longhorns. "The buyers will dock you for any little thing, any excuse," he notes. "Longhorns are hardy, they're good mothers and they scrounge for food. It seems like they hold up well," he says.

Turner thinks there are additional reasons ranchers are cool to the research findings.

"If a rancher has a herd he's happy with, a lot of times he's very reluctant to bring in any other breed. It would really pain him if the buyer separated them out [Longhorn crosses] and paid less, even if he could take a 10-cent-a-pound cut and still be ahead. And the only work some ranchers—I'd call them cowboys— want to do is on a horse. They don't want to be inside during calving working on the books."

Rancher can solve the buyer problem by "taking animals all the way to slaughter the way we did," says Turner. "That way you get paid the same as for any other carcass hung on the rail. I think generally that's a more profitable way to do business anyway."

But, he says, "about half the ranchers in this country sell their cattle as weaners and most others keep them over the winter and sell them as long yearlings [16 to 18 months of age]."

"The first calf I said, 'My Lord, that thing looks like a deer.' But they get up like a deer, too."

Why?

"Cash flow is one reason," he says. "Some operate on year-to-year loans. Some don't want to gamble on market changes. Some just don't want to bother with the animals any more than they have to."

There may be ranchers, Turner speculates, who are using crossbreeding to reduce their calving problems.

"People think ranchers share everything. When something's working, people may keep it to themselves," he says. "Does Ford share with GM?"

Turner hopes to convince people to look past the cattle he used to change the weight and shape of calves.

"Again," he says, "I'm not advocating Longhorns, although there's nothing wrong with them. I'm talking about dealing with dystocia, a problem with first-calf heifers. If you're already at a low level of dystocia, say 15 to 20 percent, I'd say leave your operation alone. But if you have average or better dystocia, I'd do something to get smaller first calves. Ranchers who look seriously at the economics will see it pays off."

Breeding Longhorn bulls to Hereford-Angus first-calf heifers produced these month-old calves. In the experiment, OSU researchers cut the rate of calving problems dramatically.

It's Fresher With PRESSURE

OSU and Delaware scientists are pioneering a new food preservation system

It was Napoleon I who supposedly coined the phrase "an army marches on its stomach." In light of those words of wisdom, it shouldn't surprise any of you who have tasted K-rations, C-rations or MREs (survival meals used over the past few decades by the U.S. Army) that people at the U.S. Department of Defense continue to search for something more appetizing.

In all fairness, few food products can meet the specifications for survival rations (which are not intended to be used as normal daily meals) set down by the government. An MRE (meal, ready-to-eat) must be able to withstand 80-degree temperatures for three years and meet all recommended daily food allowances, so it is nutritionally complete. The meal typically includes an entree, starch, fruit, snack or dessert and two beverages.

To date, producers of MREs have relied heavily on thermally processed (canning process in a pouch) and some freeze-dried foods. Now, researchers are studying ultra-high-pressure processing with the objective of producing items that can not only meet the specifications, but have improved flavor.

The Department of Defense is sponsoring the development of four products preserved by this method. Scientists in the OSU Department of Food Science and Technology are working jointly on the project with colleagues at the University of Delaware. Product formulation, processing and package development are being researched at OSU. The University of Delaware is handling the microbiological testing.

"Foods will be sterilized without undergoing the changes linked to heat."

"In principle, it's canned food without the heat," explained Daniel Farkas, head of the OSU department. That means, at least theoretically, foods will be sterilized without undergoing the changes in flavor, color, texture, aroma or nutritional value often linked to the rigorous heat processing needed to inactivate microbes that can cause spoilage.

BY JOAN DRAKE

BOB ROST

High-pressure food preservation technology was developed in 1899 by Bert Hite, a scientist at the West Virginia Agricultural Experiment Station. "Conceptually it's a simple process," said Farkas. "You put some packaged food in a chamber, squeeze it, take it out of the chamber, and presumably the pressure has killed the microbes in the food." The method hasn't been used until recently because it's been too costly to build large high pressure chambers. In the past few years, however, companies in the metal working industry have developed sizable high-pressure vessels to compress powdered metal into products such as turbine blades. Similar equipment is now being used for foods.

Farkas has been intrigued by high-pressure processing of food since the 1960's and sees it as a possible alternative to the more controversial preservation method that uses ionizing radiation. He was involved in the high-pressure processing research begun at the University of Delaware in 1982-83.

The Japanese were doing parallel work at that same time, but they've progressed faster, according to Farkas. At least one company in that country is marketing three models of large high-pressure vessels for processing foods. And jellies, jams and fruit juice products produced by the method are already being sold to the general public in Japan. Farkas expects that fruit juices and fruit juice concentrates will be the first high-pressure products available to American consumers.

Fruit juices and fruit juice concentrates will be the first products available to American consumers.

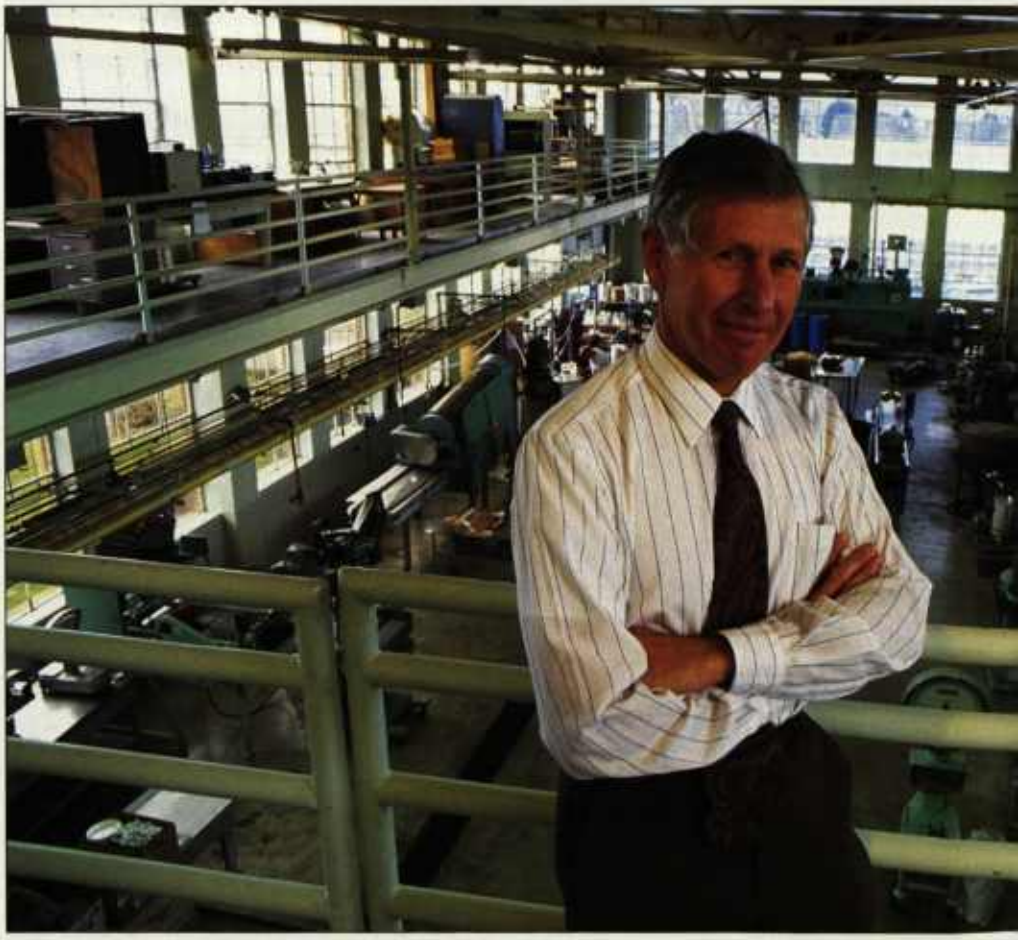
He also predicts the process will be used to extend the shelf-life of refrigerated foods such as prepared fresh fruit, fermented dairy products such as yogurt and other refrigerated acid products. Processed in more conventional ways, these foods are still subject to spoilage during refrigerated storage.

More research is needed, but according to Farkas, in the future, high-pressure processing may be used on refrigerated fresh meat, poultry and seafood to inactivate disease-causing microbes and parasites. He also foresees shelf-stable cooked entrees and refrigerated cook-chill products.

Thus far, research at OSU on the Department of Defense-sponsored project has involved formulation of the four food prototypes—Spanish rice,

BOB ROST

Above: OSU graduate student Giovanna Aleman funnels Spanish rice into a polypropelene pouch. Right: Once it's in pouches, researchers subject such food to ultra-high pressure.



Right: Dan Farkas of OSU's Department of Food Science and Technology above the pilot plant where he and colleagues test food preservation equipment.

spaghetti and meat sauce, yogurt with peaches, and mixed fruit (chunks of pineapple, grapefruit and oranges).

Scientists tested eleven varieties of fruit to determine the most desirable combination. The researchers have also been working for almost a year to determine optimum timing and pressure levels. Fifteen minutes of processing at 50,000 psi (pounds per square inch) is the most effective combination they have found for obtaining a sterile product. Shorter processing times should be possible at higher operating pressures. However, prices of equipment rise as vessels increase in size and operating pressure.

BOB ROST

BOB ROST

"We pretty much have the formulations down and can kill microorganisms," said Marcia Walker, research assistant on the project. But with food preservation there's a lot more than just microbial spoilage, added Farkas.

For instance, enzymes in fresh foods are still active and can cause browning or off flavor. To prevent that from occurring, the scientists are choosing foods that contain above normal levels of natural acid and hopefully will inhibit the germination of spores that are only damaged by high-pressure treatment. Another tact is to inactivate enzymes and viruses with the same heat needed to prepare ingredients, such as in the spaghetti with meat sauce.

Packaging plays an important role in protecting the food from oxygen. The gas accelerates deterioration of food, particularly its color and fat content.

The researchers are using a flexible plastic, trying at this stage to keep things as simple as possible, explained Walker. The 2-inch wide packaging comes in rolls and may be cut to the length desired.

One end of the plastic is heat sealed to create a pouch, then the food is added. Some air is extracted before the open end is also heat sealed. Nitrogen, which has been shown to increase shelf life of foods, may be added before sealing.

