1981 MINNESOTA SCIENCE /3

Helping in the Return of a Native page 4

AGRICULTURAL EXPERIMENT STATION
UNIVERSITY OF MINNESOTA

MINNESOTA SCIENCE
Volume 36 ○ Number 3

CONTENTS

On the cover: A young Canada goose is fitted with a neck band and radio transmitter that will allow wildlife scientist James A. Cooper to follow its movements. Banding studies lead to the discovery of the molt migration, in which non-nesting Canadas fly north from their spring migration stop to take advantage of longer daylight hours for feeding and avoiding predators while they molt. Cooper believes this is a way the geese increase survival of the year's young. By leaving nesting areas, molters do not compete for mid-summer food supplies needed by geese raising broods. See story, page 4.

Minnesota Science is published quarterly by the University of Minnesota Agricultural Experiment Station; Institute of Agriculture, Forestry, and Home Economics; St. Paul, Minnesota.

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Photo credits: Page 1: James A. Cooper; page 2: Don Breneman; page 3: Dave Hansen; page 4: J. A. Cooper; page 5: Mark Strand, J. A. Cooper; page 6: M. Strand; page 7: Lisa Ringhofer; page 8: D. Hansen, L. Ringhofer; page 9: Paul E. Read; pages 11, 12, 14: D. Hansen; page 16: Richard E. Widmer.

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Integration Strengthens Station, Extension

THE AGRICULTURAL Experiment Station and the Agricultural Extension Service are both components of Minnesota's land grant university. One conducts research; the other brings applications of what is learned from research to the citizens of the state. One employs research scientists; the other, extension specialists. One uses branch stations as its out-state bases; the other, county offices. But if you're a potato grower, a dairy farmer, a backyard gardener, or any of the other citizens who use the services and information provided by these two organizations, the differences between the two are not really obvious, nor all that important.

Richard J. Sauer, who heads the experiment station, and Norman A. Brown, extension director, are aware of this blurring of identity, but they don't necessarily see it as bad.

"Our clients see us all as part of the outreach of a land grant university," Sauer says. "In one sense, that speaks to the success we've had over the years in integrating the two programs. One could argue that the experiment station could be completely separate, located somewhere else, but I think it would be a real loss, to lose the integration."

Brown agrees: "I think it's good that our clientele don't see us as different. It may be just a historical accident, after all, that we are two different units."

Integration is a Strength

At the University of Minnesota, station scientists and extension specialists are housed as faculty in academic departments.

Director Brown: "I think it's good that our clientele don't see us as different. It may be just a historical accident, after all, that we are two different units."

Director Sauer: "Extension specialists are constantly providing input in terms of new research ideas. Say, you're a researcher and your extension colleague... says, 'You know, those farmers in the valley really have a challenge with regard to fertilizer recommendations on potatoes. What can we do to help?'"

The result is constant access and dialogue between the two groups, something the directors encourage.

Sauer says, "Extension specialists are constantly providing input in terms of new research ideas." This often occurs informally, as part of day-to-day business, he explains. "Say, you're a researcher and your extension colleague down the hall has coffee with you and says, 'You know, those farmers in the valley really have a challenge with regard to fertilizer recommendations on potatoes. What can we do to help?'

"And in some cases, specialists have joint appointments in the station and extension—the person doing the research is generating the new data base for the information he or she will be extending in the future."

Adds Brown: "I don't think a lot more could be done from a structural standpoint than what we're doing, integrating our people into a collegial setting where they are interacting on a day-to-day basis."

The advantage of that close association is that both units keep each other aware of, and their work relevant to, the needs of Minnesotans. "Extension is pretty shallow if it doesn't have quality research to extend," Brown says.

Sauer looks at it from the other direction: "I see us needing extension to deliver the results of our applied research to our clientele. Also, extension provides us some feedback that's balanced against other feedback we have in terms of the appropriateness of what we're doing. You can't have a strong experiment station without a strong extension service."

However, Sauer's cautious about the definition of "relevant." On this issue, the directors have different perspectives. Sauer is protective of the need to conduct basic research. He says, "We have some scientists who are doing very basic research that I'm sure some of the county agents don't understand. I'm sure they're asking, 'Why is he over there by himself and not doing things that will help us?'

"Well, I think some of that basic research anticipates a need for an answer to a problem 10 years from now, whereas you'll find extension people under the pressure of the moment, wanting help right now out there."

Brown, on the other hand, would like to see research findings made public sooner. "One of the criticisms that Director Sauer and I heard in our listening meetings out state when we first got here is that we tend to be too conservative in releasing research data," he says, "where farmers might say, 'If you've run the same experiment two years in a row and show a trend or a probable conclusion, we'd like to know about it, even if you're not ready to recommend a particular practice.'"

But, Brown admits that this would have to be contingent on the type of research and the risks involved. "If we're dealing with research on pesticides, for example, we don't have any choice," he says. "On the other hand, there are some things, for example, conservation tillage, where we may not be constrained by legal requirements. I think we could not only gain respect by releasing data in those cases, but might even get some farmers to collaborate with us and collect data for us, or at least give us their reactions.

"I think we need to be very cautious as we do that, so we don't lead people down the wrong path, especially where it's going to be dangerous from a health, legal, or economic standpoint, but it seems that in many cases we have individual farmers who are willing to take risks."

Brown Wants More Research on Marketing, Social Problems

Brown has some recommendations for station research: "What I hear constantly is that we need to do more research on marketing, both domestic and international. I also feel there's a need for more research on the family and youth programs. We have limited funds to do that, and we conduct more research in that area than many other experiment stations, but there are many social problems that need studying that relate to rural communities, to families in general, and to youth development."

