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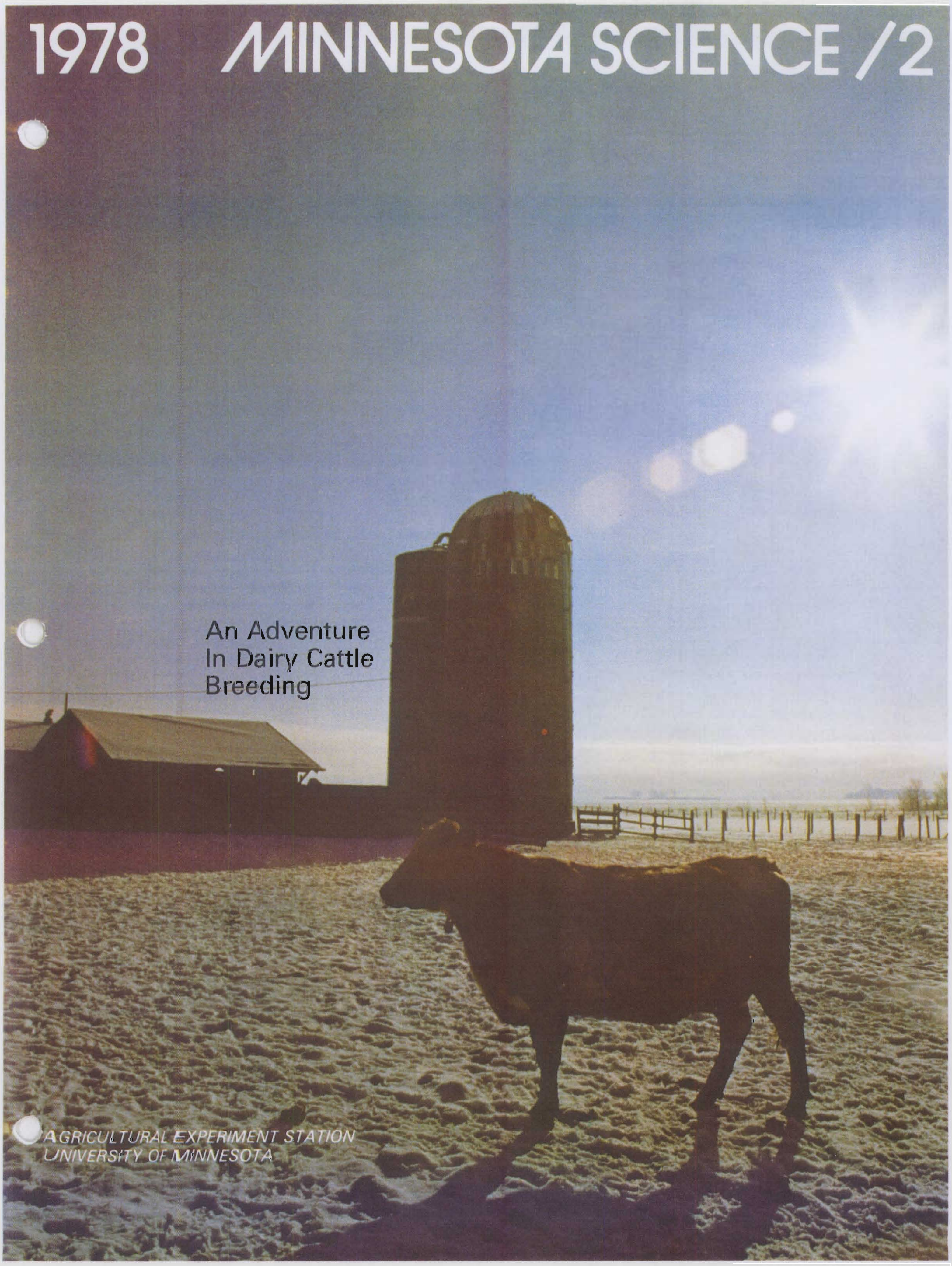

An Adventure
In Dairy Cattle
Breeding

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MINNESOTA

Harvesting Today's Research

KEITH HUSTON
Director, Minnesota Agricultural Experiment Station

WINTER IS AN ODD TIME for harvest in Minnesota. Yet, that's when the past year's research is harvested and plans for the future are made. During this time, Experiment Station scientists summarize their research results and evaluate their accomplishments.

It is an exciting time and sometimes a frustrating time. Not all research bears useful fruit each year; some is bitter and disappointing. A few research problems are solved in a year. Many are solved in 3 to 10 years. But most are solved only slowly, step-by-step, with each discovery pointing to other unknowns, each begging to be answered.

No one knows how research will turn out, for who can predict the mysteries of the unknown. Who can predict which one of thousands of crosses of wheat, soybeans, alfalfa, or blueberries will be the new high-yielding, disease- and insect-resistant one? Who can predict what a new feed additive will add to efficiency of gain in the feedlot? Who knows how long it will take to discover the virus that causes a disease? How many years will be required to find a less costly way of refrigerating and packaging chickens; or a better way of helping youngsters understand themselves; or a feasible alternate energy source?

Despite the uncertainty and frustrations, the perseverance, curiosity, and faith of our scientists continue to pay off handsomely. Current estimates suggest that crop and livestock research the next 5 years will show an annual return on investment of nearly 30 percent—a phenomenal rate.

In many areas of research, dollar measures of return on investment can't be gotten. But none will deny the benefit of being able to protect food from botulism, of strengthening marriages and family ties, of a better understanding of one's hopes and aspirations, of a lake producing bigger walleyes, of cleaner rivers and fresher air. Those are the kinds of problems Minnesota Experiment Station scientists are working to solve.

This year's research harvest looks every bit as promising as the most successful year of the past. The pages of *Minnesota Science* will bring you some of those discoveries.

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CONTENTS

COVER: The red and white dairy cattle at the Rosemount Experiment Station "represent an improved strain of Milking Shorthorns, or they may be the forerunner of a new breed," says Dr. C.W. Young, dairy cattle breeding scientist, UM Agricultural Experiment Station (see story on page 8). Photo by Vince Becker.

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Director: Keith Huston
Editor: Vince Becker
Designer: Dianne Swanson

Address all correspondence and requests to Editor, *Minnesota Science*, 448 Coffey Hall, University of Minnesota, St. Paul, MN 55108.