Two filled pouches are inserted into a longer plastic sleeve, which is then filled with distilled water. The extra cushion of plastic and water is a safety measure—should one of the tubes leak, it won't contaminate the solution of water and two percent hydraulic fluid that fills the chamber. (The hydraulic fluid aids functioning of the machine.)

BOB ROST

Research assistant Marcia Walker puts a fruit-filled pouch in a cyclinder where pressure will kill spoilage microbes.

"Normally it takes five years to get a concept such as this into practice."

The experimental chamber is 2 inches in diameter and 22 inches deep. Once the plastic sleeve is lowered into it, the pressure is raised to 50,000 psi and held for 15 minutes.

Following processing, juices released from the mixed fruit and some air bubbles can be seen in the prototype pouches, but no significant difference in flavor or texture was detected between the processed and unprocessed fruit in a simple taste test.

Researchers now plan to develop larger pouches of the foods and conduct a sensory evaluation comparing treated and untreated foods to see if the cost of processing is justified.

A research and development consortium to study high-pressure technology has been formed at OSU, made up of university, government and industry representatives. It "brings together food processors, process equipment and package and ingredient suppliers to solve some of the puzzles of applying high-pressure processing to foods," said Farkas.

"Normally it takes five years to get a concept such as this into practice," said Farkas. "It's going to be a long-term effort. We're pioneering a new food preservation method, much like canning was pioneered almost 200 years ago."

Joan Drake, of McMinnville, Oregon, writes a nationally syndicated food column.

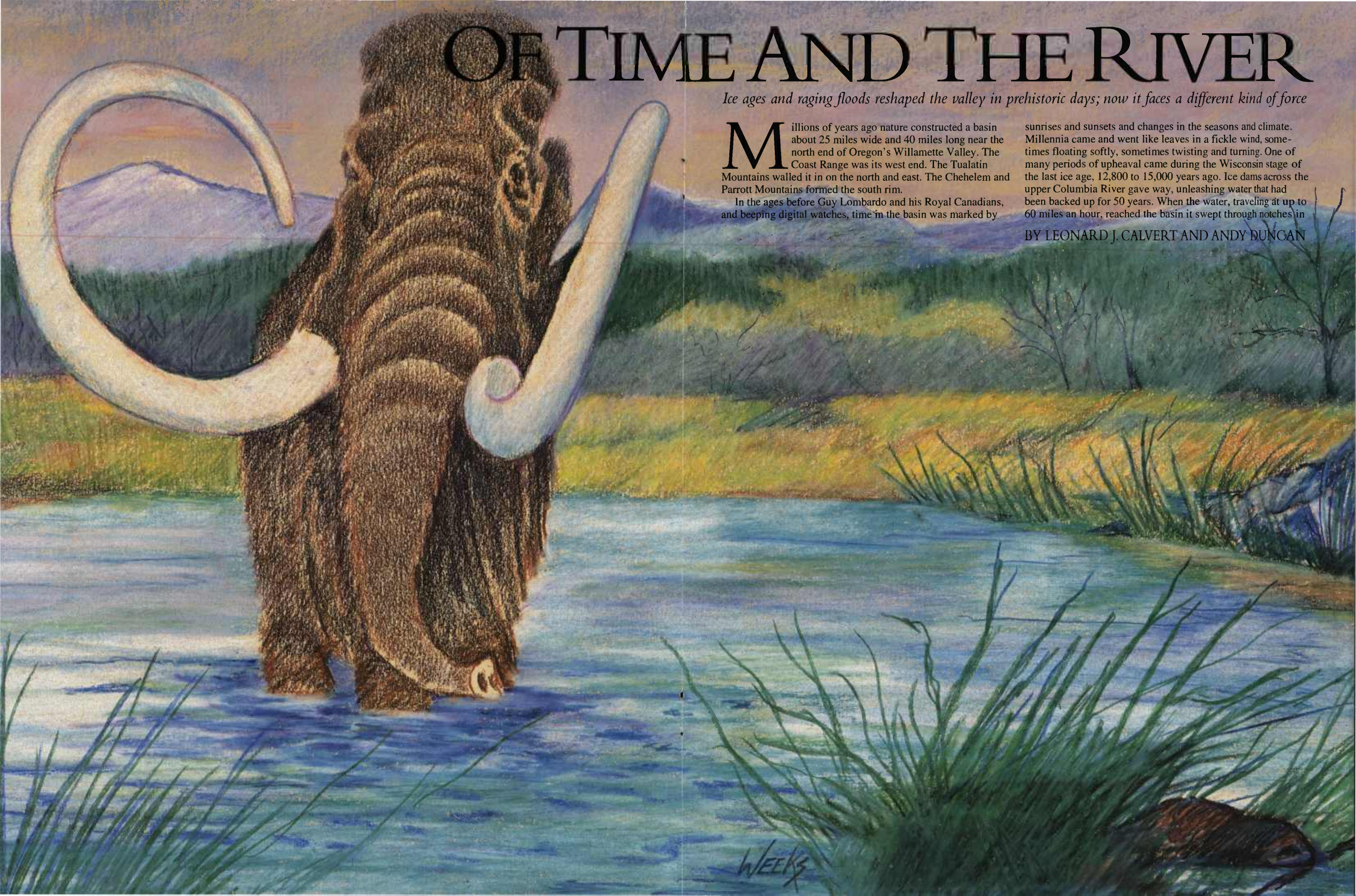
OF TIME AND THE RIVER

Ice ages and raging floods reshaped the valley in prehistoric days; now it faces a different kind of force

Millions of years ago nature constructed a basin about 25 miles wide and 40 miles long near the north end of Oregon's Willamette Valley. The Coast Range was its west end. The Tualatin Mountains walled it in on the north and east. The Chehelem and Parrott Mountains formed the south rim.

In the ages before Guy Lombardo and his Royal Canadians, and beeping digital watches, time in the basin was marked by sunrises and sunsets and changes in the seasons and climate. Millennia came and went like leaves in a fickle wind, sometimes floating softly, sometimes twisting and turning. One of many periods of upheaval came during the Wisconsin stage of the last ice age, 12,800 to 15,000 years ago. Ice dams across the upper Columbia River gave way, unleashing water that had been backed up for 50 years. When the water, traveling at up to 60 miles an hour, reached the basin it swept through notches in

BY LEONARD J. CALVERT AND ANDY DUNCAN



its east end, including one around present-day Lake Oswego. The basin filled to a depth of about 400 feet (at this time, the Willamette Valley became what geologists refer to as Lake Allison).

Gradually, the water receded, leaving a basin floor dominated by swamps and prairies. In earlier periods, ice-age animals and plants lived in the basin. During warmer spells there'd been a greater range of life, including elephants, camels and giant beaver. With another ice age ending, and enriched by the minerals and organic material left by the big floods, the basin bloomed again. There were wooded hills, grass-covered flatlands, lush swamps. It became the home of cougar, deer, beaver, muskrat, raccoons, coyotes and many other furry creatures. Grouse, crows, quail, geese, ducks, jays and other birds. Trout and steelhead. Salmon, possibly. The basin

As early as the 1930s, people noted problems.

was still changing, but less dramatically. Thanks to the beaver, dense vegetation and winter rains, the creeks and the river that drained it regularly overran their banks, or shifted course, enriching the area more. But eventually the Tualatin Basin, as it's known today, entered another period of upheaval, though slowly at first. This kind it had not seen before. This was the beginning of the Age of Almost Furless Two-Legged Mammals In Working Boots, Hiking Boots, Nikes, Reeboks, High Heels and Wingtips. Our time.

Some scientists believe humans first crossed the land bridge that used to connect Siberia to Alaska and came south 11,000 or so years ago. Others point to recent findings and suggest it might have been more like 60,000 years ago. The exact arrival time of those scattered wanderers probably doesn't matter in discussing the latest upheaval in the Tualatin Basin. But an event 6,000 years ago appears to be worth noting. According to historian Stephen Dow Beckham, of Lewis and Clark College in Portland, that's about when village life appeared in the Willamette Valley. That would be the Kalapuya people, who'd already been in the area several thousand years. Distinct groups occupied river valleys, including the Tualatin.

The Kalapuya hunted, fished, gathered plants. They may have burned some of the land to maintain the treeless grasslands they preferred, to make it easier to harvest seeds, to concentrate game animals in unburned areas. But the Kalapuya had a minor impact on the Tualatin Basin compared to humans who arrived in the 19th century—trappers and settlers, mostly of European descent, who arrived on the heels of explorers. The trappers caught the beaver. The settlers cut trees, built houses and roads, tilled some of the land, tried to clear streams for water travel, built a few dams and canals. Then there's the 20th century. Settlement in the basin grew from scattered farms, mills, logging camps and communities to the current population of more than 270,000, increasing about 220,000 in the last 30 years. Many of these people live in huge villages such as the cities of Forest

OREGON HISTORICAL SOCIETY

Logging in bygone days helped change the face of the Tualatin River Basin.

Grove, Hillsboro, Beaverton and Tigard (most of the basin is in Washington County, although it reaches slightly into Clackamas and Multnomah counties).

Today it's one of Oregon's fastest growing areas, a place of highly developed agricultural, forestry, industrial, commercial and residential activities. And related changes in the landscape, such as manipulating streams so they don't flood, draining wetlands (including the swamps) and building housing subdivisions and businesses and the associated driveways, roads and parking lots, have had a major, often unforeseen, impact on that basin nature created so long ago.

There have been signs of trouble for quite a while.

As early as the 1930s, according to the Oregon Department of Environmental Quality (DEQ), people noted water quality problems in the 83-mile-long Tualatin River, the basin's major waterway. From its headwaters in the Coast Range near the crest of Grindstone Ridge, at an elevation of about 2,800 feet, the

Tualatin plunges over three sets of falls before it enters the Tualatin Valley plain at an elevation of about 120 feet. Then, like many rivers in the Willamette Valley, the Tualatin takes on a placid personality, dropping only 20 feet in 45 miles. The last six miles before it runs into the Willamette, it roars again over and through bedrock, dropping 30 feet the last mile to its mouth near West Linn.