(Continued on page 14)

Welcome Back, Wild Goose, Brother Goose

Canada geese live and nest on many Twin Cities lakes. These geese, resting near the Lake of the Isles in Minneapolis, take advantage of the good grazing afforded by lawns. Geese continue to grow in numbers in urban areas unless management practices limit reproduction or spread the birds to outlying locations.

ALMOST ALWAYS, THEIR CALLS come to us before they do. As they come into view, we feel lucky to be where we are. Everything about them—the steady honking; the powerful, unswerving flight; the excitement they create, speaks to us of what it must be like to be wild and free.

We stop what we're doing to watch them pass, to appreciate the vocal blessing of a flock of Canada geese. As the honking fades, they are gone.

For a few minutes, the sky seems very empty.

How empty, indeed, Minnesota's skies must have seemed in the late 1920s, when the last wild Canada goose nesting in the state was gone. At that time, according to James A. Cooper, associate professor in the Department of Entomology, Fisheries and Wildlife, the pressures of market hunting and a spring hunting season had done away with Minnesota's "Canadas," save for a few seasonal migrants.

That they were once all gone makes their comeback remarkable. Restocking, begun in the mid-1950s, and elimination of the spring hunting season and market hunting gave them a new start.

Today, Minnesota is home to perhaps as many as 30,000 nesting Canadas, and Cooper, who has studied the Twin Cities' geese since 1973, estimates that 4,000 to 5,000 Canadas are produced annually in the metropolitan area alone.

The picture is bright for Minnesota's Canadas, partly because of the research of Cooper and his students. They are currently studying Canadas at the Talcot Wildlife Management Area in southwestern Minnesota, near Dundee; in rural areas near Fergus Falls; and in 14 Twin Cities locations.

At Talcot, the researchers are looking at the role a refuge plays in developing a goose population. At Fergus Falls, where the goose population is growing

rapidly and geese are beginning to damage crops, they are seeking ways to control populations and steer grazing geese away from farmers' fields.

In the Twin Cities area, where eight years ago they began studying the effects of disturbances on nesting, Cooper and his charges have shifted the thrust of their research. The geese have proven to be hardy nesters in urban environments, so the researchers have begun to look at the increasing interplay of man and goose.

"I prefer to call them (the interplay) relationships, not conflicts," Cooper says. "We are trying to learn how to minimize the conflicts and maximize the benefits people get from geese."

Growing Goose Numbers Bring New Problems

There are two problems: crop depredation in rural situations and overpopulation leading to nuisances in urban areas. Through the use of research techniques such as time-lapse photography and neckbanding (to learn normal nesting behavior and what breeding-nesting sites geese use) and radio telemetry (to study where geese feed and the extent that different flocks come together socially), Cooper and his students have learned much about the bird and have found potential methods of mitigating both problems.

From banding studies, they know that Canadas return to where they were raised each spring to mate and nest. The returnees and their mates disperse to new nest sites (the parents drive them from the original site) in the direction of their fall flights, the direction "they know." The new pairs select sites offering protection from predators, even if food is lacking; they will fast during nesting. Then, a few days after the eggs hatch, the parents lead the goslings as far as 10 miles to a good rearing site.

This can mean trouble for farmers, when families of geese congregate to feed in corn and soybean fields adjacent to marshes. "We're documenting the extent of this depredation in the Fergus Falls area," Cooper says.

The researchers have found what they hope is a way of dealing with this problem. It appears that geese with young will not cross a barrier that is between their escape cover (a pond, lake, or marsh) and a grazing area.

Cooper says, "It doesn't even seem to have to be more than a meter (about 3 feet) high. And it doesn't have to be a fence—that would get awfully expensive. Any barrier plant geese won't graze on will work." In fact, he thinks that hedgerows planted between the nesting sites and fields may suffice.

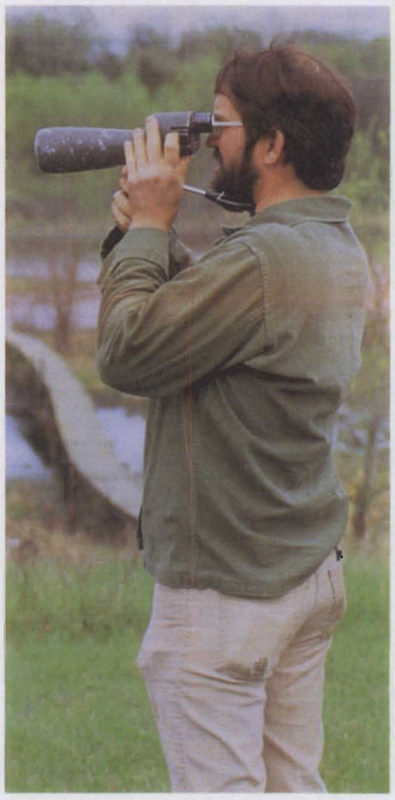
Urban Areas Become Havens for Geese

In urban areas, geese tend to cause different problems because civilization has provided well for them.

"We improve goose habitat in the urban environments by mowing our lawns," Cooper explains. "Geese are grazers. Cutting the grass keeps the meristems (the tender tips) growing. Also, our cities and towns tend to pass laws prohibiting shooting, mostly for safety reasons, and thus create refuges for the geese.

"Some people like them around and some don't. There will be complaints. Some people are offended by concentrations of geese, especially the droppings they leave behind."