Biological Seed Coating Wards Off Diseases

VINCE BECKER
Department of Information
and Agricultural Journalism

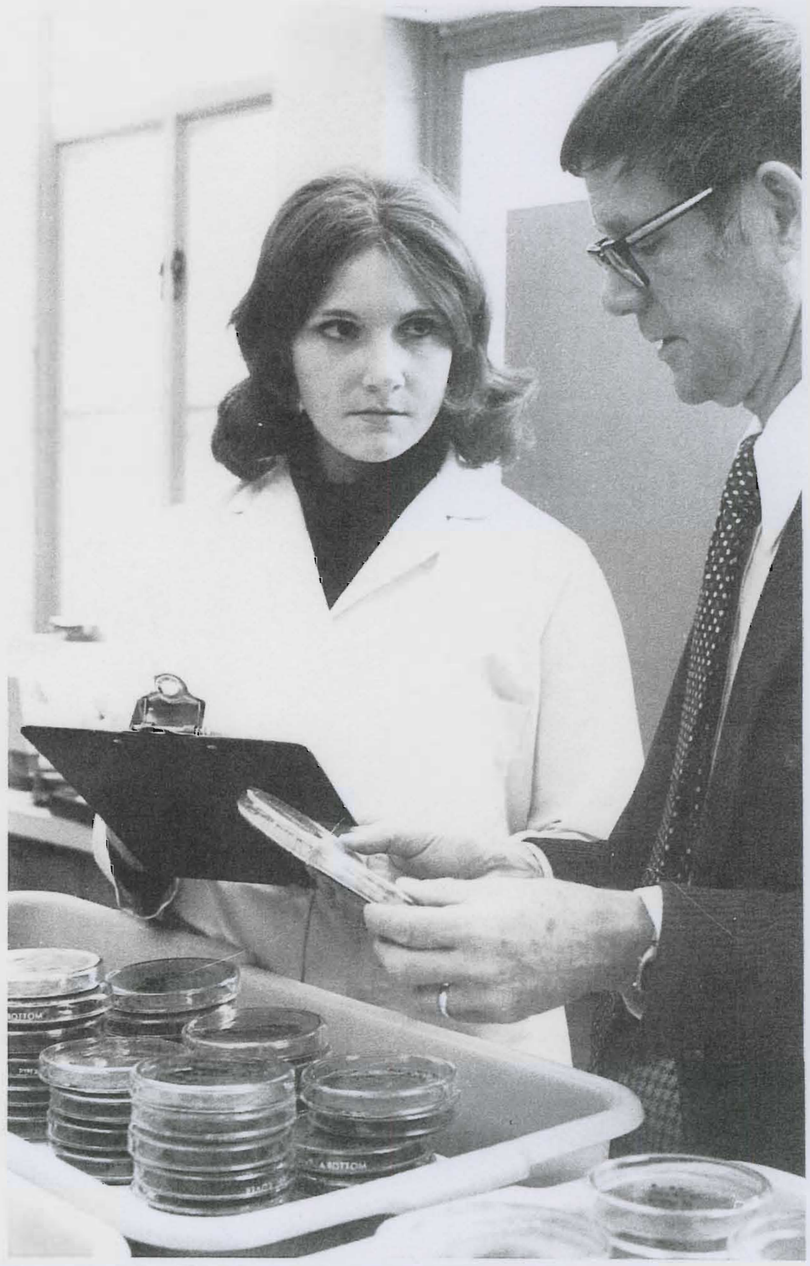
ANTAGONIST VS. PATHOGEN.

That's the strategy two University plant pathologists are pursuing in their efforts to protect plants from seedling diseases.

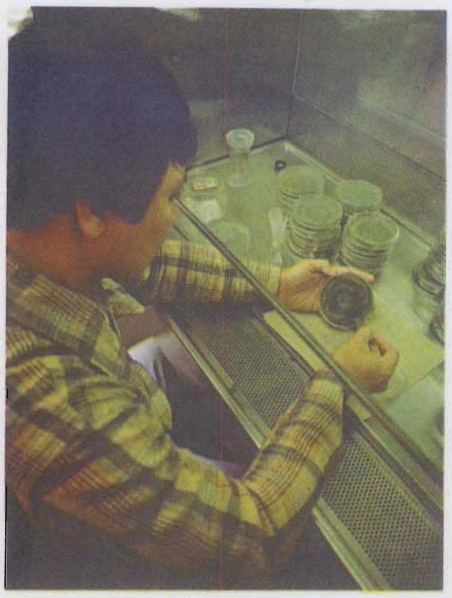
Thor Kommedahl and Carol Windels have been coating seeds with fungi and bacteria that are harmless to plants and antagonistic to pathogenic root-infecting fungi. They've used this biological seed treatment on corn, soybeans, peas, and other garden vegetables. Currently, their research emphasizes evaluation of the seed treatment for controlling root diseases in garden vegetables.

"By coating seeds with beneficial organisms capable of growing on the germinating seed and along the root surface, naturally occurring biological control can be enhanced," explains Kommedahl. The effectiveness of these antagonists is compared to no treatment and to captan, a commonly used seed fungicide. In a wide range of experiments, some of the antagonists have provided control generally comparable to captan. Better control of seedling diseases was obtained with the biological treatment in some instances. If biological control becomes commercially feasible, it would be a viable alternative to chemical control.

Sources of antagonistic fungi and bacteria are plant roots and seeds. The fungi and bacteria are then grown in the lab and evaluated under four different conditions to determine if they are antagonistic to particular disease-causing fungi.



Plant pathologists Thor Kommedahl and Carol Windels collect fungi and bacteria from plant roots and seed then grow the microorganisms in the lab to test antagonistic behavior to disease-causing fungi (photo by Vince Becker).



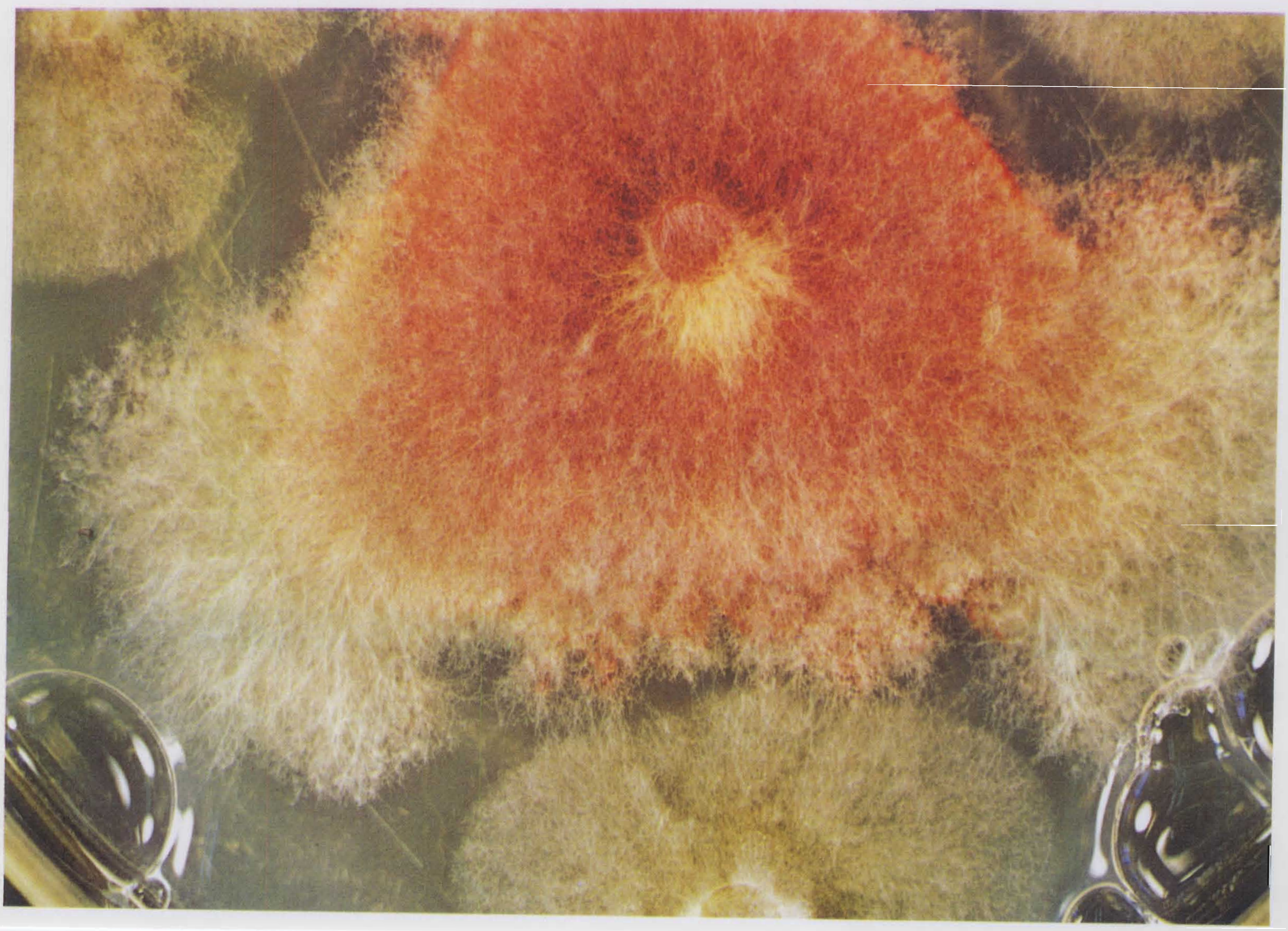
Fungus spores harvested by Gusti Sarbini, graduate student, will be tested for antagonism to pathogens that cause soybean seedling diseases (photo by Vince Becker).

