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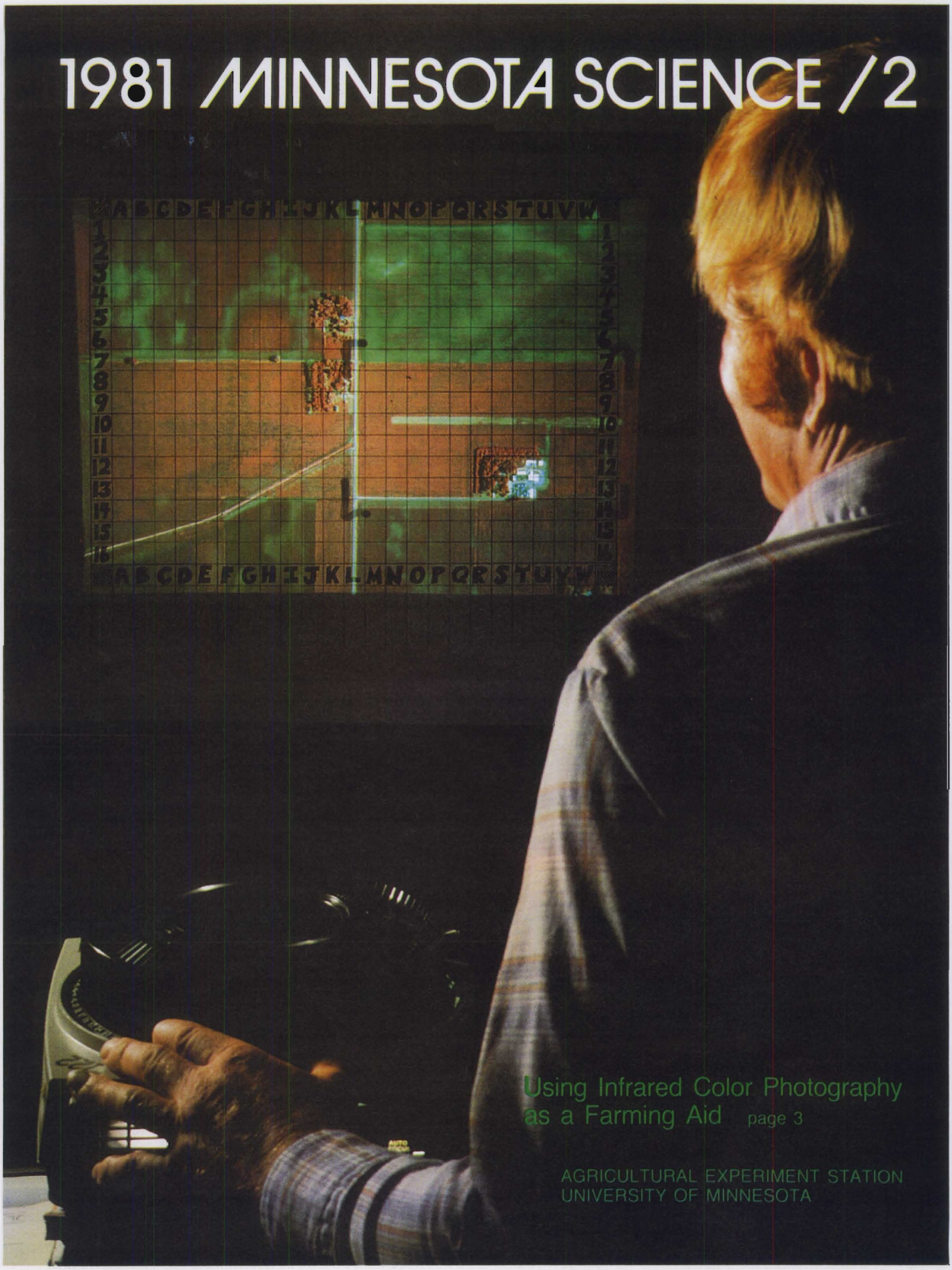

Using Infrared Color Photography as a Farming Aid page 3

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CONTENTS

On the cover: Ray Thorne, Jr., who farms just northwest of Mankato, studies an aerial infrared color photograph of a portion of his cropland. Thorne was one of the 15 southern Minnesota farmers who cooperated in a two-year Agricultural Experiment Station study which explored and evaluated the use of aerial infrared color photography as a farm management aid. See story, page 3.

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Research specialist Bill Johnson of the Remote Sensing Lab demonstrates how he takes aerial photos. He determines camera exposures by coordinating visual sightings of roads, farmsteads, and other landmarks with those charted on a map.

Seeing Cropland in a New Light

EACH YEAR, FARMERS FACE the same frustrating dilemma: at a time when they need information on their crops, they are busiest and least able to gather that information. A management tool that would provide reliable information without having to take time out from tilling, planting, fertilizing, spraying, or harvesting to walk fields would be valuable indeed.

Soil scientist Richard H. Rust has been investigating the potential of one such tool, aerial infrared color photography. His research began in 1976 with some infrared photographs taken by satellite.

"We looked at these images of Minnesota farmland," he recalls, "and thought we could identify large areas of corn that appeared to have been damaged by drouth. We could also tell some areas that were damaged by hail."

It occurred to Rust that this kind of information could be very useful if given to farmers about their cropland in a timely manner. The idea lead him and research assistant Pierre Robert down several paths: to southwestern Minnesota to study methods of tracking drouth stress, to the Red River Valley to do the same under different crop and soil conditions, then to southern Minnesota to develop a method of using aerial infrared color photography to manage crops.

Healthy Vegetation Reflects Infrared Rays

Providing timely information to farmers through a simple, inexpensive method is the goal of the research. Fast-growing, healthy vegetation reflects infrared rays very well, while stressed, dying, or dead vegetation does not. Consequently, infrared color photography can distinguish between what is growing properly and what is not, a meaningful distinction for a farmer.

The first test of the value of aerial color infrared photography is whether it can reveal information sooner than a farmer can see it in the field. The moisture stress research in southwestern Minnesota addressed that question, among others.

For three years, flights were made over 12 representative tracts of cropland at selected times during the growing season. In the plane was Bill Johnson, from the university's Remote Sensing Laboratory, who took color infrared photos to document any possible cases of moisture stress. Soil scientists from the Soil Conservation Service, the West-Central Experiment Station, Morris, and the Southwest Experiment Station, Lamberton, took soil samples from the sites that were photographed. The water content of each sample was determined to verify interpretations of the aerial photographs. Meanwhile, laboratory tests were conducted to determine how differing degrees of water stress and plant and foliage structure affected the ability of corn and soybean plants to reflect infrared rays.