The crowding problem won't get better by itself, according to Cooper's findings. As the metro-



Above: Jim Cooper studies the movements of a family of Canadas through a spotting scope at the George Metcaft Nature Center near Afton, Minnesota. Below: A pair of Canadas completes their nest. The female (right) pulls down from her breast to line the nest while the gander watches for danger. The strength of the pair bond is very important in nesting success. If a female must fend off intruders without help from her mate, she is more likely to abandon the nest or not have the energy to hatch and rear the young.

politan goose population grows, wildlife managers will have to take steps to thin and disperse the birds.

"As far as the geese are concerned, they're not overpopulated," Cooper says. "So in these areas, such as the Lake of the Isles, we need to increase the hunting pressure on them."

An increased bag limit or an extended hunting season would help accomplish this, and the increased goose numbers would mean better hunting. But Cooper also suggests physically moving some of the metro birds to outlying areas where they haven't spread yet.

"There is no shortage of goose habitat in Minnesota," he adds, "particularly in the northern and central parts of the state. There are a lot of good areas not being used yet for nesting."

Geese Are Vulnerable During Nest Establishment

Despite their steady increase, Canadas remain vulnerable at certain times, particularly when establishing nests, around mid- to late March. By studying time-lapse movies, Cooper and his students have learned that geese bothered at this time might abandon their nests; the birds won't defend their territory as willingly as after the eggs are laid and incubation has begun. Anything that forces the geese to get off the nest more than once a day is considered detrimental. It's hard to predict what types of intrusion geese will tolerate before nesting success is affected, Cooper cautions, although geese in urban areas that are used to people tend to be more tolerant of disturbances.

Cooper's research seems to bear out that, given a minimum of courtesy and some help leading them to places where they can cause little trouble, Minnesota's Canada goose population will increase in the coming years. Cooper estimates that the number of nesting Canadas in the state could rise to 200,000 in the next 25 years.

The Canadas' comeback may be one of the bigger success stories in modern-day wildlife management, thanks to Cooper and his associates, who have also studied wood ducks, northern shovelers, and trumpeter swans. The goal, Cooper says, is to learn enough about each species to make sound management decisions.

"Once we have the answers we need," he says, "we won't be in the business of neckbanding birds anymore. Our objective in the long run is to have no bands at all on our wild critters. We band to learn something."

Then, it will be time for the ducks and geese to thank people like Jim Cooper and his students by "speaking" to them, as they do so well, about what it's like to be wild and free.

—Mark Strand

A pair of Canadas leads their week-old goslings from the refuge of open water to a grassy area along the shoreline to feed. Cooper's research has shown that open water fringed with areas of nourishing grasses—and with no barriers to cross—is ideal for brood rearing. The goslings will grow fast. They will begin to show the distinctive white cheek patches by four and one-half weeks of age. By five weeks, they will have lost all natal down, and by nine or ten weeks of age, they will be able to fly.

For Peat's Sake, Energy *Does* Grow on Trees

IMAGINE YOURSELF in the year 2000. The evening news now holds more for you than a horrifying picture of what the OPEC nations are doing to world oil prices.

This dream could be reality by then, perhaps sooner, if University of Minnesota soil scientist Rouse Farnham can rally support for his ideas.

Farnham is the principal investigator in an experiment station project that could lead to the development of an alternative energy source—woody biomass—for Minnesota. He sees it as a partial solution to the state's $14-million-a-day energy bill, of which $9.7 million leaves the state. Biomass, the Minnesota Energy Agency estimates, could provide as much as 17.9 percent of Minnesota's energy by A.D. 2000.

"I advocate a multiple use of our peatlands," Farnham says, adding that Minnesota has enough undeveloped peatlands that some could be allocated for energy research and production.

In fact, Minnesota has approximately 7.5 million acres of peatlands, second only to Alaska among the states. The largest portion is in state and national forests. Wildlife refuges, natural areas, and recreational sites account for a lesser amount. But more than half, or 4.3 million acres, consists of undeveloped, natural bogs.

Farnham cooperates with resource managers from the Department of Natural Resources' peat program, which has looked at peatland inventories and constraints to development. "The state plans to select sites which will minimize any harm to the environment," he says. "Peatlands which lie within state and national forests, wildlife refuges, and recreational areas will not even be considered for energy development."

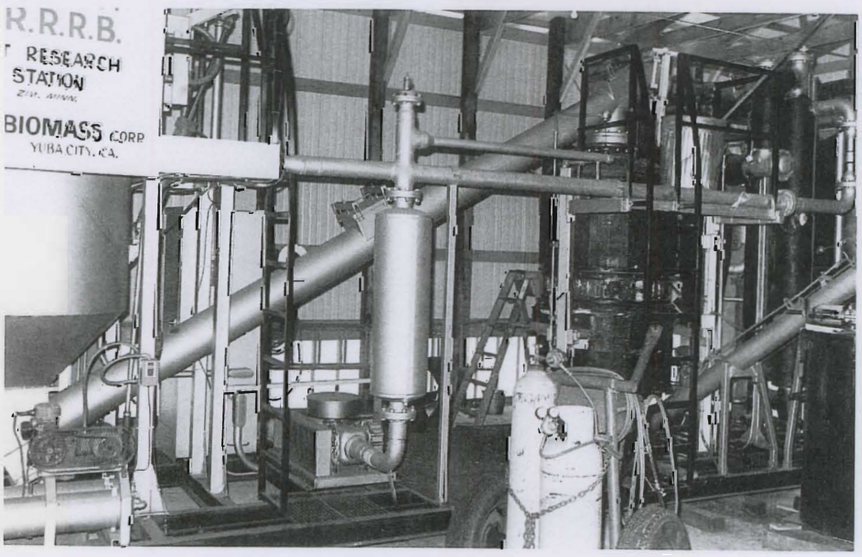
Minnesota's peat could be mined and burned for energy, but the resource would be depleted in perhaps 50 years if mined intensively, the Minnesota Department of Energy estimates.