In their most recent work with peas, Kommedahl and Windels tested about 100 bacteria and fungi for antagonism to *Fusarium solani* and *Rhizoctonia solani.* "Out of the total, 37 fungi and 22 bacteria proved antagonistic to one or both pathogens in culture," says Windels. These 59 organisms were further tested against additional pathogens in petri dish cultures. "Behavior of the 37 fungal antagonists was more uniform than that of the bacterial antagonists," she adds.

Those bacteria and fungi that proved to be effective in inhibiting pea root pathogens in petri dishes were tested further in the laboratory, greenhouse, and in the field. In these experiments seeds were coated with antagonists and measured against no treatment and captan.

Coating seeds with fungi involves placing seeds on the culture in the petri dish or adding seeds to a vessel with harvested fungus spores and shaking the contents to ensure good coverage. If bacteria are used as a coating, seeds and sterile water are added to the culture in the petri dish and shaken, or seeds are added to a

Antagonistic behavior of fungi used in biological seed coating experiments is illustrated in this petri dish setting. *Fusarium roseum*, center, a pathogenic fungus that causes root diseases in corn, is under attack by beneficial fungi (photo by Thor Kommedahl).



flask of liquid culture, then dried on paper towels.

Germination of coated seeds was tested in the lab using a paper towel test. "In our procedure, a sheet of wax paper was covered first with a wet paper towel and then a layer of soil was added on which 50 organism-coated seeds were placed," explains Kommedahl. "Another wet paper towel then was laid over the seeds and the entire unit was loosely rolled into a cylinder and held together with rubber bands. These units were stacked vertically in a container and incubated at 24° C. After 7-8 days, the rolled-towel units were opened and germination data recorded."

In the greenhouse test, coated seeds were planted in metal flats and grown at 21-24° C. After a few weeks plant stands and root rot were evaluated. "In both rolled paper towel and greenhouse tests, soil was taken from a field 'disease nursery' where peas had been grown each season for several decades and in which pathogens of pea roots were present," says Kommedahl.

Finally, coated seeds were planted in the pea disease nursery. Final stand, vine weight, pod and seed weights were recorded at harvest.

Bacterium coated seed appeared to be less effective than fungus coated seeds in controlling disease. "In fact, some bacteria appeared to be pathogenic, causing reductions in stands," says Windels. "Only a few of the fungi tested seemed promising as candidates for further testing." One of these fungal antagonists, *Penicillium oxalicum*, when coated on seeds of peas, produced greater stands than untreated seed.

"This antagonist works well on peas, both in the greenhouse and in the field," explains Kommedahl.

After two weeks in the greenhouse, pea seed coated with *Penicillium oxalicum*, right, produced superior stands than captan treated seed, center, and no treatment, left, when planted in soil infected with pea root pathogens (photo by Vince Becker).

"In 1977, greenhouse results were confirmed by field tests using *P. oxalicum*, probably because seedling blight occurred early in the season—a situation like that occurring in the greenhouse with seedlings."

Kommedahl feels that captan probably is still a more effective treatment because the antagonists have been somewhat inconsistent. "However, antagonists give longer protection under prolonged low temperatures," he says. "This is because roots grow away from captan treated seed, whereas the antagonists multiply and tend to grow along the root surface."

Kommedahl and Windels are looking at ways of improving their biological seed coating process. Currently, they are studying certain coating materials that may increase the efficiency of antagonists. In addition, effect of moisture and temperature on coated seed is being investigated.

"Ideally, we're looking for a broad spectrum antagonist that does well under a wide variety of conditions," says Kommedahl. If biological coating of seeds becomes commercially feasible, farmers and vegetable growers would have a choice of weapons to combat seedling diseases.

Safety of Slow Meat Cookery

DIEDRE NAGY
Department of Information
and Agricultural Journalism

AMERICANS LOVE THEIR BEEF. And they love it most when it's cooked slo-o-owly to rare perfection.

What they don't like, however, is getting sick from the beef they eat. It's this potential problem that has led Agricultural Experiment Station researchers to study the safety of long time, low temperature (LTLT) cookery such as that done in a crockery type, slow cooking appliance or in a low temperature oven.

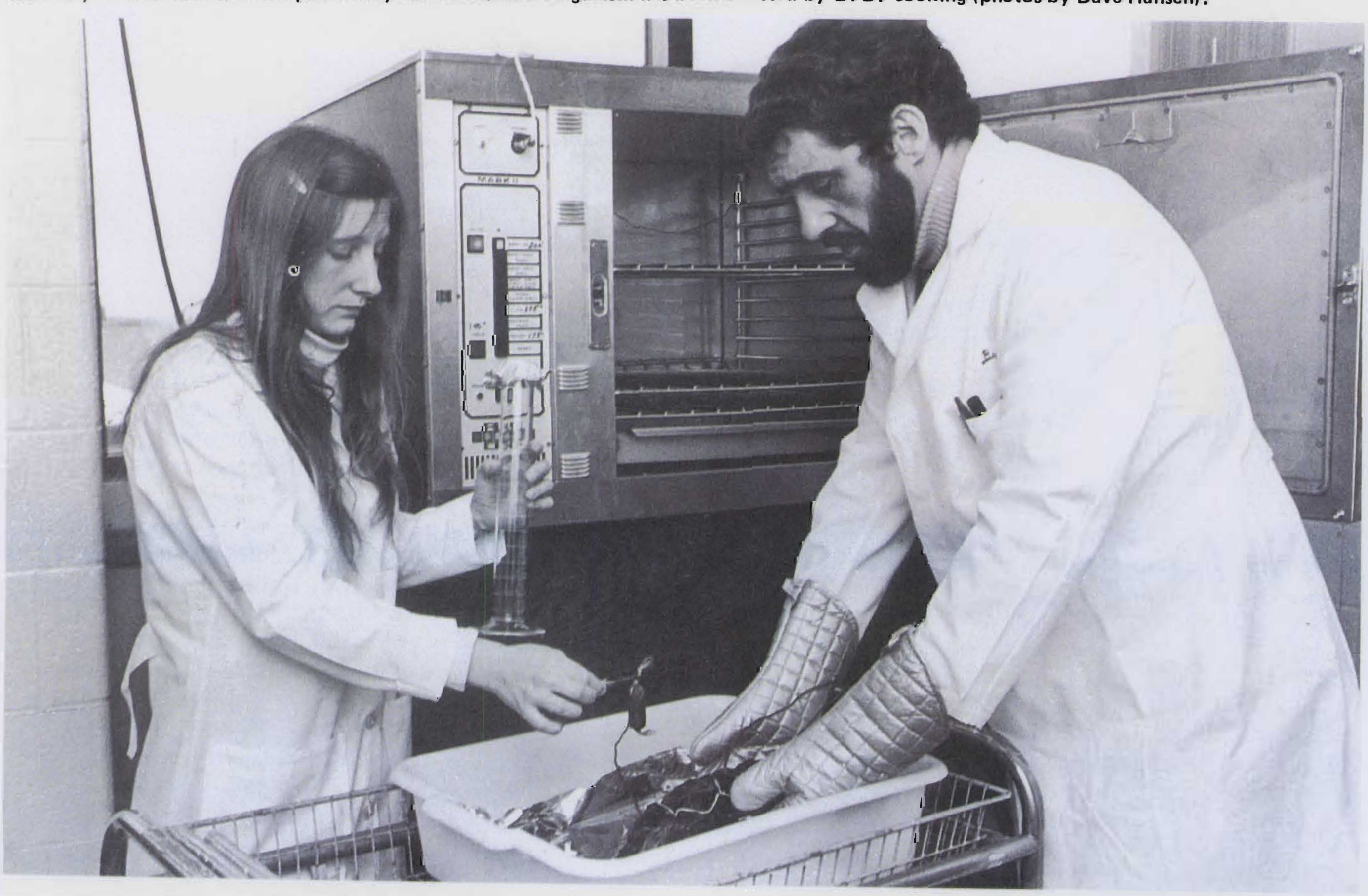
The potentially hazardous microorganism under scrutiny, *Clostridium perfringens,* is the culprit in one of the most common types of food poisoning, according to C.E. Allen, Department of Animal Science, and F.F. Busta, Department of Food Science and Nutrition. Their research is funded by the Agricultural Experiment Station and the Minnesota Beef Council.