In the 1940s, the State Sanitary Authority, the DEQ's predecessor, expressed concern about potential health threats to people swimming and fishing in the river. In the 1960s, algae blooms choked much of the lower river during the summer, and at times irrigation withdrawals very nearly dried up some portions. In a 1969 report, the DEQ said several sewage treatment plants would have to clean up wastewater more effectively or stop releasing it into the river. The DEQ also said there should be a guaranteed minimum flow of high-quality water in the river and its major tributaries.

Several things happened in the 1970s, after that report came out: There was a brief moratorium on continued growth in the basin. A dam was built on Scoggins Creek, southwest of Forest Grove, creating Hagg Lake. During the summer water was released, allowing irrigation while maintaining the flow of the main stem of the river. A system was built to pump water from the Trask River, which flows into Tillamook Bay, into the Tualatin. Also, voters created the Unified Sewerage Agency of Washington County. Control of most sewage treatment plants in the Tualatin Basin was transferred to this new service district governed by the county commissioners. Several small plants were decommissioned and two large plants built, one at Durham and the other near the mouth of Rock Creek. Sewage treatment improved and so did water quality in the river, for a while.

BOB ROST

Assistant Basin Watermaster Darrel Hedin checks the flow rate on the upper Tualatin.

But by the mid-1980s, the lower river was in trouble again. DEQ attributes these water quality problems to a number of factors. Examples: population growth resulting in a much larger volume of waste; stepped up construction leading to increased urban runoff; runoff from agricultural operations.

For decades there's been trouble on the federal regulatory scene, too. In 1972 the government passed the Clean Water Act, which required that states identify "water quality limited" streams and develop total maximum daily load standards for pollutants in the streams. In the case of the Tualatin, the state was slow in following up. In 1986 an organization called the National Environmental Defense Council sued the U.S. Environmental Protection Agency for failing to enforce the Clean Water Act in the Tualatin Basin. The following year,

BOB ROST

OREGON HISTORICAL SOCIETY

Left: Farming along the Tualatin River. Above: Catching crawdads on the river, circa 1895. Today the river, which drops only 20 feet in elevation in one 45-mile stretch, has excessive algae growth related to a high phosphorus level and slow current.

DEQ signed a consent degree in federal district court saying the state would comply with the law.

One said it was "mostly water connected by swamps."

Since 1987, as before, there have been efforts involving private citizens and organizations, and involving an increasingly wide range of local, state and federal agencies, to improve water quality in the river. One attempt to analyze the situation came from the Oregon Legislature, acting through the DEQ. Oregon State University and Portland State University scientists were asked to collect scientific data, evaluate it and recommend alternative pollution control strategies for the Tualatin River Basin. They submitted a report to the DEQ in March 1993.

In November 1993, people interested in the Tualatin, including many who helped with the OSU-PSU study, gathered at OSU for a conference titled "The Management of Over-Utilized Streams: Lessons from the Tualatin Basin." The conference offered a sampling of many of the preservation and cleanup efforts underway and of current thinking about the Tualatin. Excerpts from presentations at the conference:

■ The Tualatin River is an "omen of things to come" for other Oregon streams less researched, asserted Benno Warkentin, an OSU soil scientist who participated in the OSU-PSU study. Warkentin said although controlling "point sources" of pollutants, such as major advances in water quality achieved through the work of sewage treatment plants in Washington County, are very important, that approach can't solve all the problem. The current emphasis of the federal Clean Water Act is on control of "non-point source" pollution, which involves land use.

The researcher noted that the Tualatin Basin holds, among other things, light industry, urban areas, commercial and hobby farms, forestry, dairies and nurseries. Much of the lower watershed is filled with commercial and residential activity, the middle portion features intensively managed agriculture, and the upper part is primarily Douglas-fir forests with extensive timber activity.

BOB HOST

Above: A golf course along the Tualatin. Right: Interstate 5 in the Tigard-Beaverton area. Such development changes the quality and quantity of water entering the river.

Historically, summer flows in the Tualatin River were low, he said, and now about half the summer flow is treated wastewater. Flow in the middle and much of the lower river is so slow it resembles a lake, he noted (one of many causes of that is a dam that diverts water to Lake Oswego, site of some of Oregon's most prestigious real estate).

Warkentin said the main problem in the middle and lower part of the river (except for the last six miles) is excessive algae growth in the summer. The algae makes the river green when it blooms and brown when it dies. Decomposing algae contributes to periods of low dissolved oxygen that stress the river's fish and violate water quality standards. Excessive phosphorus in the river is a big part of the excessive algae problem, along with a weak current, warm temperatures, low stream flows and intense sunlight.

■ Ron Miner, a water quality specialist with the OSU Extension Service, discussed the history of the Tualatin Basin and the river. He noted that early trappers and surveyors described a basin that was wet and contained numerous beaver dams and alder bottoms. One said it was "mostly water connected by swamps." Floods and quicksand were common.

Miner discussed how residents of the Tualatin Valley cleared the river and its

banks and straightened the river to make it more accommodating to their interests. "We have changed the nature of the hydrology of the area, which has changed the quality and the quantity of water in the river at any particular time," he said.

■ The Tualatin River "is more than green slime [algae]," said Stan Gregory, an OSU fisheries biologist who reviewed data on the aquatic health of the river as part of the OSU-PSU study for DEQ. The slime has attracted attention to one component of an ecosystem, the lower stretches of the river, he said.

Broken connections between the river's headwaters and lower reaches, loss of riparian zones and wetlands, and the introduction of exotic species (including fish) are other parts of the story of "aquatic ecology meets modern development," said Gregory, who described a complex web of life from phytoplanton, bacteria, insects, leaves, needles and wood to animals suspended in the water and fish.

Gregory said there's been very little study of the aquatic ecosystem in the Tualatin River Basin, including not only the river but the stream-side lands such as forests that once provided stability during floods, habitat for a variety of organisms and sediment stabilization that prevented erosion.

"We can make our future what we want it to be. We can change things," said Gregory. But "we have to recognize our history is a very important legacy of what we have today. We are quickly forgetting what our landscape has been. Change is occurring so rapidly that it's difficult to remember what systems were like." The Tualatin River system offers an important opportunity for Oregon, he added, because the same questions will be asked in other river basins and finding solutions will require that people work together.

■ Bob Baumgartner, senior environmental analyst with the DEQ's Water Quality Division, discussed historic violations of water quality standards in the Tualatin and outlined current efforts to protect the river. Those efforts include taking a more holistic look at the basin, organizing and evaluating available information, developing tools to assess alternatives for protecting uses of the river, and evaluating a range of alternative strategies.

Baumgartner said the Tualatin may be "the most studied basin in the world." Yet, he warned, choosing a water quality approach means setting pollution loading allocations based on what is necessary to maintain a healthy riparian ecosystem, and such an approach requires that decisions sometimes be made based on uncertain data.

■ Roy Koch, a Portland State University civil engineer, discussed two water quality modeling programs he and other researchers used as part of the OSU-PSU study. With the models they examined how changing various land management options might change hydrologic flow processes.

Koch said all models have some limitations. It was hard to test hypotheses about how land use management might affect the overall dynamics of sediment in the river, without historic data from winter months when most sediment is

BOB ROST

ROB BAUR

Evidence of human activity by the Tualatin's Mt. Richmond Bridge, near Hillsboro.

BOB ROST

In summer a dam diverts water from the Tualatin River into Lake Oswego, site of some of Oregon's most expensive real estate. Much of the river flows so slowly *it* resembles a lake.

transported. But he said the modeling was useful in testing several scenarios, including the potential impact of adding extra stored water to the river in the summer while also taking down boards on the dam that divert water to Lake Oswego. The model suggested this would reduce the number of algae blooms.

■ Wes Jarrell, head of the Department of Environmental Sciences at the Oregon Graduate Institute of Science and Technology, talked about what's going on underground, as well as in the river. Jarrell and his graduate students have studied groundwater, soils, deep geology and bottom sediments. He raised a number of questions about the little-known relationship of naturally occurring phosphorus and groundwater that goes into the Tualatin. Naturally occurring phosphorus may be entering groundwater and contributing significantly to the phosphorus level in the river, Jarrell's work suggests.

BOB ROST

Washington County is fighting for the Tualatin. School children painted fish by storm drains as a reminder the drains release untreated water into the river.

BOB ROST

Above: OSU Extension agent Neil Rambo, examining corn, says farmers are working to reduce pollution. Those recyling livestock wastes to fertilize crops are careful to keep the manure out of streams. Right: Haines Falls near the headwaters of the Tualatin River.

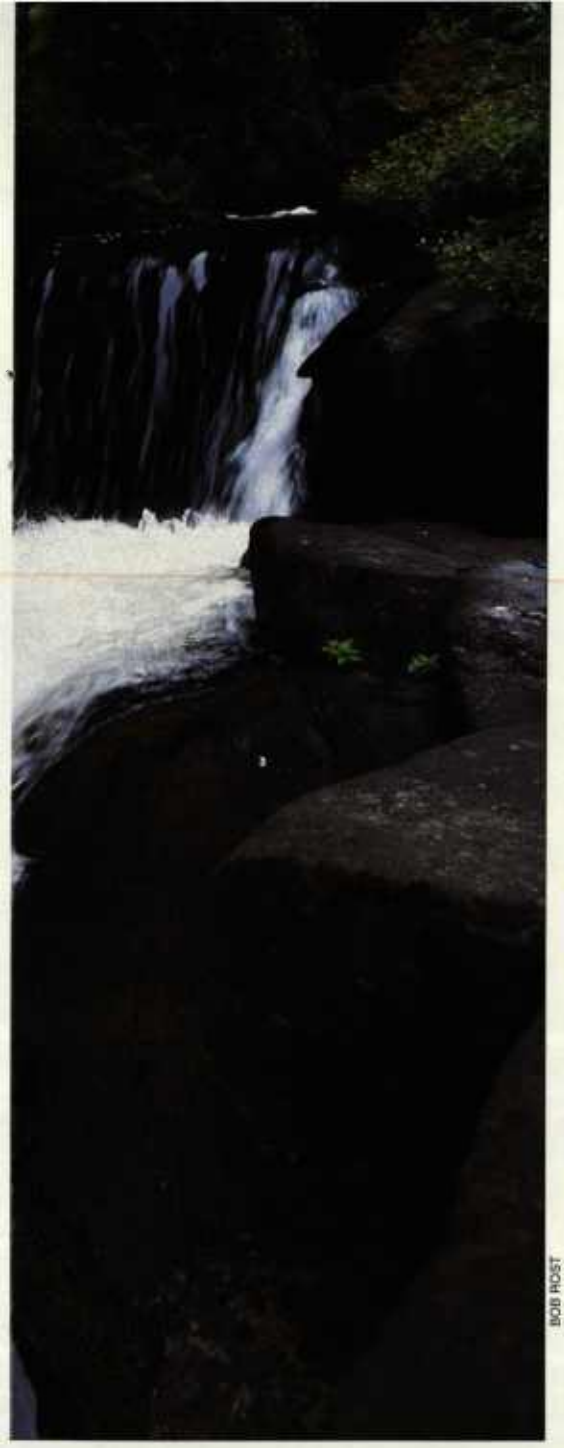
■ Tim Cross, a farm management specialist with the OSU Extension Service, reported on his study of the potential economic impact of various changes the Tualatin Valley's 1,700 farmers and livestock owners might make in their practices to try and improve the river.