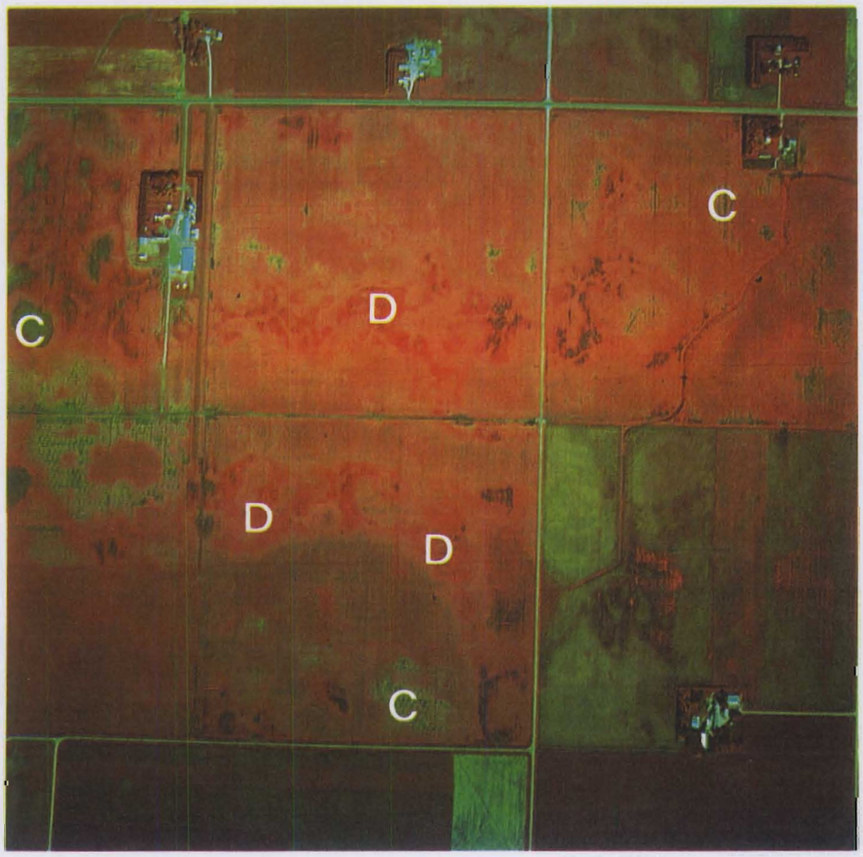
Rust says the field and laboratory tests indicated that "a plant will probably evidence some stress in thermal and infrared before one sees it visually."

Adds Robert, "With this information, we can tell farmers when drouth stress is developing and suggest remedial action to those with more susceptible landscapes. If they know in time, they could perhaps turn over their crop and plant a more tolerant one, such as sunflowers."

Satellite Photos Lack Sufficient Resolution

At first, Rust and Robert worked with imagery taken by LANDSAT satellite, provided by a laboratory in Sioux Falls, South Dakota. But because of delays in getting the imagery and because each satellite photo covered 10,000 square miles—with lower resolution than they wanted —they opted for 35mm aerial photography at lower altitudes over individual fields. Film could be developed within a week, and each frame, taken from an altitude of 8,200 feet, encompassed only 534 acres.

One advantage of infrared film in aerial photography is its ability to penetrate haze, a common summer phenomenon. Cloud cover, however, renders it



In the Nicollet County infrared photo above, taken in July 1980, stunted, chlorotic soybeans growing in high-lime areas (A) and where erosion has exposed the alkaline subsoil (B) are evident. In the Waseca County photo at left, taken in September 1979, poorly drained areas with excess soil moisture (C) are dark green. Patches of vigorously growing weeds (D) show up as darker red areas in the maturing soybean fields.

useless, unless the clouds are high enough so the plane can fly under them. The procedure requires careful planning but it is not difficult to do. The important part is knowing how to correctly translate the information revealed in the infrared images.

Information gained from the drouth stress studies led Rust and Robert to thinking about how the method could be used for "biosensing," to track the growth and health of a crop throughout the growing season. For the past two years, they have worked with 15 southern Minnesota farmers, photographing their croplands in a series of flights beginning before planting

and ending after harvest.

An obvious advantage of aerial photography is the perspective it offers. As Robert points out, "Aerial photography gives you a much better area evaluation of a problem than when you see it from the ground. For example, it's difficult to see past the first row of a corn field in the middle of the growing season. Besides, many farmers have told me they don't have time to go out in the field and check crop conditions even if they could do it from the ground. But by looking at the aerial photos, they can pick out any possible problems very quickly."

Aerial Photos Provide a Variety of Information

"Some information in those photos can help the farmer immediately," Rust explains. He cites bare spots or weedy patches that indicate skips by malfunctioning planting or herbicide applicator equipment.

Other information may help a farmer make decisions on next year's crop: the density of planting, what crop and even what variety to plant. If the photos reveal drouthy soils, the farmer can aim for a lower corn plant population, which demands less water. If a soil is poorly drained, he can plant a crop that is more tolerant to "wet feet" or improve drainage. And if iron chlorosis is a problem, he can plant a soybean variety that is more tolerant to high-lime soils.

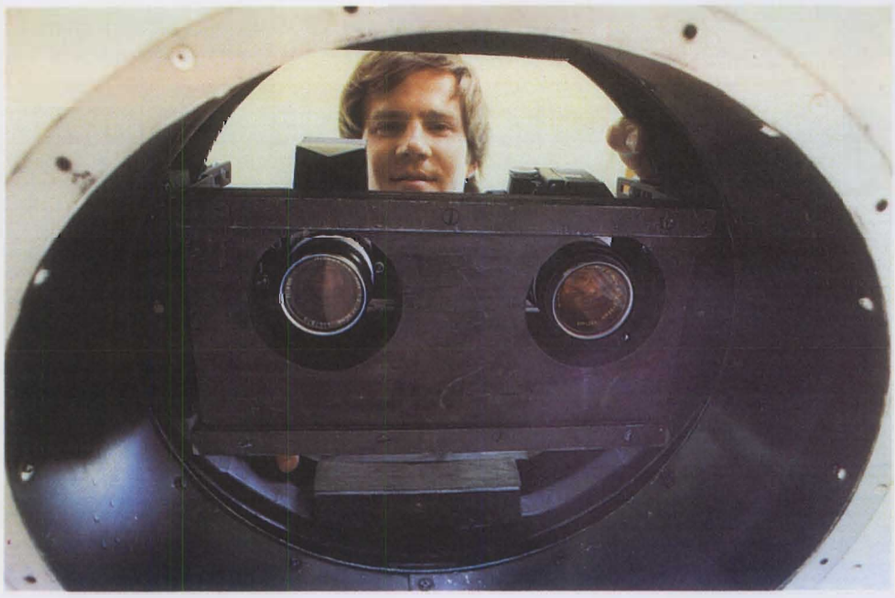
Says Ray Thorne, Jr., a Mankato farmer who participated in the final year of the study, "To be of real use, you have to have the photos soon after they're taken to be able to react to them." He recalls being puzzled by one spot on an infrared photo that showed poor soybean growth. "I'd forgotten that I'd put atrazine and oil on one corn field as a rescue measure," he says, "and what was showing up was really herbicide carryover."

Thorne sees another use for the photos: "If a person knew how to interpret the photos and had a set to view of land he was going to rent, he would have a clue where to avoid planting soybeans, where to plant a chlorosis-resistant variety, or where the low spots are and tiling might be needed."

How often should flights be made to provide enough information? "The farmers we've been working with in the past two years advise four to five times a growing season," Rust replies, "once before planting, then at crop emergence, before harvesting, again after harvesting, and possibly any time any special problems arise, for example, after heavy rain, to check for erosion."