Uncooked meat frequently is contaminated with *C. perfringens* organisms, the scientists say. But the organisms must be alive and present in large numbers to pose a health hazard. This happens when the normally occurring cells multiply, which happens rapidly in the temperature range between 75° F. and 125° F. Salmonellae microorganisms, the cause of another major food-borne illness, survive or are killed by the same conditions that benefit or destroy *C.perfringens,* according to parallel research being done by University food science undergraduate Wendy Thompson.

Allen and Busta explain that although many foods may be susceptible to *C.perfringens* problems, beef can be a particular hazard. It is often served rare (at or below 140° F.) and sometimes is kept in the dangerous temperature range (between 75° F. and 125° F.) for hours—for example, when warmed improperly under a restaurant or institution's infra-red lamp. Because even high concentrations of the organism may not change the smell or flavor of meat, many victims eat it without suspecting the danger.

In addition to favorable temperature, very long cooking

A sample of meat inoculated with *C. perfringens* and located in the center of a beef roast will be analyzed by F.F. Busta, right, and Pat Noren, junior scientist, to determine how the potentially hazardous microorganism has been affected by LTLT cooking (photos by Dave Hansen).



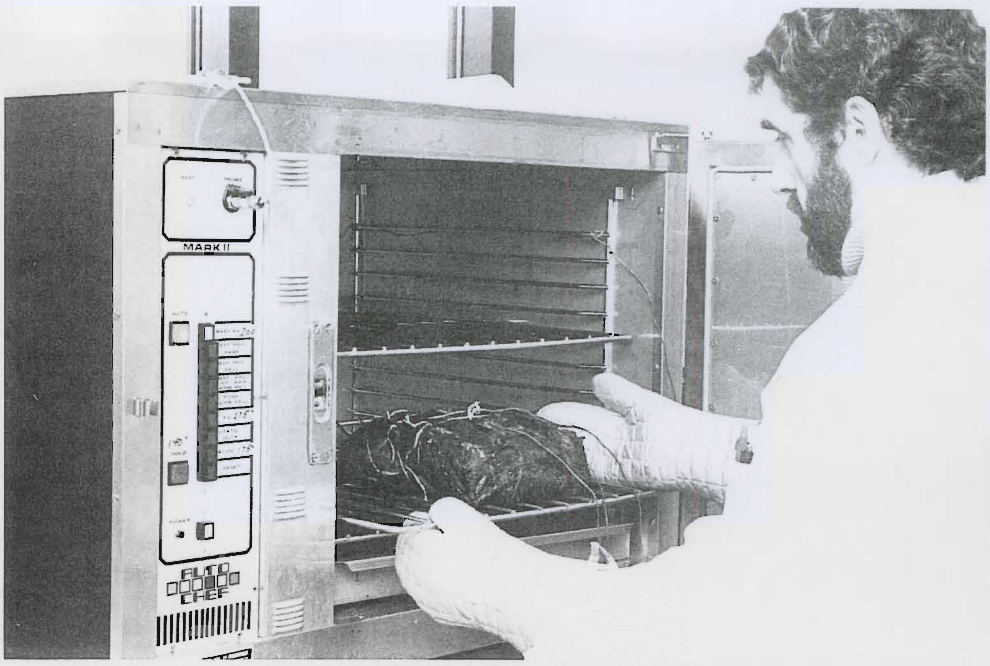
periods add to the risk of food poisoning from *C.perfringens* or salmonellae. Allen and Busta say that a crockery pot overloaded or set on low (without first elevating the heat) or a slow oven offers ideal temperatures and sufficient time for many new generations of microorganisms to develop. For example, a 7-pound roast cooked in a 185° F. oven would reach a rare stage in seven hours. But in a 325° F. oven it would take less than 3 hours.

Another potentially dangerous fad in beef cookery is preheating an oven, placing a roast inside, immediately turning off the oven and allowing the meat to stay in the slowly cooling oven for many hours.

Allen and Busta expect that their research will help define what conditions are safe from the potential for food poisoning in various sizes and kinds of roasts under a variety of slow cooking methods. They hope that what they find will eliminate any beef-related risks of *C.perfringens* food poisoning, which is rarely fatal but causes severe abdominal cramps and diarrhea.

Theirs' is a unique approach to food safety research, and because of this they expect the findings to be particularly useful to consumers, meat processors, and restaurant operators. Busta explains that unlike most food research that normally is done at constant temperature, this research project deals with changing (dynamic) food temperatures similar to those found in a slowly warming crockery pot, low temperature oven, or under an institution's infra-red warming light.

With the help of a computer and the heat transfer expertise of David Thompson, Department of Agricultural Engineering, the research team hopes to develop a set of charts or models that will allow them to judge the safety of many beef handling methods. Eventually they also will look at the variables of cooling and reheating cooked beef to add another dimension to the research.



C. perfringens **that may be present in uncooked beef can multiply rapidly and spread throughout a roast during the LTLT cooking process. High concentrations of the microorganism pose a potential health hazard.**

So far, one noteworthy spin-off of the research has been the development of a technique for contaminating a small plug of meat encased inside a permeable sheath. The plug is then re-inserted into the roast and cooked. New generations of the microorganisms under study are confined inside the membrane for much easier detection and counting than if they had spread throughout the roast and its juices.

The eyes of more than the research team are on the data now coming out of the roast experiments. Late last year, the U.S. Department of Agriculture (USDA) set 145° F. as the minimum temperature that commercially processed precooked beef, a staple of many restaurants, must have reached to be safe. Officials there admit this temperature probably is higher than needed but in the absence of other data they have chosen to err on the side of caution.

The restaurant and delicatessen industry objects to the 145° F. regulation because it makes it impossible to serve patrons rare beef. Beef at 145° F. is classified as medium or medium rare. Allen and Busta expect that their data will help the USDA and industry formulate new regulations that may prove less restrictive.