About a third of the land in the basin is in agricultural production, Cross noted. Crops are diverse, ranging from berries to nurseries, grains, hay and livestock. The annual farm gate value of the area's crop is about $140 million. Non-point sources of agriculture-related pollution originate with things like fertilizer applications (a source of phosphorus), sediment that runs off into waterways and livestock activities around streams.

An agricultural economist, Cross examined the implication of various "best management practices" such as reducing fertilization rates and incorporating fertilizer into the soil differently to control runoff, tilling less and planting strips of grass between crop rows to hold the soil in place, and placing fencing around streamside areas to keep livestock out.

Cross estimated that implementing all these control technologies could cost basin farmers more than $6 million, though the "best case" scenarios suggest the changes could actually increase farm profits if costs were reduced and yields remained constant. The "worst case" scenario could result in a net loss of $13 million, due primarily to decreased yields.

■ David Degenhart of the Oregon Department of Forestry said foresters have sampled the main stem of the Tualatin River for four years without finding a clear link between timber harvesting and phosphorus levels.



Phosphorus fertilizers aren't used in forests in the basin, he said, noting that the current thinking is that, because spots in the basin high in sedimentary (rather than volcanic) rock tend to have higher phosphorus levels, harvesting in those areas may have more potential for contributing to the river's phosphorus level.

■ When the Tualatin Basin had more dense vegetation and meandering waterways that flooded from time to time, rainwater was absorbed into the ground and released into streams gradually through the year. But that's changed. In many stretches the straightened channel of the Tualatin flows through urban areas speckled with impermeable surfaces that increase the volume and speed of runoff. Wayne Huber, an OSU civil engineering professor who participated in the OSU-PSU study, outlined various alternatives for reducing non-point source pollution in urban areas.

According to Huber, those alternatives include source control through public information, planning, control of illegal dumping, recycling and the use of alternative products. He discussed increasing storage to capture more storm water runoff so it can be cleaned before entering the river, and innovative ideas such as constructing artificial wetlands and using porous pavements.

■ Peter Klingeman, another OSU civil engineer, has been studying methods of increasing flow in the Tualatin River with strategies like storing additional water, not allowing as much diversion, conserving water, purchasing water rights and decreasing ground water usage. Among his observations:

BOB ROST BOB ROST

This Unified Sewerage Agency plant cleans water entering the Tualatin.

Increasing the height of Scoggins Dam, which forms Hagg Lake, to impound more water would be difficult, technically. Building other dams and flooding sizable areas would be tricky politically. Bringing more water into the basin would be, too. For example, taking more water from the Trask River would lower a stream already low in the summer and having salmon problems. Taking water from the Willamette River near Newberg would be possible but expensive, and that could affect summer water quality in the Willamette. Such choices may not be best ones in the long run, he said.

■ Judy Li, an OSU fisheries biologist who worked with Stan Gregory in reviewing the status of aquatic life in the Tualatin River system, offered people attending the conference thoughts on river restoration. Li urged people to look at what's happening in the basin and work together in solving problems. Restoration goals she identified included improving shading around the river, stabilizing the soil and increasing nutrient infiltration, encouraging the development of in-stream habitat for aquatic life and establishing animal corridors around the river.

Building other dams and flooding sizeable areas would be tricky politically.

■ Bonnie Hayes, chair of the Washington County Commissioners, discussed what the county is doing to improve the Tualatin. While some say the river was "never a pristine bubbling brook," said Hayes, it is the only river serving the many needs of the Washington County population. Keeping the river's water clean hasn't been cheap, she said. Recent charges by the United Sewerage Agency for a single home were $20.50 a month, plus $3 for surface water management and an additional 19 cents per $1,000 assessed valuation in property taxes. Hayes said a newly formed group, the Tualatin River Basin Council, will help stakeholders come together to develop a common vision for the river.

■ John Jackson, head of the Unified Sewerage Agency (USA for short), said Oregonians have begun to realize the Tualatin is a great resource, offering recreation opportunities and open and green space in a developing area. Jackson said steps taken the last 20 years by USA and others have removed most of the pollutants from the water. "What we are dealing with is the last finite amount and it's difficult," he said. Cleanup strategies he mentioned include a ban on detergents containing phosphates and installation of the new treatment technology at USA's Rock Creek and Durham facilities. "What has been accomplished is remarkable," said Jackson.

■ Dick Kover, a rural landowner and a director of the Washington County Soil and Water Conservation District

(SWCD), talked about the river from the rural landowner's perspective. The county SWCD, and the federal Soil and Conservation Service and Agricultural Stabilization and Conservation Service, are working to control erosion and sediment loss primarily in four areas, he said: confined animal feeding operations, container nurseries, stream bank protection and non-commercial farm operations. Kover cited several accomplishments, such as storage systems to keep animal wastes from entering streams, container nurseries' water quality strategies and a district plan to address stream bank erosion and protection and restoration of riparian areas and wetlands.

■ Dick Porn, of the Western Realty Advisors of Hillsboro, spoke from the urban land user's perspective. No one wants to see another building moratorium in the county, he said, so developers and other commercial enterprises are getting involved in water quality issues. Environmental health is critical to the economic health of the area, Porn suggested, which means regulatory agencies have to "keep the heat on."

■ Volunteer organizations are working on Tualatin River problems, too. A group called The Friends of Jackson Bottom has been successful in preserving and enhancing a wetland on the edge of Hillsboro. But Kathy Clair, of another volunteer group called the Tualatin Riverkeepers, told conference attendees "it's difficult to connect with the river because there's almost no public access." Each June her organization sponsors Tualatin Discovery Days, trying to get people on the river to see it for themselves.

■ Local governments often are in the role of encouraging people "to do the right thing," said Vergie Ries, policy manager for the city of Beaverton. One example of education underway in Washington County is a program for fourth graders, Ries explained. The idea is to teach children about their responsibility for water quality, hoping they will pass information on to their parents. In another program, young people put pictures of fish on storm drains to remind people the drains empty directly into the river without treatment. Sometimes the public is ahead of the planners, Ries said, pointing to public support for the phosphate detergent ban when it was presented among a list of options for reducing water pollution.

BOB ROST

Vast wetlands once helped keep streams clean and sheltered a complex web of life in the Tualatin Basin. The city of Hillsboro preserved this wetland in a greenway. "The Friends of Jackson Bottom" are looking after another wetland on the edge of the city.

"It comes down to choices—this we'll live with; this we won't."

■ ■ ■

A slender man in a plaid shirt, jeans and work boots is watching white water plunge down a rocky chute, maybe 25 feet, into a deep pool. The banks of the narrow stream are moss-splotched rock, backed by ferns, alder, a few Douglas-fir, a few red cedar. The forest is wet, dripping. If you close your eyes, listen, smell, the place has a primal feel. These are the mountain headwaters of the Tualatin River. The Tualatin was never like this farther down, where it meanders across the fertile soils of the lower basin. But it has changed a lot down there in the last 150 years.

The slender man knows this. He is Neil Rambo, an agent in the OSU Extension Service's Washington County office. Rambo works with what's called the Dairy-McKay Hydrologic Unit Area, established in 1991 by the county Soil and Water Conservation District and the U.S. Department of Agriculture. The goal is to provide technical and financial help to landowners and other citizens in the Dairy and McKay Creeks drainages of the Tualatin Basin, to help them improve water quality. Rambo's role is

TOM AND PAT LEESON

TOM AND PAT LEESON

to provide education and information, to increase public awareness. He does on-farm research, goes to meetings, helps give courses and sponsor demonstrations.

"It's easy to be a critic. But we're past the finger-pointing stage," he says. "Taking action is tougher. People can bicker, but the problem is everyone. The problem is all of us. Prevention and cleanup are not easy. It's expensive. It takes time."

TOM AND PAT LEESON

Left, above and below: Cougars once lived in the Tualatin Basin. Raccoons and snakes are common wetland residents.

He says he sees progress. He mentions dairy farmers who are building holding tanks and lagoons to store manure in the winter, instead of letting it run off. In the spring they spread it on their corn. He talks about other causes of water pollution. Septic tanks. People fertilizing their lawns. Ditches by roads that channel runoff water into streams.

"Sometimes it comes down to choices—this we'll live with; this we won't," he says. "People used to think we didn't have a problem. Now they're saying 'we better do something before someone comes in and tells us what to do.' People are working on farm plans that take a holistic approach. Looking at inputs and outputs and how they will affect water quality."

■ ■ ■

"Every activity in the Tualatin River Basin contributed minutely to the vastly different river we see today—the original floods, the Kalapuya field burning and animals drives, the beaver trapping, the draining of swamps, the introduction of cattle, sheep, and pigs, the conversion of belly-high grass to agriculture, the use of fertilizers and pesticides, the digging of wells and diversion of stream water, the felling of forests and the loss of understory brush, the straightening of channels and the removal of log jams and obstructions, the building of dams, the increased population living on the flood plain, the production and treatment of sewage, the water used for industry or to accept industrial wastes—each had a role in the conversion of the Tualatin River."