Biomass Could Be Grown on Partially Mined Bogs

Instead, Farnham advocates a dual-use concept. First, peat would be mined off the top of a bog for direct use in energy production. But 1 to 3 feet of the partially decayed plant matter would be left as a substrate on which a woody biomass farm would be established.

Keith Renaldo records the yield of top growth harvested from a research plot of willows at Wilderness Valley Farms.

With this downdraft gasifier, university scientists measure the energy contained in woody biomass from the research plots. The low-Btu gas produced by the gasifier can be used for heat or to run an electrical generator.



Above, left: Paul Read checks a willow that was grown hydroponically to provide softwood cuttings for establishing clonal yield plots. Cuttings from stock plants are potted and placed under intermittent mist for rooting in the 30 × 144-foot greenhouse at Wilderness Valley Farms (bottom, right). Top, right: Dormant hardwood cuttings of a poplar are planted in the peat, the least expensive way of establishing a clonal plot. Two planting rates are being tested for the alders, poplars, and willows: 7,688 trees per acre and half that number.

Not all of Minnesota's peatland could be used this way. Farnham estimates that about 40 percent of the state's undeveloped peatlands are not deep enough to be mined and still be used for energy or food crop production. Instead, these shallow deposits could be used solely for biomass or food crop production.

So, what Farnham sees as a possibility are energy farms on reclaimed peatlands, which would convert solar energy to plant matter that could be used to generate energy. The plantings on these farms would be a renewable energy resource that he says could provide woody biomass for as long as 50 years before replanting would be necessary.

Farnham's ideas are being tested at Wilderness Valley Farms near Zim, in St. Louis County, a 610-acre parcel of reclaimed peatland maintained by the state's Iron Range Resources and Rehabilitation Board. There, Farnham and other researchers from the Department of Soil Science are evaluating promising tree species on 30 acres, the only peatland in the United States that has been planted to woody biomass crops.

Fanham and his assistants Bill Berguson, Tom Levar, Keith Renaldo, and Dale Sherf have so far established a number of woody biomass plantings at Wilderness Valley Farms. And by 1980, an experimental downdraft gasifier was in place at the farms with which the researchers could measure the energy contained in peat and various biomass feedstocks and demonstrate the feasibility of using biomass for energy production. In the gasifier, a feedstock is burned, producing methane, which the gasifier converts into low-Btu gas. The gas can be used di-

rectly for heat or to run an electrical generator.

Farnham's research team was assisted by Paul Read and Stephen Garton of the Department of Horticultural Science and Landscape Architecture, who designed a system for propagating rooted cuttings of 10 European willow clones. Within nine months, the number of cuttings had been increased to more than 60,000, and these have been planted in field plots at the farm. Plots of four native Minnesota willow clones, four hybrid poplar clones (from the U.S. Forest Service Experimental Farm, Rhinelander, Wisconsin), and three alder species, propagated from seed, have also been established.

The willows and poplars under evaluation are good candidates for woody biomass production because they are easily propagated from cuttings, grow rapidly on organic soils, and are able to regenerate top growth when coppiced (cut back to stimulate regrowth). The alders are more difficult to propagate vegetatively, but they can be increased from seed or by tissue culture. Once established, they also grow and regenerate well on organic soils. In addition, alders have the ability to "fix" atmospheric nitrogen to help them meet their nitrogen fertilizer needs.

To increase the Swedish and native willow clones, Read and Garton first rooted dormant hardwood cuttings under intermittent mist in a greenhouse on the St. Paul campus. The resulting primary stock plants were then grown hydroponically until they were large enough to provide softwood cuttings. These cuttings were in turn rooted under mist, potted, and grown in the greenhouse before being transported north to Wilderness Valley Farms. There, softwood cuttings were taken from the potted plants. These, after being placed in compressed peat blocks and rooted under mist, were transplanted to establish the clonal research plots from which Farnham is gathering data.

Read says this type of macropropagation—producing new plants by rooting cuttings, which are comparatively large pieces of plant material—can be used effectively to produce the relatively small numbers of trees required for the experimental plots.

Tissue Culture Would Figure in Large-scale Ventures

"We developed new techniques much like those we developed for the hardy, deciduous azaleas that were originated at the Landscape Arboretum," Read says, "but when Farnham's team selects the super willow or super alder that grows the fastest and produces the most energy per acre, there will be a need for

Willows grow rapidly on peatland; this Irish planting was coppiced 3 months (foreground) and 15 months (background) before this photo was taken. About five sprouts develop after a willow is first coppiced. After the first year, the trees' dense growth prevents weeds from growing in the plantings. Although the research plots in St. Louis County are now hand-harvested, mechanical harvesters will be needed for large plantings. Prototypes for harvesting woody biomass crops have been developed in Ireland and Sweden.

micropropagation or tissue culture to quickly establish large plantings." Tissue culture, he explains, makes possible the mass production of plants from a single bud.

The ultimate goal of the research is to select the trees that will produce the most energy per acre when planted densely and managed intensively, much as an agronomic crop would be. But many questions remain to be answered. Which clones are the most productive and persistent? How much fertilizer is needed for optimum yields without endangering water quality? What plant populations work best? What effect does time and frequency of harvest have on persistence, productivity, and recycling of nutrients?

Research has shown that more Btu's can be obtained by burning 1 pound of peat than by burning a pound of oven-dry biomass—9,000 Btu's versus 7,500 to 8,000. And although more peatland would be needed to produce the same amount of energy from woody biomass plantings than from peat mines, biomass crops are completely renewable. Mined peatlands, on the other hand, renew themselves much more slowly.