But where does this leave the chef in the home who wants slowly cooked rare beef but doesn't want to risk the family's health to achieve it? "If you follow all recommended kitchen procedures and keep food above 140° F. or below 50° F. as much as possible, there is little worry," Allen and Busta agree. "Even if you don't, we cannot guarantee that you'll get sick as a result of a slip-up. For if enough conditions are right for the growth of organisms, the potential for food poisoning is there."

They note, however, that even homemakers and chefs who have violated safe food handling principles many times may never have inflicted *C.perfringens* poisoning upon anyone. Or if they have, their victims may have blamed the symptoms on stomach flu or some other malady. Because of this, Allen and Busta are certain that the number of documented *C.perfringens* cases yearly (ranging between 400 and 18,000 in recent years) is a fraction of the actual occurrences.

Anyone who violates safe meat cooking procedures often enough probably will cause an outbreak of *C.perfringens* poisoning sooner or later, the scientists agree. However, as a result of their research they are convinced that consumers can enjoy fine rare beef prepared in LTLT cookery without worrying about *C.perfringens* food-borne illness.

An Adventure in Dairy Cattle Breeding

VINCE BECKER
Department of Information
and Agricultural Journalism

Red and white dairy animals like this roan-colored cow at the Rosemount Experiment Station evolved after years of crossbreeding research (photos by Vince Becker).

IT ALL BEGAN about 18 years ago at the Rosemount Experiment Station. A herd of Milking Shorthorns was brought to the station from Maryland and Pennsylvania by Dr. C.L. Cole, then head of the Dairy Husbandry Department at the University.

At that time most of the cattle tended to fatten easily and milk little. However, there were a few good dairy animals in the herd. Dr. Cole set out to upgrade the herd genetically and worked to that end until 1969 when the breeding and management of the herd was passed on to Dr. C.W. Young. The Dairy Husbandry Department by then had become a part of the Department of Animal Science.

Today Rosemount is the home of the Minnesota red and white herd that evolved from the original herd of Milking Shorthorns.

Exploring Genetic Potential

"Dr. Cole's early experiences with the Milking Shorthorns soon led him to the conclusion that the breed needed to bring in genes from some source other than the Milking Shorthorn breed in the U.S.," explains Young. "After investigating several sources of sires, he was successful in importing semen from two New Zealand Milking Shorthorn sires in 1961.

Daughters of these two bulls had a tremendous impact on the improvement of the Rosemount herd and on the Milking Shorthorn breed in the U.S. One of the two bulls, Kaiwarehou Duke, sired two daughters that set national records for the breed for milk and fat yield," adds Young.

This same bull also sired Minn Duke Darius, who today continues as the breed's leading AI (artificial insemination) sire with Predicted Differences of +1398 for milk, +.07 for fat percentage, +59 for fat, +144 dollars for product value. Young notes that these figures are single lactation superiorities expected of Darius daughters relative to the breed average.

Dr. Cole's introduction of the New Zealand bulls via frozen semen soon led to the importation of semen from Australian Illawarra Shorthorn sires. The Australian Illawarra Shorthorn includes genetic contributions from the Ayrshire, Devon, and possibly other breeds in addition to the Milking Shorthorn. "Consideration of this has led in recent years to the crossing of the cattle at Rosemount with Ayrshire sires," says Young. "The reasoning behind this move was that the Australian Illawarra Shorthorn seems to represent an improvement over most other Shorthorns bred for dairy purposes." He points out that there are Ayrshire bulls in the U.S. and Canada today that are superior to anything that was available to the Australians when they synthesized the Illawarra.

"The combination of Ayrshire and Australian Illawarra Shorthorn breeding has allowed us to put Selwood Betty's Commander and Sunny View Little Princess 30th into the same gene pool," explains Young. The former is an outstanding Ayrshire bull and the latter is an outstanding Australian Illawarra Shorthorn cow. "With this combination we hope to breed animals that can compete with the Holsteins."

Launching a New Breed

Young's ultimate goal in his crossbreeding work is to form a new breed that will not only be competitive with the Holstein but that might also cross with the Holstein to produce crossbreds superior to either breed for commercial dairy production.

The decision to use Milking Shorthorns in this project was influenced to some degree by what was available. However, Young believes that Milking Shorthorns are a logical breed to use as a basis for his crossbreeding project. He lists some reasons why:

☐ Milking Shorthorns are one of the best dual purpose breeds. In order for a breed to be competitive with the Holstein it must be dual purpose. The most profitable cow is one that excels for dairy production, produces calves that do well for beef or veal, and brings a good price when sold for slaughter when her productive life is finished.

☐ The Milking Shorthorn is red and white as are many of the other breeds that might be used to form a gene pool. Even though color may not influence productivity, there is some advantage in breed development of avoiding what appears to be complete mongrelization. Most dairymen probably prefer some uniformity in the color of their cattle.

☐ The University's Milking Shorthorn herd had been the source of most of the high Predicted Difference sires used in this breed in recent years. Therefore, it was very likely well above breed average, genetically.

The red and white herd at Rosemount bears little resemblance to the early Milking Shorthorns. Most of the more recent genetic improvement is directly related to Young's crossbreeding program utilizing frozen semen from Australian Illawarra Shorthorn and Ayrshire sires. Since the original crossbreeding was started in 1960 through 1977, the herd's production has been dramatically increased. DHI rolling herd averages have gone from 7,220 to 13, 079 pounds of milk and 258 to 512 pounds of butterfat during that period.

Although the Holsteins at Rosemount still outproduce the red and whites, the production gap is getting smaller. The red and white herd has improved annually at a rate of 331 pounds of milk and 13 pounds of fat. The cows have been gaining an average of 89 pounds of milk and 2.3 pounds of butterfat annually on the Holsteins. "Over 17 years, the difference between the two herds has decreased by 1,523 pounds of milk and 39 pounds of butterfat," says Young.