Those are the words of OSU graduate student Penny Cass and water quality specialist Ron Miner, prepared for a publication titled "The Historical Tualatin River Basin." They continue:

"The isolation of the Tualatin River from its flood plain, the draining of wetlands, and the increased urbanization are intertwined with the dreams and efforts of the valley's residents .... No one set out to create a river too rich in phosphorus and too subject to algal blooms. The philosophy of the original settlers differs little from that of present day inhabitants, only today we understand more about the consequences of the slow accretion of small, individual changes."

An interesting question about all this: Through the lens of the ages, do these recent changes *really* add up to an upheaval, like the floods of the last ice age that filled the basin with 400 feet of water and turned it into a lake? Or is this less dramatic, a tremor that will pass without major long-term impact? Maybe there's still time to choose.

FOR MORE INFORMATION

Much of the information in this article was gleaned from publications published through the Oregon Water Resources Research Institute at OSU. A limited number of copies of the papers are available to anyone interested.

The publications: "The Historical Tualatin River Basin," by Penny Cass and Ron Miner; "Landscape Change in the Tualatin Basin Following Euro-American Settlement," by David D. Shively; "The Management of Over-Utilized Streams: Lessons from the Tualatin Watershed (a report on the sixth James A. Vomocil Water Quality Conference)."

To get a copy of one of the papers write the Water Resources Research Institute, 210 Strand Agriculture Hall, Oregon State University, Corvallis, OR 97331. The cost is $5 per copy.

A BRIDGE ACROSS DISCIPLINES

Some say part of Oregon's future is in OSU'S new Agricultural and Life Sciences complex

BY CAROL SAVONEN

There's an old joke that a university really is 50 fiefdoms connected by a heating plant. What the joke is getting at is that universities are segmented by disciplines—math and biology and history and so on. Departments formed around these disciplines tend to have their own office and laboratory space, even buildings, if they're big enough. Deep concentration in an area of study is important. But in the agricultural and environmental sciences, research questions are increasingly interdisciplinary. One research project on nutrient uptake in crop plants for example, may involve soil scientists, horticulturists, chemists and agricultural engineers.

What if scientists who do research and teach in different departments were located together, or at least connected closely? Would that spark new ways of solving society's problems? New, integrated ways of teaching?

"It was wonderful to see," says Bob Witters, grinning shyly as he recalls his return to Oregon in the fall of 1993 after spending five years in on an agricultural development project in Bangladesh. Specifically, what was wonderful, he remembers, was gazing for the first time at a figure of brick, windows and tile on the west side of the OSU campus, at state of the art laboratories, at sky bridges connecting scientists from various disciplines the way nerve pathways connect regions of the human brain. Bob Witters was staring at a dream turned into reality.

The mind of Witters, you see, was the birthplace of OSU's new interdisciplinary Agricultural and Life Sciences building, a facility that, by all rights, and common sense, should not exist.

"Back in the early 1980s, we were having severe space limitations," explained Witters, former acting director of the Oregon Agricultural Experiment Station and associate dean of the College of Agricultural Sciences at OSU. "Horticulture, Entomology, Botany and Plant Pathology, Rangeland Resources, Soil Science, and Fisheries and Wildlife were overcrowded and had antiquated, overtaxed classrooms and laboratories. And we were buried in budget restrictions and budget cuts in those days too," added Witters.

While most people felt constrained by Spartan circumstances, Witters, whose own personal philosophy is "kites fly highest against the wind," felt it to be a time of opportunity.

Left: This sky bridge connects OSU's new Agricultural and Life Sciences building to Cordley Hall; another sky bridge leads to Nash Hall. Above: Construction began in 1990. Photos: Tom Gentle

"It seemed to me it was an appropriate time to strike," he said.

In the mid-1980s, Witters communicated the need for new facilities to supporters of OSU agriculture and suggested that they discuss his proposal with Oregon Senator Mark Hatfield. The senator was very supportive and later helped in providing about $9.7 million for a new facility through the U.S. Department of Agriculture, the agency funding many of the Agricultural Experiment Station's research projects at OSU. The Oregon legislature voted to allocate about $14.9 million to the effort. More than $4 million more would have to be raised through private donations for equipment, furniture and future building maintenance.

The physical "guts" are slightly reminiscent of Jurassic Park.

"Hatfield was instrumental in the whole process," said Witters. "He did not falter."

The funds were earmarked to fill a need for a new building—the money couldn't be used in any other way, explained C. J. "Bud" Weiser, dean emeritus of the College of Agriculture.

"Some decried the fact that we were building a huge, beautiful edifice at the same time people were losing their jobs," said Weiser, who was head of the Department of Horticulture during the planning stages of the building. "But they didn't realize there wasn't a choice about what to do with the money. It was either spend it on the building or nothing at all."

Once his idea gained momentum and most of the funding procured, Witters took off for an overseas assignment in 1987. For the next three years at OSU, George Keller, OSU's vice provost for research and international programs, OSU president John Byrne and many others pursued the long process of planning, cooperation, fund-raising and perseverance it takes to guide a huge idea into a workable reality.

Most faculty to occupy ALS met with the architect to design labs, offices and classrooms to meet their specialized needs. How many lab benches would need to be installed? Where could lab animals be kept in isolation? Where could you put plant growth chambers, drain lines and pumps? Where were outlets and sinks to go? What about emergency eye washes and hoods to vent noxious fumes? Where should group space be in relation to individual offices?

"For over a year, we talked with more than 100 very strong individuals who didn't always agree on the design," chuckled Howard Smith, architect from Settecase Smith Doss, the Salem architectural firm that designed ALS, and previously other buildings on campus including Veterinary Medicine, Electrical Engineering and Parker Stadium.

The architects attempted to give all of the researchers their wishes for things like laboratories with windows to the outside and state-of-the-art fume hoods, to remove toxic fumes during experiments. Desires proved to be too much—cost estimates came in nearly $7 million over budget. A few months later, Smith Settecase Doss's modified plans fell within budget, with the same amount of floor space, but with fewer outside walls and more economical equipment.

"We got a heck of a bang for the buck," said architect Smith. "The building went up for about $100 per square foot, ready to move in to. That's unbelievably cheap. And we finished near the estimated cost—$200,000 to the good of a $20 million dollar project."

TOM GENTLE

Former Agricultural Experiment Station acting director Bob Witters first saw the need for the new facility during the crowded days of the early 1980s. Last fall, when he returned from a five-year assignment in Bangladesh, his dream had turned into reality.

TOM GENTLE

U.S. Senator Mark Hatfield, shoveling at the building's 1990 groundbreaking, helped secure funds for the Agricultural and Life Sciences facility.

The physical "guts" of the new building are slightly reminiscent of the futuristic theme park in the movie "Jurassic Park." Ultra-modern technology snakes into every room. A master computer controls heating, cooling and lighting needs for each room. Infrared and ultra-sonic motion sensors detect when researchers occupy a room, automatically turning the lights on and off. These systems conserve energy and ultimately will pay for themselves, according to Ed Leslie and Jim Arends, of OSU's Facilities Services Department.

With windowed seminar rooms and offices, modern research and teaching laboratories, energy efficient heating and lighting, the new building is quite a

contrast to the older, and in many cases, shop-worn or cramped buildings where agricultural research, teaching and extension goes on, such as in Strand Agriculture, Cordley and Weniger Halls.

All in all, the new building has given the agricultural and life sciences at OSU a "big shot in the arm," said dean emeritus Weiser.

"The completion of this building couldn't have been more timely," said Weiser. "Measure 5 dictates we do things differently. In the midst of all the travail, we have an investment in the future that makes it possible to do more with less. It has allowed us to integrate programs."

The new building houses OSU's Center for Gene Research and Biotechnology, the Environmental Health


TOM GENTLE

Left: Scientists and students listen to a talk on immunology in one of the building's new seminar rooms.

SAVING A PIECE OF THE PAST

Most people walk by and don't even notice them. In the basement of the new Agricultural Life Sciences (ALS) building are two old Ionic columns, gracing the foyer outside the soils teaching lab.

These tall tan columns were not in the new building's blueprints.

"I pulled them out of the old dairy barn that was originally on the site and torn down in 1989 to build ALS," said Howard Smith, ALS architect. "I refinished them and snuck them in at the end of the project—I wanted something of the past, some personality in there."

The old dairy barn was designed by John Bennes, a prominent Portland architect who later built at least 27 more buildings on campus and many others in Portland. Built in 1908, the dairy barn had a Greek Revival-style entrance flanked by two Ionic columns. It was the talk of the town. The February 25, 1908, *Corvallis Times* said: "Its conveniences for housing livestock are so perfect as to make the visitor wish himself and herself a horse or cow, at least temporarily."

For thirty years, the barn did what it was designed to do—house the university dairy herd, horses, feed, the milking room, and vehicles. The west wing housed agricultural engineering teaching and research.

In the late 1930s, a new dairy barn was built to the northwest of the old one. At the same time, social and economic changes steered college curricula away from the traditional old-fashioned agriculture the barn had housed. Part of the barn was converted to office space in 1938 when Gilmore Hall (the farm mechanics building) was gutted by fire. The transition from barn to office was rather aromatic for some.

"The manure was still pretty fresh when the high pressure heat warmed things up," recalled professor emeritus Dale Kirk, interviewed by students Shawn Steinmatz and Dennis Werth in 1989, for an anthropology class report. "The odor became pretty intense."

Over the decades, the barn was repeatedly remodeled and used for new purposes—from hop drying, to agricultural engineering work with flax during World War II's fiber shortage. According to Steinmatz and Werth's report, the 1940s through the 1970s brought, "a veritable slew of alterations," to the barn.

Slowly drifting into obscurity, the "Agricultural Utility Barn," as it became known, grew yet more anonymous. By the 1970s, the OSU administration directed that the building no longer be used for teaching or labs. But an ever-more-crowded campus put space at a premium—several departments took advantage of vacant space. The Department of Agricultural Engineering, the Seed Lab, USDA, and the Department of Computer Science all used office or space on the barn's grounds. The loft was full of stored equipment from several departments. Most of these uses were unsanctioned.

In early 1988, the OSU administration mandated by memo that all occupants vacate the premises. The dairy barn had "become the university's unwanted child," wrote Steinmetz and Werth.