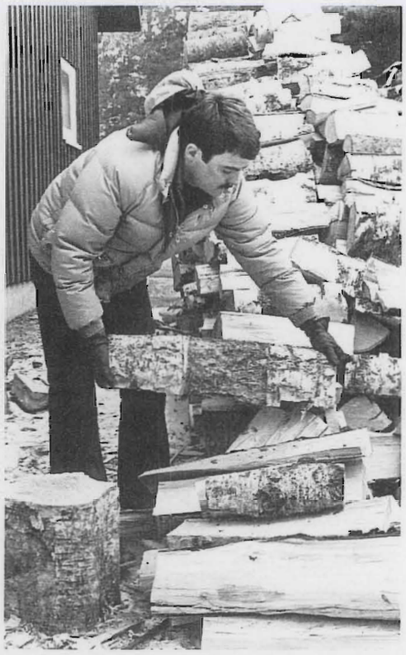
To the untrained, the aerial color infrared photos reveal only cryptic shades of pink and green. But to those who can interpret them, they yield much meaningful information. LANDSAT imagery offers water and land resource information from a continental perspective. The idea transposed to a smaller scale can provide farmers with practical information on which to base sound crop management decisions.

—Jennifer Obst



Seen from outside, below the plane's "belly hole," Johnson sights through the camera view finder. He takes photos with two cameras simultaneously, with infrared color film and with normal color film.

Buying Insulated Outerwear: Playing a Guessing Game



Light weight and warmth makes insulated outerwear popular with Minnesotans, who find it ideal for cold-weather chores and recreation.

WHEN THE TEMPERATURE DROPS, Minnesotans bundle up. Whether working or playing, they often don insulated outerwear—garments that consist of two layers of fabric enclosing a layer of down or synthetic insulating material.

Just how warm are those insulated jackets, vests, coats, and mittens? With the variety of styles, fabrics, inner construction, and insulation available, do Minnesotans, as consumers, know which garment is best for activities such as skiing, winter camping, or doing outdoor chores?

"A number of people are confused about terms, definitions; about the advantages or disadvantages of the garments on the market," says Sherri A. Johnson, instructor and extension specialist in textiles and clothing.

Johnson's observation is based in part on a study she and departmental colleague Ruth E. Franzen recently completed for the experiment station. They investigated the types of insulated outerwear available in nonmetropolitan stores and how rural consumers shop for, use, and clean these garments. For their study, the researchers chose Grand Rapids, with its predominantly rural clientele, extreme winter temperatures, and varied outdoor winter activities.

In the market survey they conducted in the north-central Minnesota city, the researchers found 48 different men's all-purpose insulated jackets that varied widely in fabrics and insulation materials used, design, price, and labeling information regarding thermal value and care recommendations.

The fabric used in most of the jackets was either nylon or a cotton-polyester blend; the insulation, polyester fiberfill or down.

The researchers found a tremendous variety of design features. Examples of features that help insulate the wearer are a drawstring or other fitted waistline treatment, adjustable cuffs to control fit at wrists, inside sleeve cuffs, a wind flap over or under the zipper, and an outer third layer of smooth fabric with a separate insulated baffled or quilted lining. These were features some of the jackets available to Grand Rapids shoppers had while others did not.

No Correlation Was Found Between Price, Probable Warmth

Prices of the jackets ranged from $25 to $195. There was no correlation between the price of a jacket and the number of warmth-related design features it had, the researchers concluded. Nor was the price indicative of probable warmth value.

The study clearly evidenced the need for standardized measurement and terminology to convey information about warmth value.

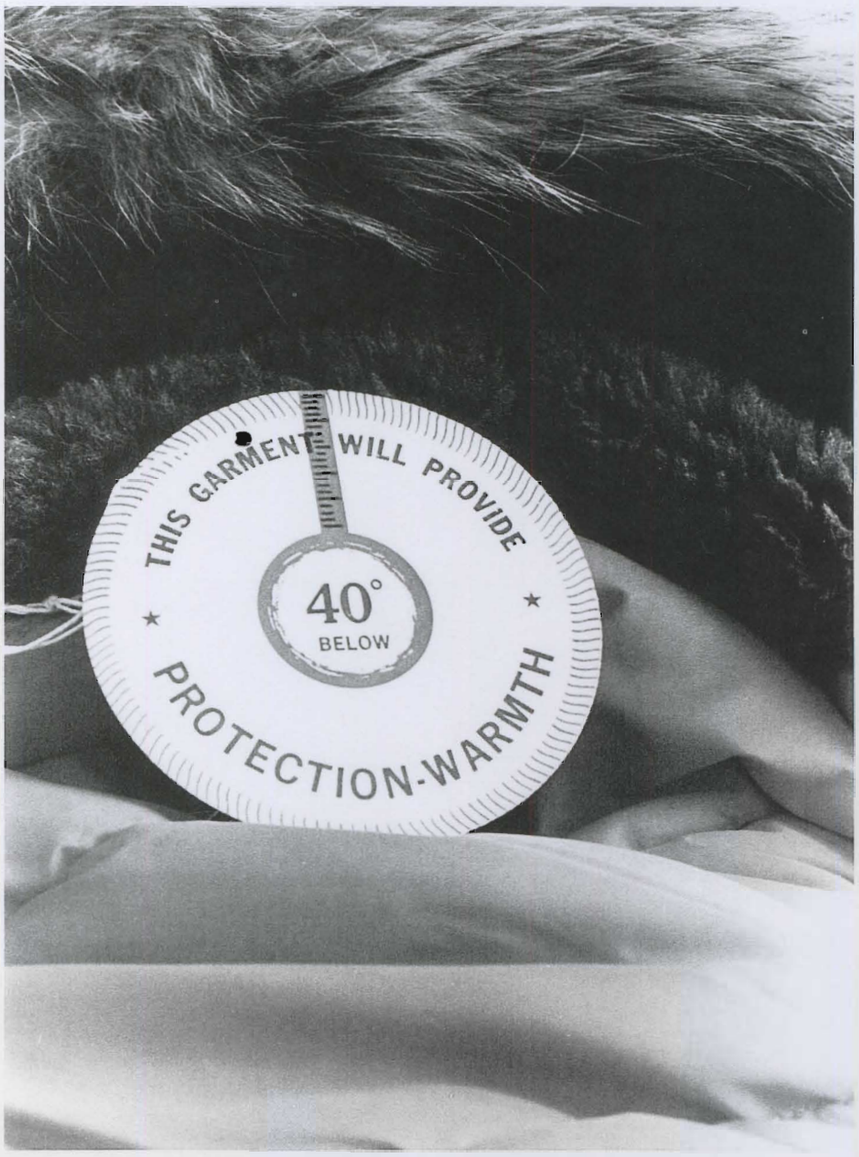
Garment labels carried no information that would help a consumer evaluate warmth. While some of the jackets had features that offered more protection from the cold than others—such as pockets with side openings for handwarming—their labels did not explain the advantages of these design features. Often, the labels carried phrases with meaningless implication: "light weight, efficient warmth," "superior warmth," "protective

warmth," "warmth without bulk," and "designed for cold weather."

Also, the labels did not give thermal insulation values for fabrics and fabric assemblies—the combination of outer fabric, lining, interlining, and insulation. "Thermal insulation is provided by the materials used and the garment design," Franzen explains. "There were no thermal insulation ratings on the jackets by which the insulation values of fabrics could be measured and compared."