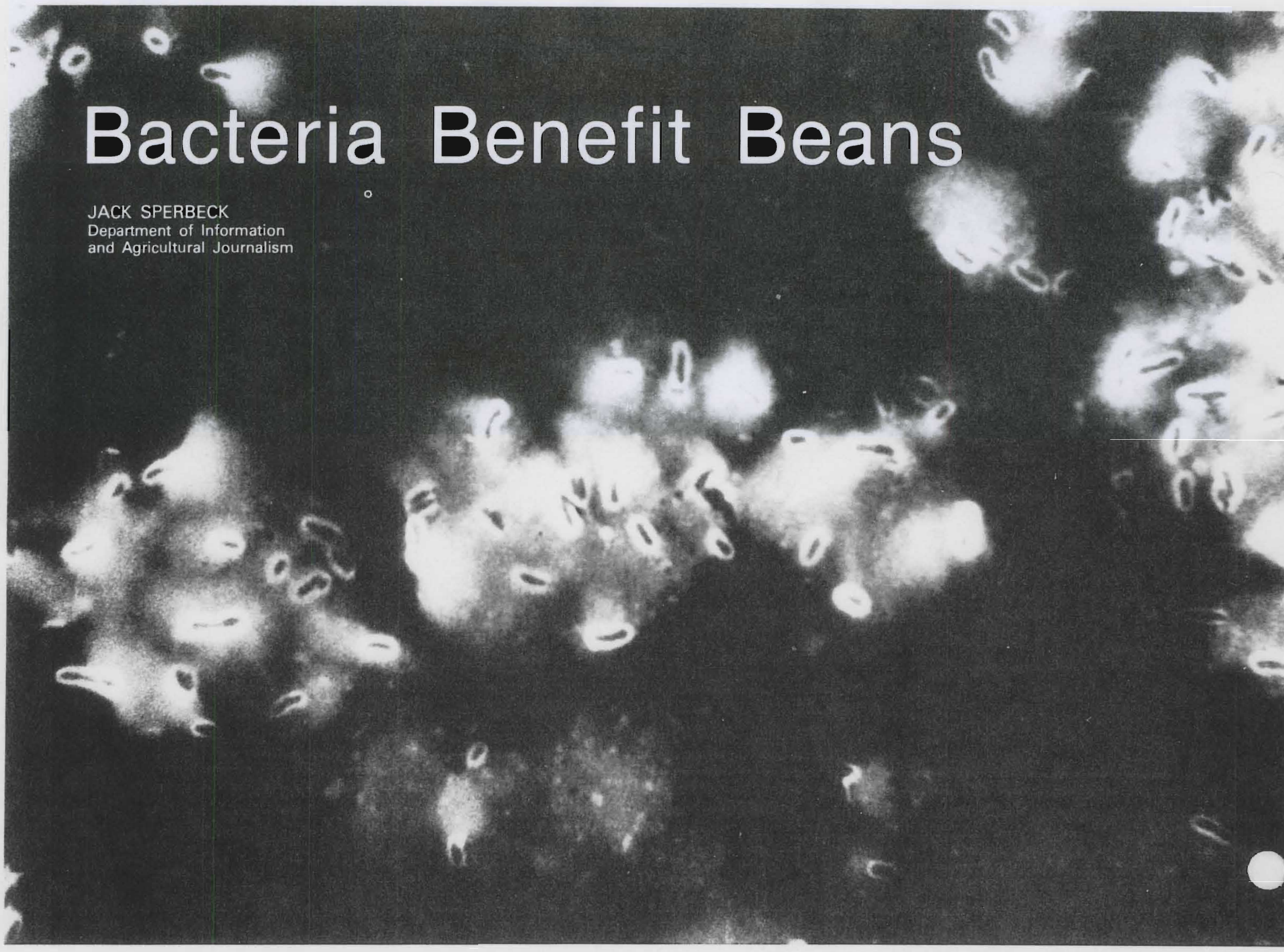
The red and white cattle at Rosemount are no longer referred to as Milking Shorthorns, although most are registered with that breed society. "They represent an improved strain of Milking Shorthorns, or they may be the forerunner of a new breed," he explains.

"In any event, they have been and continue to be an exciting adventure in dairy cattle improvement through genetics."

This heifer and the rest of the red and white herd represent an improved strain of Milking Shorthorns.

Bacteria Benefit Beans

JACK SPERBECK
Department of Information
and Agricultural Journalism



Clouds of special proteins (lectins) from the soybean are shown binding to cells of *R. japonicum*--the only kind of bacteria capable of forming nitrogen--fixing nodules on soybean plants (photomicrograph by Edwin L. Schmidt).

A MINNESOTA SOILS SCIENTIST is one of the world's top experts on soil bacteria. And he probably knows as much as anyone about *Rhizobium japonicum,* the bacterial strain that attaches to soybean roots to trigger nitrogen fixation in the soybean root system.

Edwin L. Schmidt and his coworkers work with what they call the "soil community"—made up of hundreds of different microorganisms.

The ultimate goal of Schmidt's research projects is to increase nodulation and maximize nitrogen fixation in the soil. This could increase crop yields, leading to greater protein production per acre. It would also save energy, since atmospheric nitrogen converted to soil nitrogen is "free," whereas fertilizer nitrogen requires fossil fuels to produce.

Hundreds of different strains of microorganisms live in the soil so the research is a very complicated, involved process. The first challenge is identifying and observing specific bacterial strains.

Starting about 15 years ago, Schmidt developed a system to "tag" or identify specific strains with fluorescent dye. He found that the fluorescent tag allowed him to study the immensely important soil bacteria that attach themselves to the roots of legumes, such as alfalfa, soybeans and peas. These useful bacteria, known as Rhizobia, metabolize atmospheric nitrogen in the legume roots and excrete it as ammonia and other nitrogen compounds beneficial to plant growth.

The bacterial strain he's worked with most is *R. japonicum,* which takes up residence in soybean roots.

It's important to note that *R. japonicum* is in the soil, along with hundreds of other bacteria, before the soybean seed is planted. "We need to know how beneficial strains such as *R. japonicum* survive and compete with other soil microorganisms to get the most out of the final bacteria-plant root association after the crop is planted," says Schmidt.

"When we learn more about this, it may be possible to alter the soil's environment to favor one bacterial strain. If a geneticist would develop a 'red hot' bacterial strain, conceivably we could alter the soil environment to favor the strain once it's introduced so it could favorably compete with other soil microorganisms."

Another area of Schmidt's research concerns led to what he calls the "recognition mechanism." "How does the legume plant know that the *Rhizobium* strain is the 'right' one? Likewise, how does the *R. japonicum* strain know that the soybean root is the right root to associate with? We think there's a recognition mechanism that's necessary before the two develop a beneficial relationship.

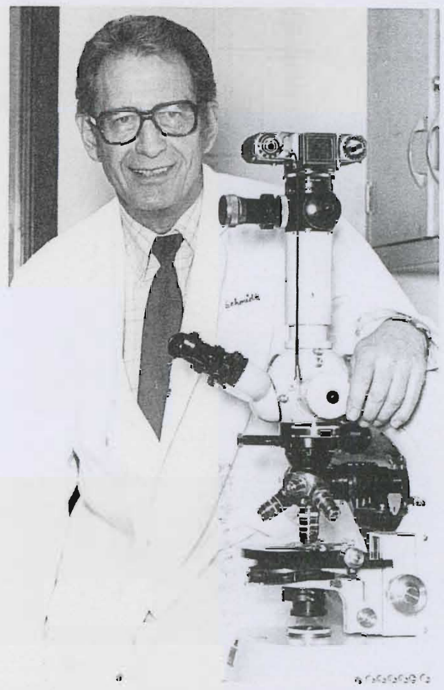
"We think that special proteins (lectins) produced by legume plants react with a 'receptor site' on the bacterial cell. Only the bacteria with the proper receptor site are recognized by the plant.

"Just getting more nodules on soybean roots isn't the answer. (Some nodules are much more efficient at nitrogen fixation than others.) What we want is maximum plant-*Rhizobium* strain interaction for increased yields."

Increasing nitrogen fertilizer supplies in the soil from atmospheric rather than fertilizer nitrogen sources has tremendous potential, especially in developing countries. "In Morocco, the stable protein food source is a plant called horse beans," says Schmidt, who has worked as a consultant in Morocco in conjunction with the University's International Agricultural Programs operation. "This legume produces big, flat beans that are critical in the diets of the small farmers who produce them."