The dairy barn, they wrote, was "tolerated at times because of an occasional usefulness, but more often than not, regarded as a burden." They hoped their report would help to save the old building as a "a lone reminder in 1989 of the college farm and livestock that were a common sight in that area of the campus so many years ago." All the other campus barns, were "gone, burned, or demolished to make allowances for an expanding university. . . The Dairy Barn remains a solitary figure, voicing what can only be found buried in archives . . ."

The building was torn down in 1989. And luckily, unbeknownst to most at the time, architect Howard Smith saved some remnants of the College of Agricultural Science's heritage for generations to come.


OSU ARCHIVES

Architect Howard Smith used columns from this old campus dairy barn in the Agricultural and Life Sciences building.

Sciences Center, the Departments of Biochemistry and Biophysics, Agricultural Chemistry, Horticulture, and the soil science section of the Department of Crop and Soil Science. Adjoining ALS via a sky bridge to the north is Cordley Hall, with the Departments of Botany and Plant Pathology, Entomology, and Zoology. And via another sky bridge to the west is Nash Hall, with the Departments of Microbiology and Fisheries and Wildlife.

"Not only are we connecting buildings—we are also connecting disciplines, programs and most importantly, people," said Weiser. "We have new ways of doing business now. Instead of staying within departmental lines, we are creating new integrated degree and research programs such as the undergraduate Bioresource Research degree and the graduate Molecular and Cellular Biology program."

"The new Agricultural Life Sciences building married our programs physically," explained Betty Brose, director of development for the E.R. Jackman Foundation, a fund-raising arm of the College of Agricultural Sciences. "I think of the new building as a heart and the sky bridges as arteries—a heart for science and research, bringing information to Oregon agriculture."

The move to ALS has united some facilities and made them more efficient. The Department of Crop and Soil Science's soil testing laboratory and research plant analysis lab, and the Department of Horticulture's plant analysis lab, are now merged into a single Central Analytical Laboratory. In one facility instead of three, soils are tested for commercial growers, home gardeners and research projects; plants are analyzed for commercial and research purposes; water is tested. Personnel, equipment and computer software are shared.

TOM GENTLE

From the west the new building provides an impressive entrance to the OSU campus.

TOM GENTLE

The busy main entryway. In good weather, an outside fountain is a popular spot.

"With three facilities, we used to be spread out between buildings and floors," said John Hart, soil science specialist for the OSU Extension Service. "Now we are much more efficient in one location on the third floor of the new building."

The Center for Gene Research and Biotechnology's Central Services Laboratory is centrally located in ALS. The laboratory analyzes and makes materials necessary for much of the genetic, biotechnology and molecular biology research on the OSU campus and other research institutions in the state.

"We now have twice the square footage of floor space than we had in Weniger Hall," said Reg McParland, director of the Central Services Lab. "Being more centrally located, we have more interaction with researchers, and have more work than ever. The new building has allowed us to accommodate this increase in workload. We have become a major facility in the state for protein and DNA sequencing, peptide and DNA synthesis, and amino acid analysis."

"Our amount of work has doubled since we moved into the new facilities," said Russ Meints, director for the Center for Gene Research and Biotechnology, which oversees the Central Services lab. "We are definitely more accessible now."

Interdisciplinary collaboration is more prevalent than ever among Agricultural Experiment Station researchers. For instance, the Department of Agricultural Chemistry's Mass Spectrometry Facility in the basement of ALS is involved in studies analyzing environmental toxins in Arctic flora and fauna. The work is for Larry Curtis, OSU interim head of the Department of Fisheries and Wildlife. Horticulturist Bernadine Strik is cooperating with entomologist Glen Fisher in the study of phylloxera, a grape pest. Researchers in the crop and soil science and horticulture departments are working together to investigate the mineral nutrition of crop plants grown using sustainable agriculture techniques.

There are more opportunities for interaction on the part of students too, said soil scientist Jerry Kling.

"The building was laid out to foster cooperation," said Kling. "Horticulture and Crop and Soil Science now have much more cooperation. We have cross-listed courses between the two departments. This didn't happen before when

we had walls between us and were a couple of blocks apart. Now we see each other every day. The students cross-pollinate ideas and aren't afraid to go to the other department and use the facilities.

"We are creating new integrated degree and research programs."

"When we moved into ALS, we moved from an old decrepit building into the 21st century," continued Kling. "In Strand we had failing hoods and drains and lead-lined sinks. Now we have a state-of-the-art soil science teaching lab. It's a really good building."

"The change between the old and new facility is like the change between old and modern medicine," said Betty Brose. "Before, it was like we were holding people down and operating on them without any anesthetic. Now we have modern tools and medicines that work."

To some, it's the little things in the new facilities that are most appreciated.

"It's nice to be able to walk to the sink and get water that is clear, that isn't rusty," said John Hart, OSU extension soil scientist who moved from Strand Agriculture Hall to ALS. "And it's nice to be able to plug something in and know you are not going to have current fluctuations that might interrupt instrument operation."

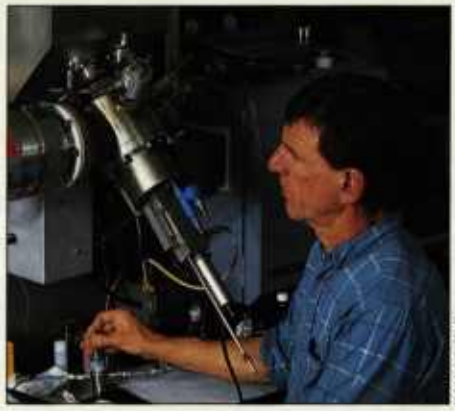
The new building provides sorely needed lab space and graduate student offices to some who previously had none of their own.

"These modern facilities have definitely benefited my research program," said Bernadine Strik, extension berry crops specialist in the Department of Horticulture. "I didn't have my own lab before. And now my graduate students have a place to work and a lab on campus."

Then there's the "domino effect" caused by the new building. Not all Agricultural Experiment Station researchers on campus moved into ALS. Many who stayed behind in buildings that housed the departments of botany and plant pathology, rangeland resources, and entomology and agricultural administration are in the process of expanding and renovating labs and offices in vacated space.

GARY TARLETON

Looking east, Agricultural and Life Sciences sits between Cordley Hall, on the extreme left, and Nash Hall, right. Researchers and students use the greenhouses in the foreground for experimentation.



TOM GENTLE

Senior research assistant Brian Arbogast in the mass spectrometry lab, which serves faculty and students in many disciplines.

"In Cordley Hall, several plant pathologists are now closer to each other in one little block in renovated labs," said Marlys Cappaert, a research assistant who works with Mary Powelson in Botany and Plant Pathology to find new strategies for managing potato diseases. "Before, we were all on different floors. And the sky bridge makes it easier to get over to the new building to interact with other researchers."

"Entomology now has about 6,000 square feet of new office and laboratory space," said Gerald Krantz, former chair of the Department of Entomology. "It has made a big difference in our lives."

CAS Dean Thayne Dutson believes the new building is an investment in the future that will bring rich returns to both OSU and the state.

"Having the new facility makes it easier to do research," said Dutson. "We have better equipment as a result of the new building, primarily through donations. As a result, we are attracting more new faculty. Where we are not very competitive in salaries, something like a new building gives you another piece in your arsenal you can use to get good people to come here. Good people get more research grants and contracts—and they often make the best teachers.

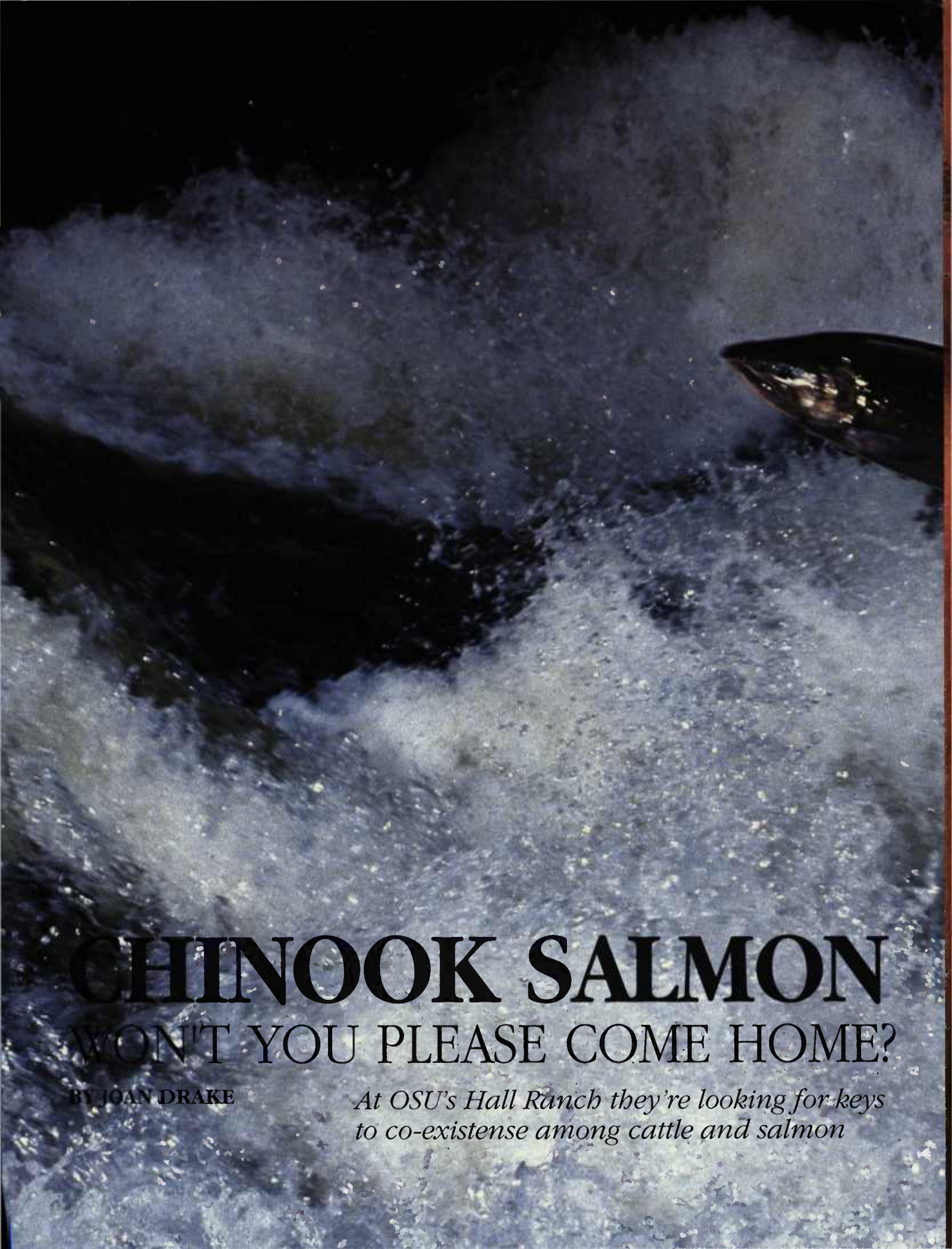
"I think the increase in the number of grants we have gotten is due to the increased interaction the building has allowed," said Dutson, who is also director of OSU's Agricultural Experiment Station. "With Nash, Cordley and ALS together, there are more multidisciplinary opportunities than before. People are writing more grants together.