However, Farnham is quick to add that at the present time the annual accumulation of organic matter in Minnesota's peatlands far exceeds the yearly consumption of this little-used resource.

Although he has yet to determine how much energy a woody biomass planting can produce in a year, he estimates that yields could be about 10 tons of dry woody material per acre. Even higher yields have been reported by Swedish researchers.

Woody biomass, like peat, can be turned into energy of various types, depending on the extraction method used. Pyrolosis (direct burning) of wood chips or briquets can be used to generate electricity; gasification produces low-, medium-, and high- (pipeline quality) Btu gas; liquefaction produces methanol and benzene, which can be converted to diesel fuel; and fermentation produces ethanol, which can be mixed with gasoline for gasohol.

With Proper Drainage, Flooding and Pollution Are Not Likely Problems

Farnham says one misconception about draining peat bogs—and a reason why many people oppose the practice—is that water from the bogs will flood nearby streams. "If draining is done properly," he says, "you do not enhance flooding. You can control outflow with proper ditch design. And, when a bog is drained properly, with the water being directed through the peat instead of directly into a stream or lake, the bog water isn't likely to pollute because the peat acts

Tissue Culture to Play a Role in Energy Farms

"SCIENTIFIC DEVELOPMENT and the practical applications of cloning have come a long way," says Paul Read, the horticultural scientist who is a coinvestigator in Rouse Farnham's woody biomass research.

Read is an expert on cloning by tissue culture, or as he refers to it, micropropagation. "A clone is a group or population of plants produced asexually from one original plant," he explains.

Although all the trees planted thus far in the field plots at Wilderness Valley Farms have been propagated by rooting cuttings, a macropropagation technique, Read says there will soon be a need for much greater numbers of trees of various clones as Farnham's research progresses to the large-scale production of woody biomass for energy.

When that times comes, Read's team will be able to produce as many as 10 million trees of a particular clone in just one year from a single bud. "That's a very realistic and conservative estimate," Read says, "as it allows for contamination losses."

Hospital-like hygiene is employed when a clone is propagated by tissue culture. A tiny piece of tissue from a bud, known as an explant, is first disinfested to remove all organisms that could contaminate the culture. Should only one fungal spore or bacterium remain, it would be ruinous to the growth of the explant. All the tools used in the process are sterilized by heating to 1,000 degrees F, then they are cooled in sterile water.

The disinfested explant is placed on a culture medium in a virtually air-tight flask. The medium contains all the nutrients necessary for normal plant growth. It also contains sugars and hormones, which an intact plant would ordinarily be able to manufacture for itself. The medium is gelled with agar, a seaweed extract.

The flask with the explant is placed in a rack under lights. After approximately two months, the flask contains a cluster of 30 to 40 microshoots.

Each microshoot can be separated from its flaskmates and recultured to produce more microshoots, or it can be rooted in a potting medium, then put through a series of steps that

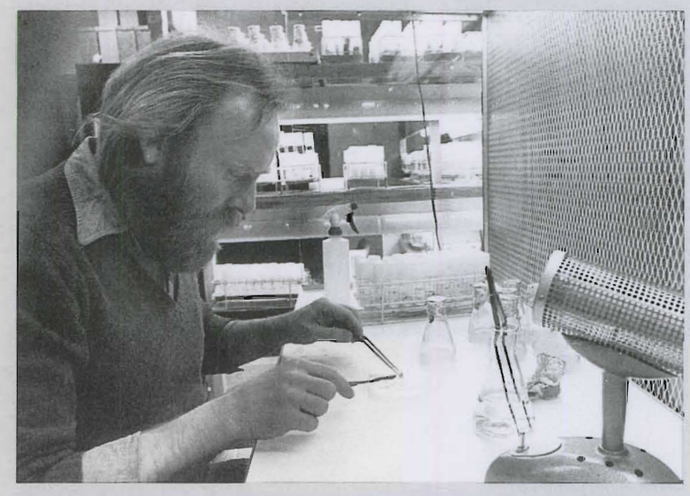
as a natural filter. In fact, my research on the Anoka Peatlands has shown that peatlands can be drained and used for intensive crop production without affecting the pH, nitrate, or phosphate levels of receiving lakes and streams."

Although the research at Wilderness Valley Farms is unique in the United States, woody biomass research is in an advanced stage in Sweden, Finland, and Ireland. Farnham cooperates with scientists from these countries, exchanging information, materials, and research findings.

Farnham has received state, federal, and private funding for his research. But the biggest problem confronting him now is to significantly reduce the cost of production and to identify peatlands and associated wetlands that have potential for commercial development. State policymakers do not always agree on where, when, and how much peatland development should take place, but they have stressed a "go slow" policy.

Nonetheless, Farnham remains confident that Minnesota will be able to partly solve its energy problems through the wise utilization of its peatlands.

—Lisa Ringhofer



Alders cannot be propagated easily by cuttings so tissue culture must be employed to increase clones. In a St. Paul campus laboratory, graduate student Stephen Garton cuts microshoots from a tissue-cultured alder explant. The excised microshoots can be reclutured to produce more microshoots, or they can be rooted (bottom, right) to produce entire trees that can be planted eventually in the greenhouse or outdoors.

will allow it to survive when planted outdoors or in a greenhouse.

This acclimation process involves the gradual reduction of the humidity surrounding the tiny plants. "This prevents the plant from suffering shock when it is removed from the nearly 100-percent humidity of the flask," Read explains.