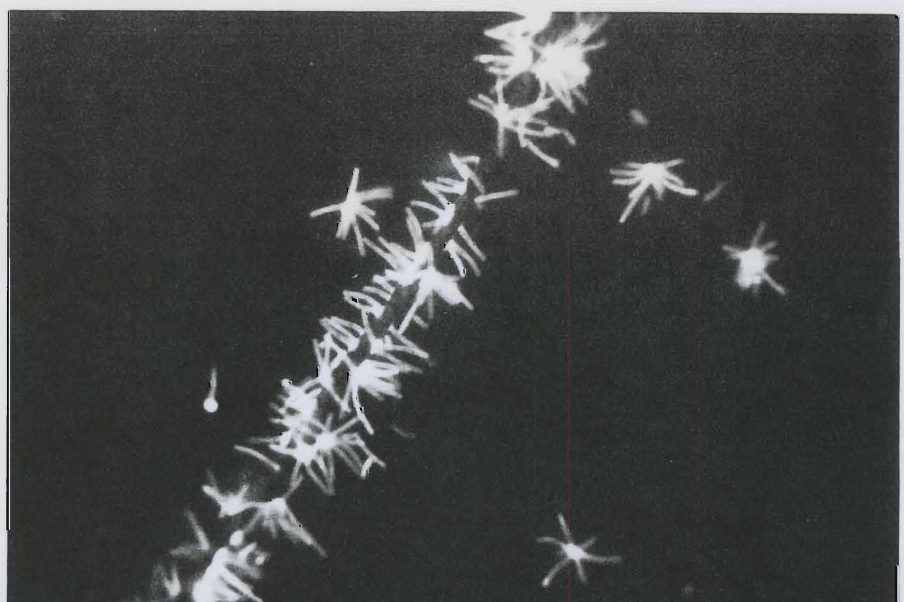
The beans also are used in rotation with wheat, so increasing nitrogen fixation in the bean crop could provide extra nitrogen for wheat the following year.

Schmidt's work is recognized world wide. He recently received the Soil Science Award from the Soil Science Society of America. The award recognizes outstanding research in soil science conducted over the past 10 years.



Edwin L. Schmidt (photo by Dave Hansen).

R. japonicum bacteria are identified in the soil by means of a fluorescent tag which attaches to the microorganism (photomicrograph by Edwin L. Schmidt).



Extended Shelf Life for Fresh Poultry

GAIL McCLURE
Department of Information and Agricultural Journalism

TO GET MORE LIFE from their chickens, poultry packers across the nation are rushing to adapt a technique perfected by Experiment Station researcher, Eugene Sander.

Sander's technique extends the shelf life of fresh packed poultry by using carbon dioxide (CO_2) to retard bacterial growth. His study showed that chickens which would normally last 10 days packed in ice can have a shelf life of 27 days or more if stored under CO_2 at 34° F. (1.1° C.).

Using his technique, the packing procedure goes something like this. Freshly slaughtered birds are chilled, drained, and placed in a corrugated box containing a nylon-surlyn film bag. The box is then positioned on a machine which automatically removes the air from the bag, backflushes the area with carbon dioxide, and seals the bag air tight. (A machine

A new packaging technique developed by Eugene Sander utilizes carbon dioxide and a special nylon-surlyn film wrap to prolong the shelf life of fresh poultry (photos by Dave Hansen).

can handle 2 or 3 boxes per minute.) The inflated bag eventually tightens around the birds as the carbon dioxide is absorbed by the poultry.

"We've taken a known art and applied it in a new way," says Sander. Carbon dioxide has been recognized as a natural means of retarding certain bacterial growth since the turn of the century. The concept, called controlled atmosphere, has been successfully used to prolong the storage of fruits and red meat. Adapting the concept to poultry packing hinged on the development of a bag or wrap with a strong oxygen barrier to keep the carbon dioxide trapped for a considerable length of time. The nylon-surlyn wrap proved a suitable barrier.

Sander made it possible for a good idea to become a reality when he tested the wrap and established a recommended usage rate for carbon dioxide per body weight. He also measured the bacterial growth in packaged poultry in trials which compared the various methods of packing poultry.

"With extended shelf life, packers can use cheaper (slower) methods of transporting their produce," Sander notes. In addition, they can ship longer distances and this has started to open up new markets. For instance, a chicken packed in Minnesota using this method could conceivably reach a consumer in Alaska or Hawaii.

In addition to extended shelf life, packers and retailers are finding economy and convenience bonus benefits. Most commonly, fresh poultry has been packaged using a wet-ice method. In terms of whole birds, this meant 22-25 fowl would be placed in waxed cartons or wooden crates. Then

Controlled environment packaging allows packers to ship 15-25 percent more poultry in the same truck space required by the wet-ice method.

10-20 pounds of ice would be added. Using the controlled atmosphere method, packers can ship 15-25 percent more poultry in smaller cartons in the same truck space, thus reducing transportation costs.

The advantages of handling clean, tight packages are considerable. The wet-ice method always left a residue of foul water which damaged warehouse floors, trailers, coolers, and other containers. Such water also made it impossible to ship poultry with other items, like produce, for fear of contamination. In addition, retailers always have had to remove mold and slime from the racks of storage and display equipment. Certainly, clean, dry packaging means improved sanitation.

Right now, packers can save 25-50 percent on shipping containers by using this new method. However, the nylon bags add a cost that currently offsets or exceeds the savings. If bags and pouches can be economically incorporated, Sander sees many ways to apply controlled atmosphere to food packaging.

"Perhaps individual birds will one day be packaged this way on a commercial scale, and then placed in a box which is also packaged using this method," he says. Then the shelf life, which now extends from the point of packing to the time the shipping container is opened, could be expanded to include the time the individual package is opened for consumption.

Sander also points to fish as a food which might benefit from this method of packaging. With an extended shelf life, new inland markets could be developed for sea food. In addition, fisheries in the Great Lakes area could expand their industry if highly perishable fish like smelt and herring could have an extended shelf life.

And Sander doesn't stop with fish. He also sees the potential of using controlled atmosphere packaging on food products such as cheese or processed vegetables like fresh-cut potatoes. "I've worked places where good ideas are put aside and you have to live with a high level of frustration," he says. "Here, I look at my research as a positive tool—a way of seeking practical solutions to immediate problems. It's a real joy to work on a project and then see the results implemented so quickly."

Lyon Outperforms Other Oats

VINCE BECKER
Department of Information
and Agricultural Journalism

SINCE ITS RELEASE last year Lyon oats has performed well in commercial seed fields and was added to the 1978 recommended crop variety list. Minnesota seed growers produced 4,200 acres of registered and certified Lyon seed in 1977. Roughly 350,000 bushels of this seed are available for planting this year.

"The amount of seed available in 1978 will plant upwards of 150,000 acres," says Deon Stuthman, UM oat breeder, who developed the new variety in cooperation with plant pathologists M.B. Moore, P. G. Rothman, and R. D. Wilcoxson. "It's not unreasonable to project that a quarter of Minnesota oat acreage could eventually be planted to Lyon, or about 500,000 acres," he adds. Lyon was grown in Arizona during the seed multiplication process in order to obtain enough seed for distribution to seed growers.

Several years of greenhouse and field research conducted by Deon Stuthman and colleagues resulted in a high yielding, smut resistant oat variety called Lyon (photo by Vince Becker).

Commercial seed growers produced 80-85 bushels per acre of clean seed from Lyon last year. "On the average this amounts to a 5-bushel per acre advantage over other oat varieties." explains Stuthman. "In terms of the total acres planted to Lyon this means that an extra 21,000 bushels of seed were produced. At $3.25 per bushel this equates to $70,000 additional income for Minnesota seed growers."

Besides its yield advantage, Lyon is smut resistant, saving growers at least $75,000 (if all 350,000 bushels had been chemically treated). Lyon is also moderately resistant to crown rust.

An evaluation of Lyon oats by seed growers suggests that they see a bright future for the new variety. Lyon got high ratings for disease resistance, grain and straw yield, and seed appearance.