Franzen and Johnson also surveyed rural consumers to discover how they shop for and clean jackets and their reasons for choosing what they do. All but one of those surveyed owned at least one insulated outerwear jacket. More than half spent as long as four hours each weekday and four to eight hours Saturday and Sunday outdoors doing chores or enjoying winter sports. And while a majority had their jackets professionally dry-cleaned, 39 percent machine washed their jackets and either machine or line dried them.

When asked what features they considered important when choosing a jacket, the consumers' five most common answers were design or style, warmth, fit, color, and lightness in weight. The survey participants were much more discerning when responding to a check list of features near the end of the interview. "Most of the people surveyed did not identify insulating characteristics when just shown the garments," Franzen says, adding that they could rate their importance after the characteristics had been pointed out. Thus, the researchers concluded that consumers need to be made aware of how garment features affect warmth.



Garment labels offer little help to consumers shopping for insulated outerwear; they often carry phrases with meaningless implication. The labels neither explain how garment features contribute to warmth nor do they give thermal insulation values for the fabrics and fabric assemblies used.

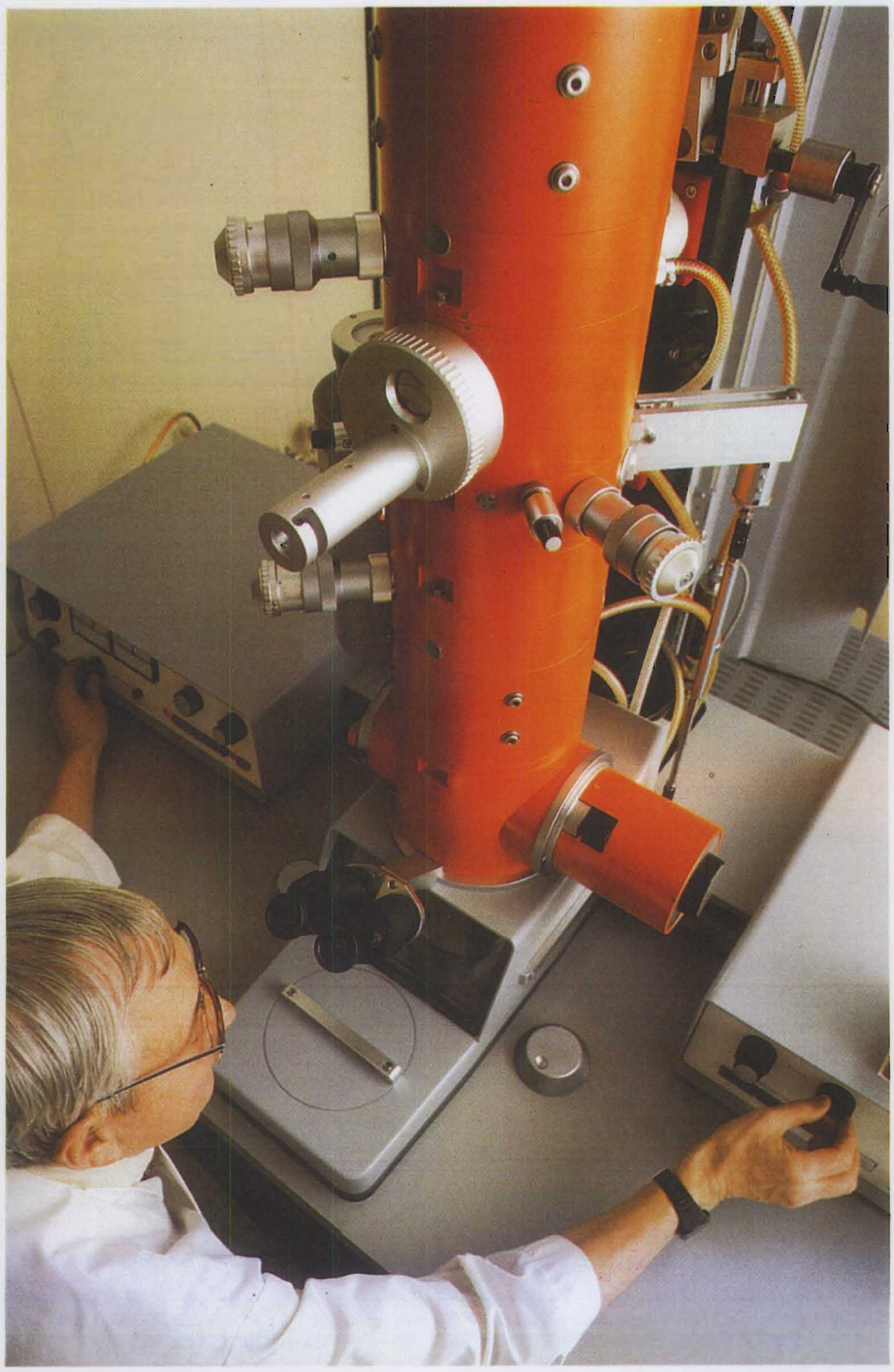
More Useful Information Needed on Manufacturers' Labels

In summary, the study showed that while not all insulated jackets are created equal, their labels—because of a lack of useful information—are of little help in enabling consumers to select garments that best fit their needs. "Manufacturers need to be aware of the differences in the thermal value of the factors that vary in the garments—materials and design," says Franzen. The study also suggested that educational services should be doing a better job of providing consumers with information on which to base buying decisions.

Franzen and Johnson would like to expand their research to include other garments, more people, and more locations in Minnesota. They would like to see a laboratory study done to measure the thermal characteristics of various fabrics, fabric assemblies, and garment designs as well as actual wear studies on these variables. Such information would be useful to manufacturers and consumers.

—Gail Tischler-Marko

Electron Microscopy Sheds New Light on Bovine Viral Disease



ALVIN F. WEBER FOCUSED on a round, fuzzy object silhouetted against the green light emitted by the electron microscope. It looked harmless enough—magnified 50,000 times and yet smaller than an "o" on this page.

But looks can be deceiving, and this and other bovine leukosis virus (BLV) particles cause a disease—enzootic bovine leukosis, better known as bovine leukemia—that kills thousands of cattle yearly in the United States. Progress in controlling the disease has been slow, partly because of the difficulty of identifying the status and extent of infection. But Weber, a veterinary biologist, has developed a test that he believes can help speed control when coupled with a serological test.

The BLV causes many economic losses. Dale K. Sorensen, another University of Minnesota veterinary medicine researcher, estimates that losses due to death and the cost of veterinary services amount to about $7 million annually in the United States. And that's only the tip of the iceberg. Many countries allow only the importation of leukosis-free breeding stock and semen from leukosis-free bulls. Since the United States has no regular BLV testing program, millions of dollars of potential

Veterinary biologist Alvin F. Weber focuses the electron transmission microscope as he searches for virus particles in the white blood cells of a cow suspected of having enzootic bovine leukosis.

exports are lost each year. Reduced thriftiness, reproductive efficiency, and milk production of infected animals account for other losses to farmers.