Last summer, Read attended the Royal Dublin Society's first International Summer School on Energy Management in Agriculture in Ireland. "The school examines all energy aspects, and the consensus at this conference was that biomass can effectively supply a portion of the world's energy needs," he says. Read thinks biomass production has great potential in Minnesota, which has no coal or oil reserves, but plenty of undeveloped peatlands. "Good common sense tells us that we should use the resources we have at hand," he says.

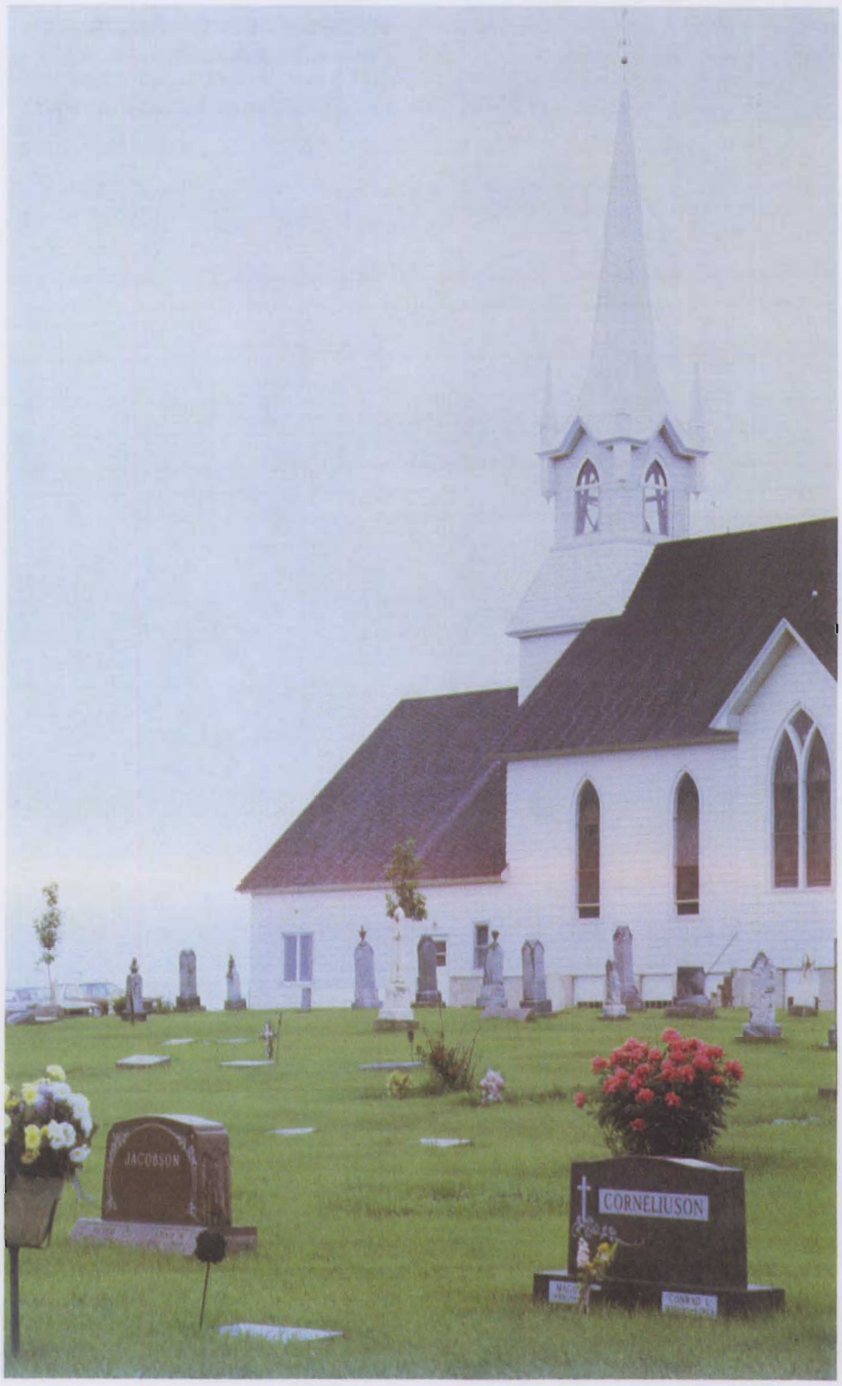
Churches: Vehicles of Change in Rural Minnesota

CHANGE. IT AFFECTS US ALL. Our society is on the verge of change as massive as the industrial and agricultural revolutions, says futurist Alvin Toffler in *The Third Wave.* At work and in our personal lives, new technology, ideas, and values clash with old. What results? How do we cope?

University of Minnesota rural sociologists are examining part of the change process in a long-term experiment station study of how decisions are made in rural communities and the role local social institutions play in this decisionmaking. "In a systematic way, we're trying to understand how conflict operates in a community and affects decisions ultimately made," says George Donahue, who heads the project. Social conflict has positive *and* negative effects and is an integral part of social change, he explains.

The first phase of the study involves Catholic, Lutheran, Methodist, Presbyterian, and United Church of Christ congregations in and near the high-voltage powerline corridor in west-central Minnesota.

Why study churches? Randy Cantrell, one of the researchers, suggests several reasons: "Churches are a readily identifiable social organization. They are



Allegiance to their parish is strong among rural Minnesotans, who often keep their church open even though they must share a minister with one or more other churches. Such is the case at Crow River Lutheran Church (right), near Belgrade, one of the churches surveyed.

a voluntary gathering place where it's acceptable—even expected to discuss values. And they've lasted, while schools, gas stations, and post offices have closed."

In many rural communities, says Cantrell, churches are genuinely important to the quality of life. They become involved in both controversial and noncontroversial decisions and sometimes are the only organizations available to help people in an area of concern, such as women's issues.