Experimental trials conducted at the six branch Experiment Stations during 1972-1977 show that Lyon yielded an average of 95.2 bushels per acre compared to 92.3 and 91.6 for Lodi and Froker, respectively. The percent protein in the groat and the total protein yield per acre were higher for Lyon than either Froker or Lodi, two of the most popular varieties in recent years. Lyon also had a higher test weight per bushel and a higher groat percent than Lodi in the 30 trials. Lodging resistance of Lyon was about equal to that of Froker and Lodi.

The seed of Lyon is white and the plant is similar in appearance to Lodi. The variety was selected from a cross of Lodi and Portage. It is intermediate in plant height; 39 inches compared to 38 for Froker and 41 for Lodi.

Science Notes

CHILDFREE COUPLES STUDIED

Remaining "childfree" finds favor with a large section of married Americans who value freedom to pursue their interests and do not wish to add to the world's population. Between 13 and 17 percent of the married couples in the U.S. are childfree—that is, they do not have any children, even by an earlier marriage. At least half of those couples probably chose not to have children.

Who are these childfree couples? For the past five years University of Minnesota researchers have sought not only to learn who they are but also to understand their decision and the rewards and costs of the decision. In a recent report of their research, Linda G. Budd and Richard N. Hey of the Department of Family Social Science describe the 275 couples that participated in the project.

On the average, these childfree couples are young (average age of about 30) and have been married for 6.7 years. They are well educated (67.5 percent have at least a college degree) and earn a family income of $15,000. The findings also indicate that for 96 percent of the couples, it is the first marriage.

The couple generally live in the city or suburbs (more than 80 percent) and come from "stable" homes where the mother had been a full-time housewife since the birth of her first child (more than 55 percent). Of the men and women in the sample, slightly more than 50 percent were either the only or eldest child.

Thirty percent of the couples had chosen surgical contraception and another 60 percent reported using temporary methods of contraception like birth control pills. Of those who filled in the two-hour long questionnaire, 56 percent said they did not practice a religion. Of those who did, over 50 percent were Protestants.

There is no major statistical difference between men and women with regard to age and education. But in income, the husbands were far ahead ($14,000) of the wives ($9,500).

The desire of both the husband and the wife to have careers appears to be the single most important reason for being childfree, says Hey. The need for freedom to pursue their personal interests and a desire not to add to the world's numbers were other explanations. Some of the couples also felt that by remaining childfree, they could do more for society and families.

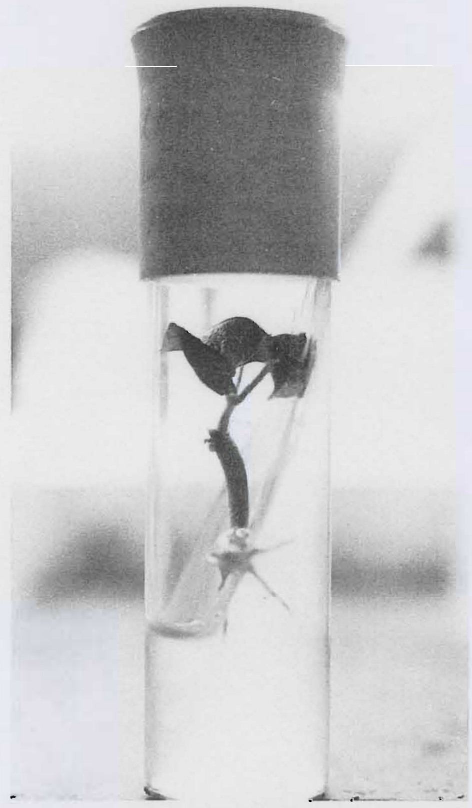
Though all details have not been analyzed, Hey feels there probably is a relation between occupations chosen and the desire to remain childfree. Business owners and administration personnel are well represented among the childfree couples, which might mean that commitment to occupation may be of greater importance than rearing children. Many couples who decide not to have children are involved (one or both partners) in occupations like teaching, social work, health services and library work which involve working with children or with families.

NEW USES FOR OLD CROPS

Snap beans and other dry edible beans have been around for a long time. In fact, these beans are a major source of food upon which cultures have been built.

In an effort to find new uses for beans Peter Ascher and David Davis, UM horticulturists, are crossing different bean species to arrive at a sort of primitive gene pool with a lot of variability. This process of reversing the evolution of the beans is called "interspecific hybridization."

"Through this process a plant breeder potentially could select bean species with certain desirable traits and crossbreed them to produce a multipurpose hybrid bean," explains Ascher. "The goal of our research is full utilization of a crop's genetic potential." Davis indicates that bean species generally have been quite isolated genetically or unable to hybridize.



A new project aimed at developing a multipurpose hybrid bean involves growing samples in test tubes (photo by Vince Becker).

The scientists believe that some day it may be feasible to produce a perennial hybrid bean that could be cut for forage, similar to alfalfa, during its first stage of growth. In the later stages of growth underground tubers rich in starch and edible bean seed high in protein could be harvested. It may sound far fetched, but 20 years ago soybeans were grown strictly for oil. Today soybeans are an important cash crop with a wide range of uses.

Snap and field beans are the basis of Ascher's and Davis' project. The scientists propogate bean plants by growing seed embryos that are 15-18 days old in test tubes. "We've found that the embryo must remain in the dark for 1 to 2½ weeks, or until the first leaf develops," Ascher says. "Otherwise the survival rate is extremely low." Ascher has successfully grown 90 out of 100 plants as a result of this breakthrough. Previously, when the embryos were under full light only 1 out of 100 plants survived.

"We need a lot of samples to conduct crossbreeding experiments because the genetic makeup of the plants is so different," says Ascher. "The discovery that light is detrimental to embryo growth has speeded our progress tremendously."

Besides snap and field beans, Ascher and Davis are conducting experiments with the tepary bean, a drought tolerant species, and the scarlet runner bean, which produces very large seeds.

The researchers are also looking into the feasibility of producing a hybrid bean that can grow under diverse environments. "A hybrid bean with a highly variable genetic background might do well under very dry conditions as well as quite moist conditions," says Ascher.

"Our plan also is to include in the research a South American bean that we know can grow for long periods with water over the top of the soil surface," Davis adds. "This is most unusual for beans."

At this point in time theoretical possibilities seem almost limitless. However, Ascher and Davis should shed some new light on the practical expectations of reversing the evolution of food crops as their research progresses.

TALL FESCUE FOR BEEF PASTURE

Tall fescue has not been used widely in Minnesota because it lacks palatability and winter hardiness. In yield trials at the North Central Experiment Station, Grand Rapids, which compared grass species for hay and pasture, tall fescue yields have been equal to or better than the yields of most grass species commonly grown in the state.

"More importantly, fall growth of tall fescue has exceeded that of other grass species," report researchers J.W. Rust and D.L. Rabas. They explain that late fall growth provides a potential for using tall fescue pastures to extend the grazing season later into the fall than is possible with other pasture species.

Kenhy tall fescue for beef pasture was evaluated at Grand Rapids by grazing the pasture with yearling beef steers in 1976 and yearling beef heifers in 1977. An adjacent orchardgrass pasture was similarly grazed for comparison.

Rust and Rabas found that average daily gain was greater on the orchardgrass pasture in both years. However, beef produced per acre and grazing days per acre were greater on the tall fescue pasture in both years. In addition, less winter injury occurred in the tall fescue pasture than in the orchardgrass pasture.

"The results suggest that satisfactory animal performance can be obtained on Kenhy tall fescue pasture," say the researchers. "If greater fall growth and improved fall palatability of fescue are real, or are found in future tests, tall fescue may be an important component of a pasture species system for late fall or stockpiled fall pasture."