The BLV's infectious nature and its unremitting spread from herd to herd makes accurate identification essential if bovine leukemia is ever to be controlled. The virus invades the lymphocytes (white blood cells) that comprise an animal's infection-resisting system. Standard serological tests are commonly used to tell whether the immune system has ever been activated in response to a BLV invasion. If it has, the blood will contain antibodies specific to the virus.

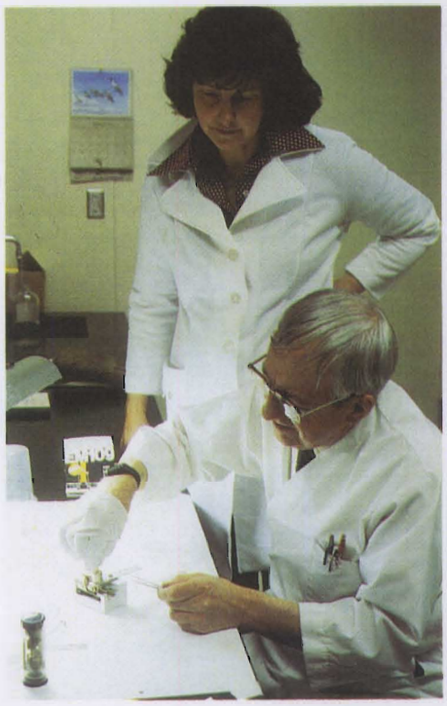
Serological Tests Can't Tell If an Animal's a Carrier

Although the presently available serological tests are rapid and relatively inexpensive, Weber says they have limitations.

He points out that the tests do not discriminate between past and present: "You still have antibodies for childhood diseases from which you recovered long ago. So, too, (it is with) a bull or cow that contracted the virus and yet was able to throw it off."

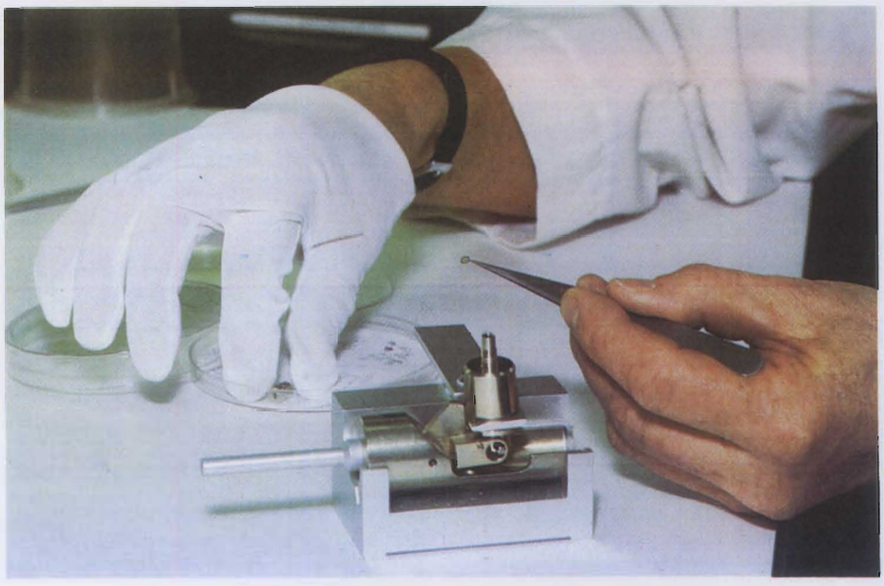
Responding to the need to distinguish animals that have overcome BLV infection from those that are becoming victims, Weber developed his test. It employs electron microscopy and is based on morphological differences between normal and BLV-infected lymphocytes.

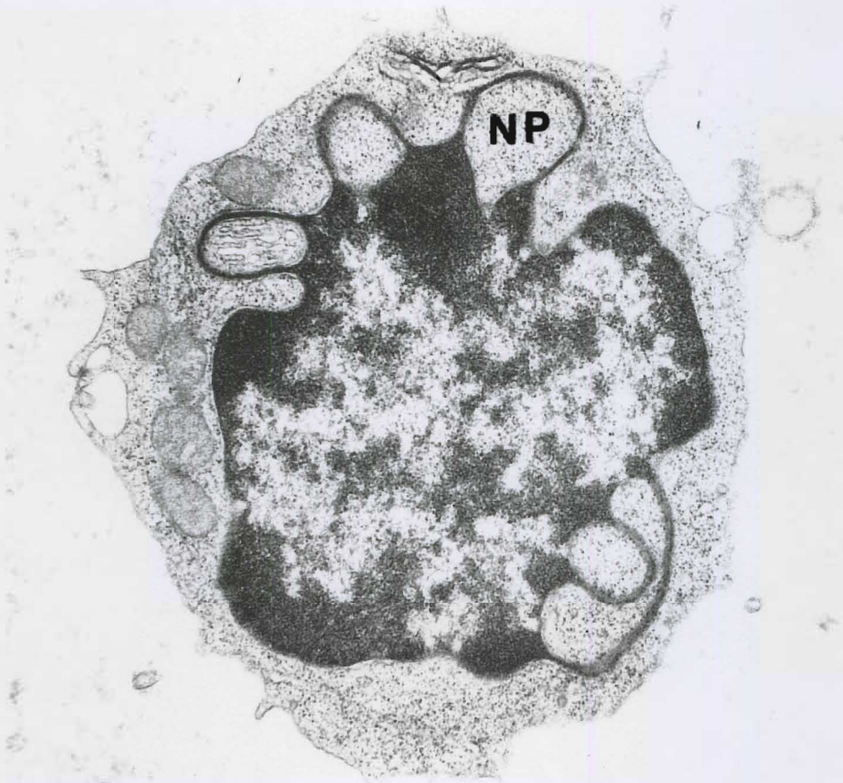
In Weber's diagnostic test, a blood sample is first drawn. After the lymphocytes in the sam-



At left: Assistant scientist Marion Wagner watches Weber prepare a section of lymphocytes embedded in plastic for examination under the electron microscope. The section will be placed on a copper grid before it is inserted in the microscope.

Below: The fine copper grid at the end of the tweezers holds thousands of bovine leukosis particles. Silk gloves help prevent contamination of the electron microscope's chamber, where electron flow is used to produce an image.





The lymphocyte in this micrograph, enlarged 12,000 times, contains several lymphocyte nuclear pockets (one of which is labeled NP). These bodies are six times more likely to occur in infected cattle than in cattle free of bovine leukemia.

ple are separated from the other blood components in a centrifuge, they are embedded in plastic. A diamond knife is then used to slice the lymphocytes into slivers ten-thousandths-of-an-inch thin that can be examined under the microscope. Under magnification, infected cells can be seen to contain structures called "lymphocyte nuclear pockets" (LNPs), which might contain BLV particles.

LNP prevalence, Weber says, may indicate better whether an animal is or ever was infected than a positive serological test. In a recent study, he used both serological and morphological tests to identify BLV infection in 554 cows and bulls and compared the results. He found a positive, though weak, correlation between LNP level and the results of serological tests.

"There remain at least two questions," says Weber, "both related to the weakness of the association. First, how can we reconcile the presence of LNPs, and indeed quite high levels of LNPs, with the absence of evidence for BLV antibodies?"