At the start of their study, the sociologists postulated that community involvement—the extent to which church activity in programs and services extends beyond the immediate congregation—results from the characteristics of the congregation and the way it is organized. They chose three criteria to measure community involvement: institutional support (sponsoring educational and other programs or making church facilities available to nonchurch organizations), ecumenism, and contributing to local community projects.

During the past three years, the sociologists conducted telephone interviews with pastors of 130 of the 137 congregations in the powerline corridor, using the results to define how local parish characteristics affect the ways the parishes get involved in their communities' decisionmaking processes. Pastors provided information on their and their congregations' involvement with several social issues and community programs. Among these were programs or activities directed toward the abortion-by-demand debate and the controversial powerline constructed in the study area.

One way the researchers analyzed the data was by comparing the community involvement of churches with growing, stable, and declining memberships. They found that rapidly growing churches and large churches in general were most active in their communities. Churches with declining membership did not have the resources to be active, and stable congregations tended to maintain the status quo.

Growing Congregations Provide "Room" for Differences

Large and growing congregations have to please a greater diversity of people. Jim Krile, graduate research assistant, says new political coalitions form and there are trade-offs in such congregations. "Generally," he says, "it's okay to expand a program that's of interest to a particular group as long as the interests of other groups are also being served. The more diverse the population, the more diverse the programming, so there are enough incentives to continue congregational involvement." And, he says, involvement in the community may actually stimulate church growth by attracting new members.

Many smaller rural churches have survived by "yoking"—the sharing of resources and a pastor with other congregations. Yoked parishes accounted for 58 percent of those surveyed, yet little was known about the impact of yoking on church life before this study was undertaken.

The researchers found that yoked parishes are less likely than single-point parishes to have any type of community involvement. The less a pastor was available, the less likely a congregation was to be involved in community activities and affairs, regardless of the congregation's size or age structure.

How Churches Are Organized Affects Community Involvement

The researchers also investigated the conditions under which a pastor, chairman of the board, or other church leader takes a stand on issues. They found that both issue and community involvement are influenced by the distribution of power in a parish.

When power is concentrated in denominational structures outside the local community, as is typical in Catholic parishes, a higher level of controversial issue involvement is likely. But when the power is concentrated in the hands of the parishoners —in rural communities, people who interact in many roles and know each other very well—there is a tendency not to allow potentially divisive issues disrupt the ties that bind the church to the community. Thus, there is more noncontroversial community involvement and less involvement in controversial local matters.

Donahue, Cantrell, and Krile will continue to study churches, and they plan to investigate other social organizations—schools, government, business, and family. They will try to determine why certain churches have survived while other institutions have declined, which may help people find way to maintain social organizations in rural areas. They will examine the ex-

tent to which social class is reflected in the church and will determine the part churches play in community decisionmaking by identifying lay leaders and seeing how they interact in other social organizations. Ultimately, they hope to gain an overview of rural community decisionmaking.

"As controversial issues like water quality and waste disposal crop up in rural communities, our findings can help us understand the decisionmaking process," says Cantrell. The researchers see their function as "analyzing the effects of change upon people and the social systems in which they live, and informing the public." Then, change agents such as political leaders and extension personnel can use this information to help local communities deal with conflict and decisionmaking.

—Sharon Farsht

Visiting after services is an important aspect of rural church life. The state of the corn crop; community happenings; cattle prices; politics; and controversial issues are all likely topics of discussion at Crow River Lutheran Church, which shares pastor James McCalmant with Big Grove Evangelical Lutheran Church.

(Continued from page 3)

In fact, for the first time the Assistant Director of Extension for 4-H has a tenured appointment in the Center for Youth Development and Research. "That was a purposeful decision to tie the research effort more closely to the youth extension effort," Brown says.

And, Sauer is investigating the possibility of establishing a formal advisory council for the station. "Extension has a state advisory council," he says. "At this point, the station doesn't, but a rider that stipulates that each branch station have an advisory council was placed on our last appropriation, and it might be logical to go the next step of drawing one or two people from each branch station advisory council and having that kind of clientele dialogue."

Sauer has other ideas to bring the station closer to extension's needs and goals: "At the branch stations, we could have some faculty who are jointly appointed by extension and the station," he suggests, "We don't have any now. In horticulture, for example, where there's a real need to do applied research on the adaptation of crops to particular areas of the state, there's also a tremendous opportunity for extension work with homeowners and commercial operations."

Despite a lack of joint appointment, many branch station faculty do extension work part time. Sauer estimates that many spend about 15 percent of their time in extension activities, although the percentage is much higher in some instances.

And, one of Brown's ideas for bringing extension closer to the station's needs and goals is to house more area extension agents at the branch stations, as some already are. He also suggests meeting with his state advisory council at a branch station every couple of years so the council members can better understand the research system.

—Jennifer Obst

Science Notes

RESEARCH CONTINUES ON HIGH-PROTEIN POTATOES

Work on the development of high-protein potatoes at the University of Minnesota is now concentrated in the laboratory, where horticulturist Sharon Desborough is developing methods to determine the nutritive value and amino acid balance and composition of the high-protein selections already developed.

Says Desborough, "We've learned a lot since we began our work in the 1970s, when we naively thought that total protein content was all important. We know now that it's not as important as the quality and balance of the amino acids and the digestibility of the proteins."

Desborough and potato breeder Florian I. Lauer developed several hundred high-protein selections by hybridizing the domesticated potato with two South American species, *Solanum phureja* and *S. andigena*. Most of the resulting hybrids with some yielding ability have about 50 percent more protein than commercial cultivars, which average 5-6 percent total protein on a dry-weight basis. Lauer is continuing to develop high-protein *S. phureja* and *S. andigena* parents and is crossing them to see whether protein content and yielding ability can be combined.