"And we don't just get the actual grant dollars—we get the benefit of the research that those dollars buy. Our data indicate that just having AES projects here returns about $100 million per year to the state."

Witters, seeing the fruition of his dream, knows an all-around good deal for the state.

"In the new facilities, the students get a better education, OSU gets more research grants and contracts and Oregonians get the benefits of interdisciplinary research."

Carol Savonen is a science writer in OSU's Department of Agricultural Communications.



CHINOOK SALMON
WON'T YOU PLEASE COME HOME?

BY JOAN DRAKE

At OSU's Hall Ranch they're looking for keys to co-existense among cattle and salmon

Eight o'clock on a crystal clear morning in early September. Yesterday temperatures in eastern Oregon were in the nineties, but it has cooled overnight.

Four people follow Marty Vavra along the banks of Catherine Creek, in search of salmon. They carry plenty of gear, but this isn't a fishing party.

Instead, the group has come to take photographs and listen to Vavra, superintendent of OSU's Eastern Oregon Agricultural Research Center, talk about research he has been conducting in this area for 15 years (since 1978). It involves the creek, cattle and salmon.

The headquarters of the Eastern Oregon Agricultural Research Center are at Burns. But the center has a branch at Union, near La Grande.

Catherine Creek flows through the Hall Ranch, a 2,000-acre land parcel about 10 miles east of Union purchased by OSU in 1939, partially with state appropriation funds and partially with money generated from the sale of cattle raised at the Union station.

"It's a very complex stream. It has a lot of deep pools, riffles and large woody debris. It's braided in areas and has separate small channels which are good salmon rearing grounds," explained Vavra. "It typically runs a very high sustained flow of water in the spring, so it changes each year. We don't have a stream that is locked within certain banks. Flood waters in the spring change the channels dramatically from one year to the next."

"Our grazing system allows the areas to proceed very rapidly ecologically."

According to Vavra, prior to 1974 the area was heavily grazed by cattle and the steam was much less complex. "In 1978-79 we removed all the trees in the channel because we and the Oregon Department of Fish and Wildlife (ODF&W) at that time thought that large woody debris was a detriment. Since then we've watched them come back and our complexity gain.

"That's not a condemnation of ODF&W, it's merely saying that our knowledge base has increased and our attitudes have changed as we've learned more over the years on how these systems function," continued Vavra. "It's a really good example of how our perceptions change over time due to our increasing observation and research."

The same is true for cattle grazing. Historically, grazing systems were season long, explained Vavra. There was just one giant pasture that might encompass the entire property boundary and livestock were put there in June and grazed anywhere they wanted until October.

"A lot of times, where they wanted to graze was along the stream. Water was there, green vegetation, it was cool—a nice environment," continued Vavra. "Everybody likes to sit next to a creek and enjoy life and cows aren't any exception."

In 1957 researchers made the first change at the Hall Ranch. They set up a pasture system, where the stream corridor was grazed separately. "They grazed it heavily early in the year through the summer, so they put quite a bit of pressure on the stream-side woody vegetation that cattle will eat as the grass dries," said Vavra.

"So cattle probably didn't impact the steam too much early in the year, but as they ate more of the grass and were still there, they switched to the woody vegetation. They over-consumed. Utilization was too high."

TOM AND PAT LEESON

Page 38, 39: Chinook salmon like this one travel about 600 miles to get to Catherine Creek in northeastern Oregon (photo by Tom and Pat Leeson). Above: OSU range scientist Marty Vavra, pointing out improved vegetation along the creek on OSU's Hall Ranch, says watching a Chinook in the stream is "almost like a religious experience."

In 1978, they switched to a grazing system conceived by Vavra and Bill Krueger of OSU's Department of Rangeland Resources. "We use it (the stream corridor) late in the year. The meadow is sub-irrigated, so the grass is still green. All the birds that live in that community have had the opportunity to nest and fledge their young unimpeded by any livestock movement," said Vavra. "Then we've grazed it late in the summer. Cattle tend to consume the grasses first and don't harm the riparian shrubs."

Riparian refers to the area directly along the banks of a steam—the green area immediately adjacent to water. Typical riparian vegetation includes willows, cottonwoods and wild rose at lower elevations and aspen and alder at higher elevations.

Under Vavra and Krueger's system, calves gain 20 pounds in three weeks of grazing at a time of year when those in conventional systems often are barely gaining at all. The researchers believe there is very little interruption of the natural process of the stream function.

"Our grazing system allows the areas that have been abandoned by the stream to proceed very rapidly ecologically into a complex woody community of black cottonwood, oliver willow and pine, after they have been grazed," said Vavra. "So the new gravel bars that have been formed will succeed into shrub communities.

"Cottonwoods grow very quickly—30 feet in ten years. They become important to birds and wildlife for perching. Or the stream may switch back and undermine their roots and drop the trees into the stream and provide structures that allow the water to drop over and form deep pools," continued Vavra. "It's a very active, dynamic system and we're not interrupting that by cattle grazing."

There is less certainty about the animals' effect on the salmon that spawn in the creek. "Salmon have been spawning on the Hall Ranch forever and we've been grazing cattle there forever. Right now we're trying to document whether the presence of cattle has an impact on the spawning behavior of salmon," said Vavra. "We don't think it has, but we don't know."

To try to find out, last year Vavra, Bill Krueger, Vavra's research assistant Teena Tibbs, Duane West, regional fish biologist with the ODF&W, and Larry Bryant of the Pacific Northwest Forest Range Experiment Station of the U.S. Forest Service began a pilot project. They

BOB ROST

A Catherine Creek Chinook after the long journey from the Pacific Ocean. In late summer the fish spawn and lay eggs in graveled areas called redds.

have been observing as the salmon spawn, seeing if cattle moving through the area scare the fish off their nests, called redds.

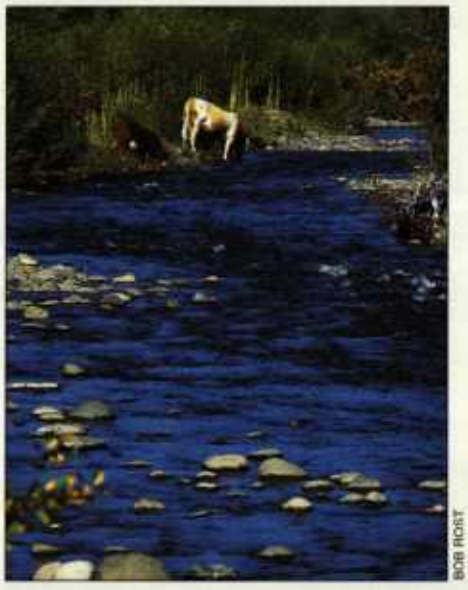
"We're treading on new ground. We want to find the best method possible and try to get techniques down so next year we can approach the project on a much more scientific, quantitative basis," said Vavra.

West has been counting salmon and redds in Catherine Creek each year since the 1960's. He tallies a section three different times during the season to be as accurate as possible. "There's been some pretty big changes in numbers—downward," said West.

He attributes the decline to dams and logging, but added, "I'd just as soon they (cattle) were all off the creeks entirely, myself. I think you can safely say some redds are destroyed by cows walking on them."

About the stream area on Hall ranch, he said "Actually the habitat looks better through that section than it did ten years ago. The stream is braided now and I feel we've got a lot more fish habitat than in the past. The better the habitat, the better chance the fish have of surviving.

"They [the scientists] have done a pretty good job out there. If they were all like that, we would probably be in a lot better shape than we are now," said West. He is particularly concerned about increased logging changing the water quality and timing of the runoff.



BOB ROST

Some worry that cattle damage eggs in spawning beds. OSU range and fish researchers plan to study potential impact.

West isn't the only one with concerns.

"While you can see some good things happening on Catherine Creek, through the Hall Ranch, you still need to put it in context of what the creek was like 50 years ago, when it wasn't exactly a pristine stream," said Bruce McIntosh, a research assistant in OSU's Department of Forest Science.

For his master's thesis McIntosh compared salmon habitat he surveyed in streams in the Grand Rhonde Valley in 1990 to a 1940s Bureau of Fisheries (now the National Marine Fisheries Service) survey of chinook salmon habitat in the valley. Overall on Catherine Creek, McIntosh said, he found a 67 percent loss in pool habitat compared to the habitat identified in the 1941 survey. The loss of pool habitat since 1941 on the stretch through the Hall Ranch was "40 to 50 percent," he said.

"You see some positive things in terms of vegetation coming back on the Hall Ranch," he said. "It's a good start. But we still don't see the complexity in the channel we had 50 years ago. The jury is still out on where it'll end up."

"I'd just as soon they (cattle) were all off the creeks."

McIntosh, who for his doctoral degree is comparing historical data on chinook habitat in the entire Columbia Basin to current habitat, said his major concern about cattle is not that they'll spook salmon but that in crossing streams they'll damage spawning areas where eggs are deposited in late August and remain until they hatch in early spring.

Krueger said he and Vavra plan to conduct a study at the Hall Ranch, with OSU fisheries biologists, to measure the potential impact of cattle on salmon spawning beds.