The answer, he surmises, is that the infected animal has repressed BLV activity within its lymphocytes. Since this animal would not be identified by the standard serological tests, it would escape culling and continue as a possible source of disease for healthy cattle. Weber's test, on the other hand, would show the animal to be highly infectious because of the presence of LNPs, and this would allow it to be isolated.

The second question is, "How can we reconcile very low LNP levels with high seropositive values?"

"Perhaps," Weber conjectures, "this finding of seropositive animals with low LNP levels signifies the infected-immune state and, equally important, the relatively noninfectious state. That's a perfectly healthy animal, but the proponents of the standard tests would mistakenly send it to the packing plant."

Breeds Vary in Resistance to Bovine Leukosis Virus

Another factor is a difference among breeds in susceptibility to the BLV. This and the predominance of Holsteins in Minnesota's large dairy industry may account for an incidence of bovine leukemia deaths in Minnesota that is twice that of most other states.

The BLV infects dairy cattle more frequently than beef cattle and there's a difference in susceptibility among dairy breeds as well. Dale Sorensen studied data from Minnesota and other states and observed, "The frequency of cases in Guernseys and Brown Swiss was significantly lower than expected. On the other hand, (the) Holstein, Jersey, and Milking Shorthorn (breeds) had a significantly excessive rate of the disease." Research in genetic re-

sistance may eventually reveal why some breeds resist BLV infection better than others.

A final concern is the BLV's possible effect on humans. A virus is suspected of causing human leukemia, and this has prompted the question whether the BLV may cause human leukemia. Reports from several countries suggest an association between enzootic bovine leukosis and human leukemia.

Human lymphocytes have been infected in the laboratory with BLV, but William Krivit, head of the university's Department of Pediatrics, says, "There is absolutely no proof that human leukemia is associated with bovine leukosis." Pediatric oncologist William Woods concurs to an extent. "It's a huge leap of faith from cell culture to the living human body," he says, but he does not rule out the possibility of a connection. He refers to a 1980 University of Iowa study of data collected in Iowa. It concluded that there is a high positive correlation between the incidence of acute lymphoid leukemia in males and cattle density. The study also showed a positive relationship between Iowa counties with excessive acute lymphoid leukemia and the presence of dairy herds with lymphosarcoma.

Whether or not there is a connection, an effective control program is needed for enzootic bovine leukosis. A mandatory surveillance program would reduce economic losses, but more research is needed, on the virus, on genetic resistance, and in devising new diagnostic tests. Alvin Weber's work is a step further along the road to bringing the disease under control.

—Norm Sherman

Bovine Leukemia: Unpredictable

THE UNPREDICTABLE NATURE of enzootic bovine leukosis complicates its diagnosis and control. The bovine leukosis virus (BLV), which causes the disease, invades and lives in the lymphocytes of cattle. These are the white blood cells that manufacture immunoglobulins, disease-fighting proteins that are common to all animals.

To date, BLV particles have not been found in egg and sperm cells, evidence that bovine leukemia is not transmitted genetically. However, the virus can be transmitted from a cow to her unborn calf when BLV-infected lymphocytes cross the placental wall and invade fetal tissue. About 20 percent of the calves of infected cows are born infected. Infection can also occur after birth, when a calf drinks the milk of its infected dam.

Many BLV-infected animals carry the virus for life, yet some of those with latent infection remain healthy and appear normal. If the latent infection develops into one of the more serious forms of bovine leukemia, it is generally when an animal is three to eight years old.

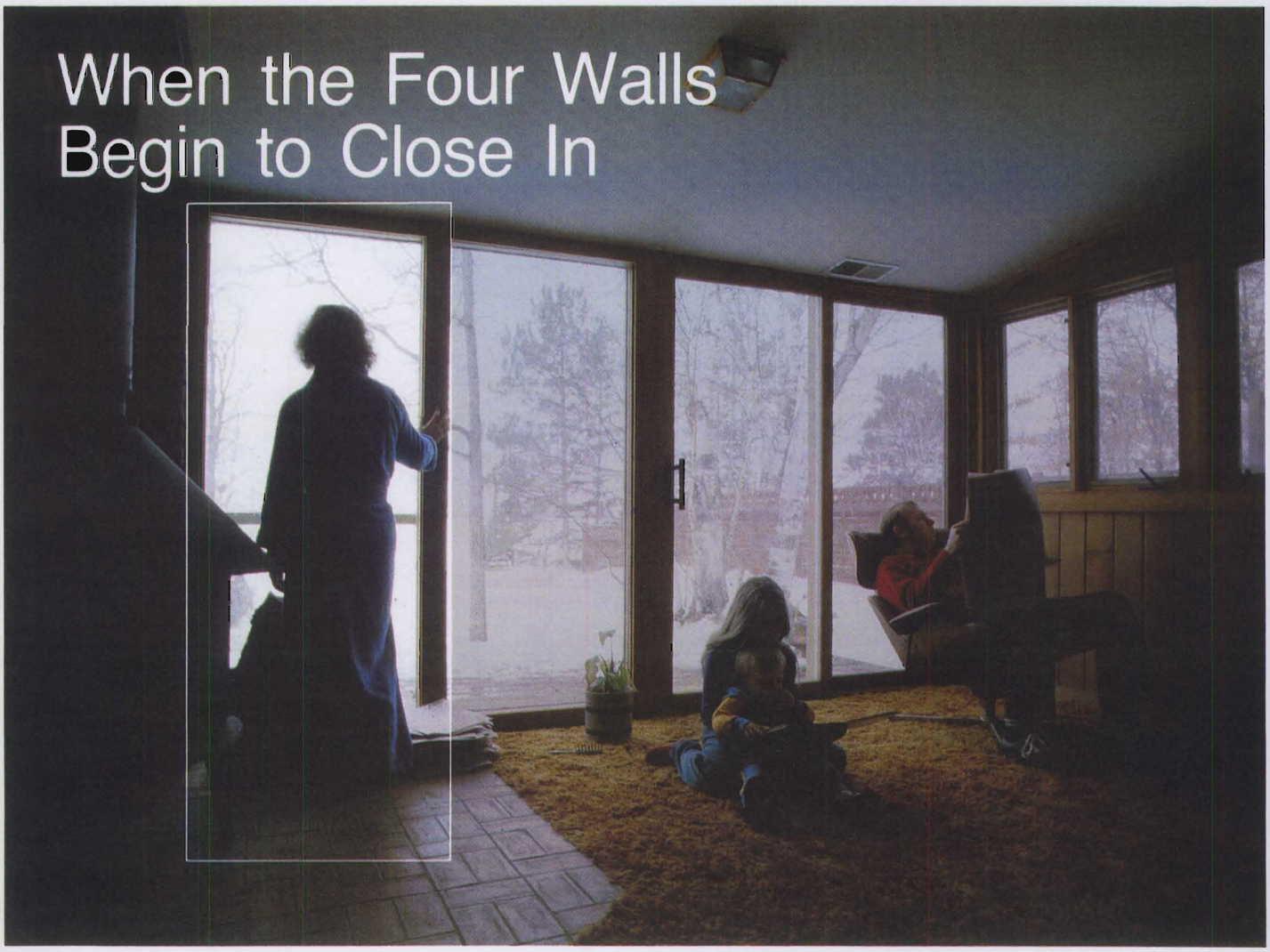
Some of the animals with latent infection develop lymphocytosis. Although these cattle produce abnormally great numbers of lymphocytes, some of them continue to grow and produce normally. However, about two-thirds of the cattle with persistent lymphocytosis develop lymphosarcoma, which is invariably fatal.