Desborough has compared the protein quality (as measured by the growth efficiency of rats) of 18 of the high-protein selections with that of Norchip, a commercial cultivar, and an "ideal" standard diet containing casein as the protein source. Potato flakes of each of the high-protein selections and of Norchip and the standard casein diet were fed to groups of rats. The protein efficiency ratio (PER) of the diet containing casein is 2.5. Norchip was found to have a PER of 2.09. But, the 18 high-protein selections had a mean of 2.3, with one scoring a PER value of 2.77, proof that the selections' protein quality is not nutritionally limiting, according to Desborough.

Desborough's research should help narrow the odds Lauer faces as he manipulates selections to develop commercially acceptable high-protein cultivars with disease resistance and good yielding ability. She is finding ways to fractionalize, identify, and measure the amino acids of the high-protein selections. She is putting together protein and component amino acid profiles for selections of common parentage, and will try to link these with the ability each group has to transmit the high-protein character to its progeny. And, she is trying to find out which proteins or enzymes play a role in tuber starch accumulation, which would be useful in screening selections to find potentially useful parents in a breeding program. Ultimately, she and Lauer hope to use a computer to predict the PER values they can expect from certain crosses.

Tests have shown that high-protein tubers yield flakes that are superior in texture, but it may be years before commercially acceptable high-protein cultivars are available to U.S. growers. High-protein potatoes may find acceptance sooner in developing countries, where they could provide a nutrient-rich alternative to rice as a basic food.

—Mary Kay O'Hearn

STATION SCIENTIST DESIGNS ENERGY-EFFICIENT PARCHER FOR WILD RICE INDUSTRY

Minnesota's wild rice industry is entering the age of energy efficiency with a new type of parcher designed by agricultural engineer John Strait. A continuous-flow parcher, based on a model Strait designed and built on the St. Paul campus, was tested during the 1981 wild rice harvest at Deerwood, Minnesota. The continuous-flow parcher uses only about half as much energy to parch a given amount of wild rice as a conventional rotary drum parcher.

There are 18,000 acres of commercial paddy wild rice, as opposed to wild stands, in Minnesota. Each year, farmers produce 2 to 4 million pounds of

FINANCIAL STATEMENT
MINNESOTA AGRICULTURAL EXPERIMENT STATION
Research Fund Expenditures
Fiscal Year 1981

Expenditures by Source	**Percent**	**Amount**
Federal Funds	12.6	$ 3,806,536
State Appropriations	61.0	18,416,092
Gifts and Grants	18.1	5,472,822
Fees, Sales, Miscellaneous	8.3	2,499,270
Total	100.0	$30,194,720
Expenditures by Objective Classification		
Personal Services	70.9	$21,391,695
Travel	2.0	597,211
Equipment, Land Structures	5.0	1,522,118
Supplies and Expenses	22.1	6,683,696
Total	100.0	$30,194,720
Expenditures by Location		
University of Minnesota—St. Paul	85.6	$25,858,770
Branch Stations—Within Minnesota	14.4	4,335,950
Total	100.0	$30,194,720

wild rice from this acreage, and the grain must be parched—a process that results in its being dried and slightly toasted—before it can be hulled and marketed. During parching, the moisture content of the rice is reduced from 40 to 45 percent to 5 to 9 percent.

The parcher Strait developed dries a continuous flow of rice, 1,000 pounds each hour, unlike conventional rotary drum parchers, which dry the grain by the batch. The main part of the unit is the parching compartment, which is 26 feet long and has three conveyors. A feeder sends a uniform, 1-inch layer of green wild rice through an airlock into the compartment. The airlock acts like a revolving door, letting rice into the parcher but preventing the influx of cold air. In the compartment, the rice is subjected to superheated steam at 295 degrees F for 40 minutes.

Why use steam? "Laboratory experiments showed us that steam causes fewer stress cracks and less breakage in the rice than dry air," says Strait.

The parcher also has a return duct, which allows for the continuous recirculation of the superheated steam and contributes to energy efficiency.

"Industry data indicate that about 21 to 23 gallons of propane are needed to dry 1,000 pounds of green rice with a rotary drum parcher. Only about 10 gallons of propane were used to dry the same amount of rice in the continuous-flow parcher," Strait says.

Although the prototype tested at Deerwood dried rice to the proper moisture content, Strait says it produced more kernel breakage than his laboratory model. He thinks this may be due to air infiltrating into the unit, creating air-drying conditions rather than the more desirable steam drying. Now, he is working on pinpointing and correcting the difficulty.

—Jennifer Obst

STATION RELEASES NEW MUM FOR 1982

Minnesota gardeners will be able to buy plants of a new garden chrysanthemum, Centerpiece, at local garden centers, nurseries, and florists in 1982. Centerpiece is the 62nd garden mum that has been developed specifically for the Upper Midwest by the University of Minnesota. It was developed by scientists from the Department of Horticultural Science and Landscape Architecture in a research project funded

by the Agricultural Experiment Station.

The flowers of Centerpiece are 4 inches wide, their quilled, rose-lavender petals radiating from golden centers. They form a canopy over the vigorous plants, which are 20 inches wide and 24 to 26 inches high. The flowers are borne on relatively long, willowy stems covered with rich green foliage, making Centerpiece a good cut flower cultivar.

In the Twin Cities area, Centerpiece begins to bloom the first week of September and continues until killing frost. The blossoms have displayed above-average frost resistance.

—Sam Brungardt

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