Chinook salmon return to Catherine Creek in May or June. They have traveled close to 600 miles from the Pacific Ocean—via the Columbia, Snake and Grand Ronde rivers. They have survived the hazards of commercial fishing nets and fishermen in the ocean, illegal drift net fishing in the north Pacific, killer whales, sharks, seals, Indian nets in the Columbia, sports fishermen in the ocean and rivers, dams and fish ladders to reach their destination.

"When you come out here and watch these salmon, it's almost like a religious experience," commented Vavra.

After spending the summer in the stream's deep holes, female salmon build their redds in the gravel of the stream bed. They deposit up to 2,000 eggs, fertilized by males as they are laid in the depressions. Before the spawning fish die, the females cover the eggs with rocks.

On this day the group watches quietly as a female works. "She has already

covered her eggs and now she's. . . I call it fluffing," said Tibbs. "She'll lie there for a while, then she'll flop up out of the water and move the rocks down, then go and rest. She'll go back and do it again about every five minutes."

"So maybe cows aren't that big of a thing?" asks one of the observers. "They probably aren't in most cases, however, if improperly done, where your cattle grazing is impacting stream bank vegetation, spawning grounds can be impacted by grazing cattle," answers Vavra. "There isn't any doubt. Improperly managed cattle can do it wrong—they can hurt it."

"We need to take this approach rather than an either-or tactic."

But he adds, "In the grand scheme of things, cattle are only one small potential problem the salmon face. You can't put all the blame on cows. You have to look at the entire life cycle of the fish."

Vavra expects the study to continue for several years. "There's so much we need to learn about the habits of spawning salmon, the impact of cattle grazing not only on riparian systems, but on upland systems and ecosystem functions, that we're going to do a lot of work on this."

Pointing out a large tree that had fallen into the creek, Vavra said, "There's another chunk of good stuff into the stream. But again, in our new attitude, that causes erosion that will increase bank cutting. But we don't mind that as long as when the stream moves to the right, we have management that allows the gravel bar here on the left to go through secondary succession and have all those willows coming up.

"Now if we had cows in here that chewed that down so there was no vegetation coming up on that gravel bar, that would be improper management. But what we see right here is exactly what we want. It's a functioning system. Cows or no cows, the stream really wants to wander all over the place."

Streams are very different depending on their flow character through the mountains. They can have high sediment, low sediment, high velocity, low velocity, different kinds of runoff, added Vavra.

BOB ROST

Research assistant Teena Tibbs and Vavra study a map of spawning beds in Catherine Creek along OSU's Hall Ranch near Union.

CHARLEY DEWBERRY AND TAD LUECK

Juvenile Chinook salmon. Vavra and range scientist Bill Krueger contend that careful management of cattle on OSU's Hall Ranch the last 15 years has improved living conditions for the salmon that spawn in Catherine Creek.

Also, there are lots of manmade things that effect streams. Roads built along streams lock them in so they can't meander and develop any character, he explained. Also, they get pushed out of the way to create farmland.

"Catherine Creek is a high potential recovery stream; it can heal itself rather rapidly. But every stream system has to be managed as a separate entity. You can't have a broad brush management that will work for every steam in eastern Oregon," said Vavra.

"We can come up with principals of what to look for—a process by which you would evaluate other streams. Our time frame should speed up now that people are concerned, but they need to put their money where their mouth is. Good science costs money and somebody has to pony up the bucks," said Vavra.

"Bill Krueger can tell you this too. We've lived on shoestrings for our entire career because the rest of the world wasn't really interested in this kind of stuff," he added. "And all of a sudden they want to know everything. It's hard to come up with the answers right now when you've never had the resources to come up with the answers.

"What we're trying to do," explained Vavra, "is develop an ecologically sensitive livestock grazing system that doesn't interfere with the results of natural functioning of the ecosystem. In other words, where cattle grazing is a neutral or positive event. It doesn't have any negative impact on what's going on with the wildlife species, the salmon, the stream—the entire environment. That's our whole goal.

"The neat thing is that we're doing it with continued use. We've found a way to make the livestock use compatible with the system. And that's really one of the goals of our experiment station—to work on those kinds of systems. To search for compatibility."

Vavra believes Oregonians who raise cattle are willing to change the way their herds graze. But there are exceptions. Some land continues to be overgrazed. Vavra blames it on ignorance or greed.

"This research tends to indicate that, at least in some cases, we can have compatibility—cattle, salmon and streams," he said. "We need to take this approach rather than an either-or tactic."

Writer Joan Drake lives in McMinnville.

HER WORK FILLS A VOID FOR FARMERS

Like animals, plants catch diseases—for example, vegetable crops suffer from outbreaks of diseases such as soft rot, mold and "early-dying," costing growers and consumers millions of dollars.

Fortunately, Mary Powelson finds the fungi and bacteria that cause these ailments fascinating. During her early college days in Pennsylvania, one of her undergraduate professors encouraged her passion for microorganisms.

"As an undergraduate, I just loved the fungi and algae," mused Powelson, now a professor of botany and plant pathology at OSU. "A professor took me under his wing. I got a job with him identifying diatoms [single-celled plankton] from Lake Erie. He encouraged me to go to graduate school, so I did and I loved it."

Getting her master's degree at Michigan State University in the 1960s, Powelson found she was in the minority.

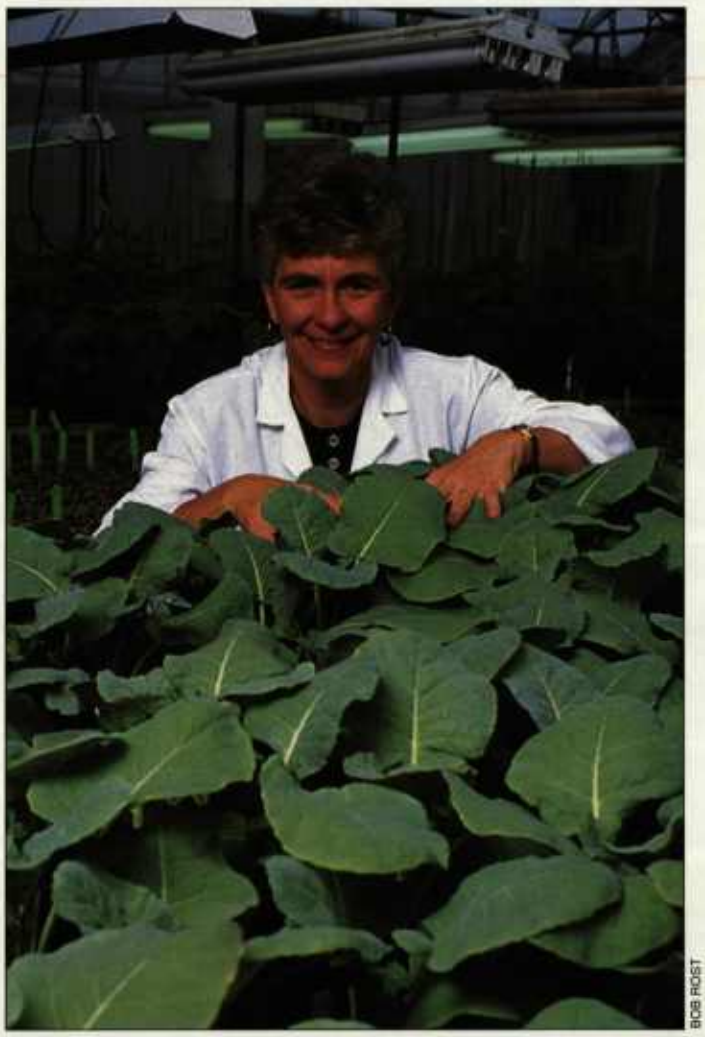
"I was one of the first females in plant pathology there," she said. "We've come a long way over the last 30 years—now about 20 percent of the people in the field are women."

Powelson also thinks she broke new ground during her first teaching position at Central Michigan University.

"I was the first pregnant person on the faculty there," she said. "They didn't know what to make of me—I had my son Mark two days after I gave final exams. Not too many women worked full time at full-term pregnancy in 1963."

Coming to OSU in 1969 to complete her doctorate in plant pathology, Powelson stayed on, first as a post-doctoral researcher with wheat breeder Warren Kronstad, then as an assistant professor in OSU's Department of Botany and Plant Pathology, where she has been since 1978.

Since 1978, she and her colleagues have been figuring out what vegetable growers can do to combat bacterial and fungal diseases. Over the years, she's seen a trend—farming procedures such as soil management, watering and the timing of cropping practices have become increasingly important. Also, environmental concerns about the effects of pesticides are growing among government agencies and consumers.



BOB ROST

Plant pathologist Mary Powelson

A whole cadre of OSU Agricultural Experiment Station and Extension Service researchers, including Powelson, are focusing more and more on integrated pest management (IPM), she said. They are assessing the insect or disease situation and then using an array of methods to fight pests and diseases—from varying the timing and amount of irrigation and fertilizer to changing planting arrangements and rotating crops, as well as using pesticides judiciously.

Powelson hopes her work will ease growers' transitions into a new era with more environmental restrictions. She and her colleagues discovered that reducing and strategically timing irrigation water on potatoes can suppress potato early dying disease, saving millions of gallons of Columbia River water and increasing potato yields by 10 to 15 percent. The need for chemical soil fumigants that are now used to control early dying also may be reduced.

Powelson and her colleagues also have discovered that the timing and frequency of irrigation of broccoli reduces broccoli head rot.

Her newest project involves planting rotations of "green manure." In this case, the green manure is a crop of Sudangrass planted on fallow potato crop land treated with a low rate of a soil fumigant, then plowed into the soil. Then researchers plant potatoes in the same soil. This helps fight potato early dying in research plots.

"We are finding that by planting green manures, we stimulate the microbial activity in the soil," she explained. "Some of these microorganisms can suppress verticillium, the fungal organism that causes potato early dying. The effects of planting green manures can be equivalent to applying chemical soil fumigants."

Powelson sees her work filling a void for farmers who are losing the use of pesticides taken off the market.

"President Clinton's agenda has 75 percent of all farms buying into an IPM program by the year 2,000," said Powelson. "What this means is reduced pesticide use. I think I'll live to see the day that some of the standard chemicals like the soil fumigant methyl bromide and chloropicram will not be used anymore. We somehow have to fill the niche that was provided by pesticides."

—Carol Savonen

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