Animals with lymphosarcoma are beset by tumors and lesions and often die within weeks of the development of these cancerous bodies. The tumors and lesions occur primarily in the lymph nodes and less frequently in the abomasum (fourth stomach), uterus, and heart. Symptoms of lymphosarcoma include weight loss, decreased milk production, anemia, and emaciation.

Because the BLV is transmitted by direct contact between animals or when the blood of an infected animal is mixed with that of an uninfected animal, dairy and beef producers can take several measures to help prevent the spread of enzootic bovine leukosis.

"Primarily, it's a matter of good herdsmanship," says Alvin Weber. Disease control practices that aid control include spraying for flies in barns, using clean needles for each injection (veterinarians should heed this precaution also, Weber advises, because "there is an eight times greater chance of transmitting the virus by reusing a needle"), taking care not to draw blood in dehorning or handling, and not subjecting cattle to excessive crowding.

When the Four Walls Begin to Close In



Cabin fever can strike at any time, not just in winter. The best way of coping with it is by recognizing it in yourself or others and adjusting to the situation.

YOU'RE BORED. Edgy and irritable. Restless and dissatisfied with being at home. Maybe even claustrophobic. Yet, you are immobilized by a pervasive feeling of inertia. You've got "cabin fever."

Most Minnesotans would recognize the symptoms; they've had cabin fever or know others who have suffered through it. Cabin fever strikes most often during our long, often severe winters, but it can get a person down any time during the year. And although Minnesotans may joke about cabin fever, several University of Minnesota researchers are taking it more seriously.

While the occurrence of cabin fever may be predictable for some people, not so predictable, the researchers have found, is how people get cabin fever, how they cope with it, and how it affects their relationships with family members.

Family social scientist Paul Rosenblatt and research assistants Roxanne Anderson and Patricia Johnson interviewed 35 Minnesotans in late summer 1979 and late winter 1980—times of the year when they expected that people would be most likely to experience confinement, restrictions on their mobility, and monotonous home or work situa-

tions. Their goal was to gain insight into how people control their emotions when they experience difficulties in their relationships with others, how they help themselves in such situations, and the influence family members have on each other.

Cabin Fever Often Involves the Entire Family

"We started out thinking of cabin fever as an individual problem, and people more or less pushed us away from our prejudice," Rosenblatt says. "We found that cabin fever affects relationships, that it's dealt with by relationships, and that it's caused by relationships, particularly for women with small children. But having a moody spouse is also a way of getting cabin fever.

"It's clear that cabin fever is not only a matter to deal with in yourself, but a matter to face when others interact with you."

The researchers found that people react to cabin fever in a variety of ways. For some, there is confusion or bewilderment. Says Rosenblatt, "Some people we interviewed blamed themselves for their spouse's cabin fever—they thought it was caused by something in the relationship. They'd feel guilty about doing something that might not even be responsible for their partner's depression."

More than anything, the study showed that Minnesotans are resourceful in dealing with cabin fever. "Although there are people who may need outside help with a problem like cabin fever, it seems clear that self help is common and that people see alternatives for coping," Rosenblatt says. "Some people we talked to could anticipate when they were going to have cabin fever and they talked about planning ways to cope with it. People who know that their kids will be home from school for two weeks at Christmastime stock some games or plan a couple of excursions. Others stock up on books or save up chores to do.

One Man's Food Can Be Another's Poison

"However," he notes, "some people's means of coping are for others a source of cabin fever. For example, routine may be a source of cabin fever, but in the form of keeping busy, it may be a means of dealing with it."

The study also showed that some people are less susceptible to cabin fever than others. Some of those interviewed said they knew *others* who came down with cabin fever during cold weather, but these people typically enjoyed the cold or snow-related activities or they were true Minnesota stoics, so accustomed to adapting to bad weather that they did not even recognize the inconveniences, much less succumb to cabin fever.

But what about those who cannot escape cabin fever? A good way to head off tense interaction in the family, Rosenblatt points out, is to give the sufferer a wide berth. A temporary change of scenery or a break in routine may help also. "Getting a social comparison, like calling a friend, is one way people end up not feeling so bad," he adds.

Perhaps Minnesotans have consciously or unconsciously built their society with some understanding of the needs of cabin fever sufferers. "You see the richness and variety of what is offered here in Minnesota for entertainment in the winter," Rosenblatt says, "and I think it's no accident."

The social scientist also suggests that a better understanding of cabin fever may lead to better social policy and leisure use decisions: "People need places to go—that's one way of dealing with cabin fever. . . . And maybe if we think about helping more, we could make the domed stadium (in Minneapolis) not a football stadium, but a park, where people could bring their children! As far as community planning is concerned, maybe more services should be provided for the elderly on Sundays rather than just on weekdays, things like more public transportation.

"I would stress the normality of cabin fever," Rosenblatt says in summary. "There's nothing wrong with you if you have those feelings. Even the inertia people get is normal. Though many people may be able to help themselves out of the doldrums, others may be stuck because they feel too inert to do something even when they can conceptualize a possible means of coping.

"The self-help angle is important. It's being able to recognize cabin fever in yourself and people around you and adjust for it."

—Dave McAllister

Science Notes

WITH HIGH BUILDING COSTS, FEEDERS MIGHT CONSIDER OPEN LOT BEEF HOUSING

Many Minnesota farmers keep feeder calves in open lots until cold weather, then they either empty the lots or use protective housing. But judging from the results of a three-year station study, the year-round use of open lots for feeder calves may be a very attractive alternative from an economic standpoint, considering today's high building costs.

In the study, conducted at the West Central Experiment Station at Morris, the gains of yearling steers and heifers fed in five housing systems were compared. In addition to an open lot, cattle were fed in cold and warm slat confinement units, a bedded confinement unit with a manure scrape system, and a conventional open shed with outside feed bunks.

Superintendent Ralph E. Smith, says, "In the summer, the open lot was equal to other systems." And while he notes that the daily gain and feed efficiency of both steers and heifers declined in winter in the open lot, the steers' performance was affected less by cold weather.

"We're not sure why, but heifers may not tolerate temperature extremes as well as steers," Smith says.

However, for farmers who do not have beef confinement units, any savings realized in gain efficiency by housing feeder calves inside during cold weather may not offset the cost of putting up housing.

—Jack Sperbeck

VITAMIN E IMPROVES TURKEY SHELF LIFE

High levels of dietary vitamin E significantly improved tissue stability and the refrigerated shelf life of fresh processed turkeys in a one-year station study, a joint effort of the Food Science and Nutrition and Animal Science departments.

With increasing consumer interest in buying fresh birds and some groceries having them available daily or several times a week, year round, research into keeping quality gains importance.

Food scientist Paul B. Addis explains that a type of rancidity can occur in the lean portion of meat, either before or after cooking. This off-flavor (a sort of warmed-over taste) can develop when the unsaturated fat of turkey comes in contact with oxygen while under refrigeration or out on a kitchen counter.

Turkeys don't absorb or store vitamin E in their tissues as well as chickens. Soybean oil, an excellent source of vitamin E, does not offer enough protection to totally block rancidity in turkeys.

In the study, diets containing a variety of dietary fat sources laced with three different levels of vitamin E were fed to turkeys. At 14 weeks of age, the birds were processed. Half of each bird was kept in a cooler for three weeks and the other half was kept frozen for 25 weeks.

One of the diets, the one with 300 international units (IU) of vitamin E per kilogram, appeared to control rancidity in fresh birds and reduced the extent of rancidity in birds which were cooked after frozen storage. The four scientists involved in the study, C. E. Rethwill, T. K. Bruin, P.E. Waibel, and Addis, report, "It would appear that due to the relatively poor absorption of vitamin E by turkeys, continuous incorporation of a higher level may be required to give the stability desired for marketing fresh and further processed turkeys."

Waibel, an animal scientist, said at least one company that manufactures vitamins has expressed interest in the study. A company spokesperson suggested that it might cost about ¼ cent per pound of bird to feed turkeys a concentrated vitamin diet in the last few weeks before slaughter. In the station study, the 300 IU/kg diet was fed for a longer time, which would add an estimated 1 cent per pound of gain to feed costs for hens and toms. That would be too costly for growers to consider, Waibel said, as they are happy to make a 1-cent-a-pound profit in some years.

But with further study, station researchers may help rewrite the sentiment that often starts, "I like turkey, but having it around two or three weeks..."

—Mary Kay O'Hearn

WEEVIL MAY LIMIT HERBICIDE'S ABILITY TO CONTROL QUACKGRASS

A weevil may be the reason why glyphosate (Roundup) herbicide doesn't control quackgrass completely, experiment station researchers have found.

Weed scientist Donald Wyse, graduate student Philip Westra, and entomologist Edwin Cook noticed that all the life stages of the weevil, *Notaris bimaculatus,* were associated with quackgrass when they examined quackgrass rhizomes from fields near Roseau that had been treated with glyphosate. They found that the weevil's larvae sever some of the rhizomes from the shoots, thereby preventing translocation of the herbicide from the aboveground portions of the plant to all the rhizomes.

Wyse says, "This is the opposite of biological control. It's biological protection of the quackgrass."

Quackgrass control with glyphosate ranges from good to excellent, but rarely is complete, Wyse says. Although the herbicide works well in sod renovation programs, incomplete control leads to quackgrass reinfestation in a few years.

"This is a special problem for northern Minnesota farmers who produce Kentucky bluegrass and timothy seed in perennial sod fields that are commonly left in production for 5 to 10 years," Wyse explains.

No mechanical or chemical techniques are available to selectively remove quackgrass from such fields, but the researchers have found that better quackgrass control can be achieved when the weevil is controlled with a soil-applied insecticide two months before applying the herbicide. However, this probably won't be practical for farmers since the weevil lives deep in the soil and its larvae are often well protected from the insecticide while they are feeding inside the rhizomes.

—Jack Sperbeck

RESEARCHERS TEST COBS FOR DRYING SHELLED CORN

Corn cobs may soon be competitive with propane as a fuel for drying grain if suitable equipment and systems become available.

"Propane fuel costs have risen to a level where it may be economically feasible to use crop residues as the energy source for drying grain," says agricultural engineer Vance Morey, who heads a station project that aims to reduce the consumption of nonrenewable energy in grain drying. He and coworkers have developed a prototype biomass burner on the St. Paul campus in which corn cobs, pelleted corn stalks, and grain have been tested as fuel.

"Burning biomass materials like corn cobs is a promising approach to reducing use of propane for drying grain," Morey says. About 60 percent of Minnesota's estimated annual on-farm propane use of 70 million gallons is used for grain drying.

The researchers are concentrating on using the biomass burner to dry grain. However, smaller versions may have potential for heating turkey brooding and hog farrowing houses. Plans are to build a biomass burner with a capacity of 2 million BTUs per hour at the Rosemount Agricultural Experiment Station this fall.

The burner will be coupled with a small continuous-flow dryer. The fuel will be corn cobs, which will be collected from the rear of a combine, separated from the husks and leaves, then conveyed to the grain tank where they will be mixed with the shelled corn. The grain-cob mixture will be transported to a drying facility, then the cobs will be separated from the shelled corn by screening before being dried and used as fuel.

With propane at 60 cents a gallon, it costs about 12 cents for propane and 1 cent for electricity to remove 10 percentage points of moisture from a bushel of corn. However, Morey says a more expensive burner will be needed for corn cobs than for propane.

In addition, handling and drying equipment will have to be modified. Agricultural engineer Cletus Schetz is heading the combine-modification work. An estimated 10 to 20 percent more trips will be needed to haul the mixed cobs and grain from the field to the drying facility. Morey estimates that about one-third of the cobs from a field would be needed to dry 25-percent moisture corn down to 15 percent.

—Jack Sperbeck

Agricultural engineer Vance Morey looks at the biomass burner in which corn cobs are being tested as a fuel for drying shelled corn on the St. Paul campus.

SUPPLEMENTAL NITROGEN IMPROVES COWS' DIGESTION OF CORN STOVER

Although dry beef cows have a low protein requirement and are often fed low-quality, fibrous feedstuffs, experiment station researchers have found that cows can make better use of one such feedstuff, corn stover, when supplemental nitrogen is fed.

Animal scientists Jay Meiske and Dick Goodrich and graduate research assistant Dan Crawford recently reported the results of a study that partially supported their theory that corn stover alone does not provide enough protein for optimum digestibility.

The researchers fed groups of beef cows corn stover supplemented with four levels of nitrogen, with crude protein comprising 7 to 10 percent of the total diet. Supplemental nitrogen

was provided by urea, soybean meal, or a corn-urea mixture. A control group received no supplemental nitrogen.

The resulting data showed variable effects of nitrogen source on rumen ammonia level and fiber digestibility, but the cows fed corn stover with a soybean meal or corn-urea supplement were better able to digest the dry matter and fiber in their rations.

—Jack Sperbeck

STATION RELEASES IMPROVED RED MAPLE

Next spring, homeowners will be able to buy stock of an improved red maple, Northwood. The experiment station began releasing budwood of the new *Acer rubrum* cultivar, on which a patent is pending, to Minnesota nurserymen for propagation several years ago.

Northwood red maple originated as a native seedling in St. Louis County, near Floodwood. Now-retired University of Minnesota horticulturist Leon Snyder selected the seedling for its good fall color.

Trees of Northwood have a round to oval crown with branches ascending from the trunk at approximately a 45-degree angle. While young, they grow more rapidly and their form is superior to other commonly grown red maple cultivars.

The new maple is suitable for planting as a shade tree, landscape specimen, or boulevard tree. Since it originated in northern Minnesota, it should be better adapted to Minnesota climatic conditions than other commercially available red maple cultivars.

Red maples require moist, slightly acid soil for optimum growth, so Northwood should grow well throughout most of the state. However, it will probably not thrive on the alkaline soils of the Red River Valley or in the hot, dry, windy climate of southwestern and extreme west-central Minnesota.

—Sam Brungardt

A Northwood red maple contributes to the fall color display at the Horticultural Research Center, Excelsior.

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