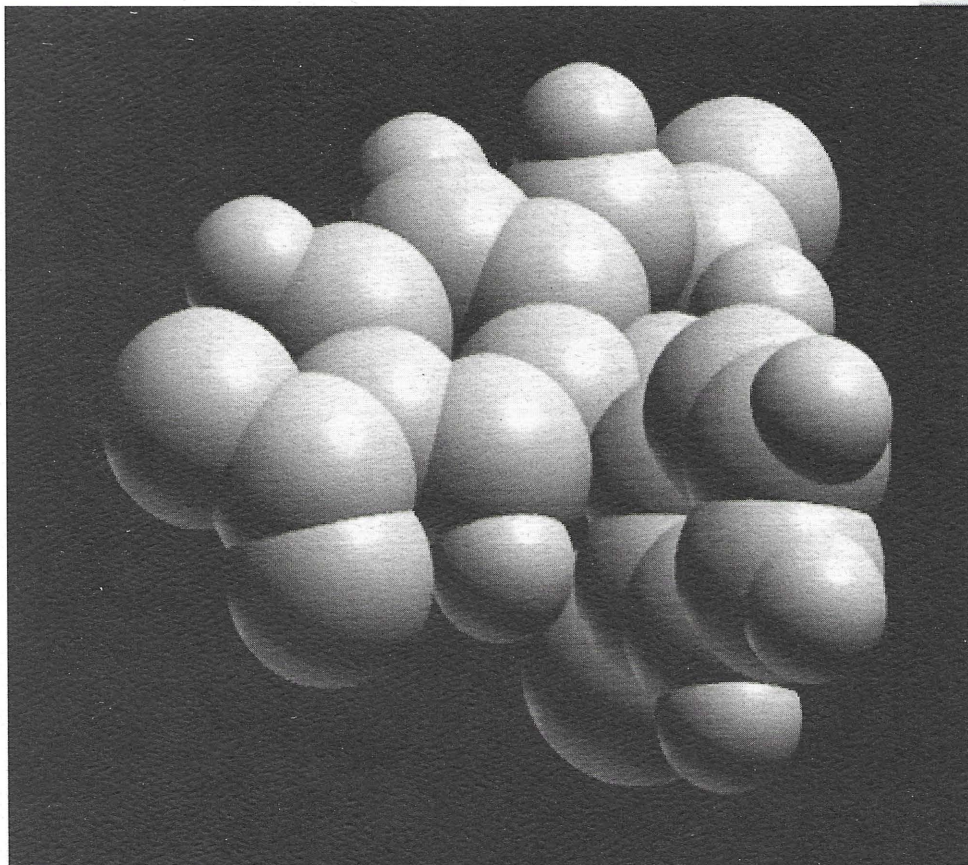


NRRI

NATURAL RESOURCES RESEARCH INSTITUTE

Noze

S U M M E R 1 9 9 3



AIDS inhibitor discovered using UMD-NRRI software

Upjohn recently identified a new family of AIDS-inhibiting compounds using computer software designed by UMD-NRRI scientists. As other major pharmaceutical companies and the National Institutes of Health work to advance medical treatments, NRRI scientists provide consultation and training through ground-breaking software development. Meanwhile, the emphasis of our environmental chemistry program continues on the path of evaluating the risk of chemicals in the environment.

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UNIVERSITY OF MINNESOTA DULUTH

In Perspective

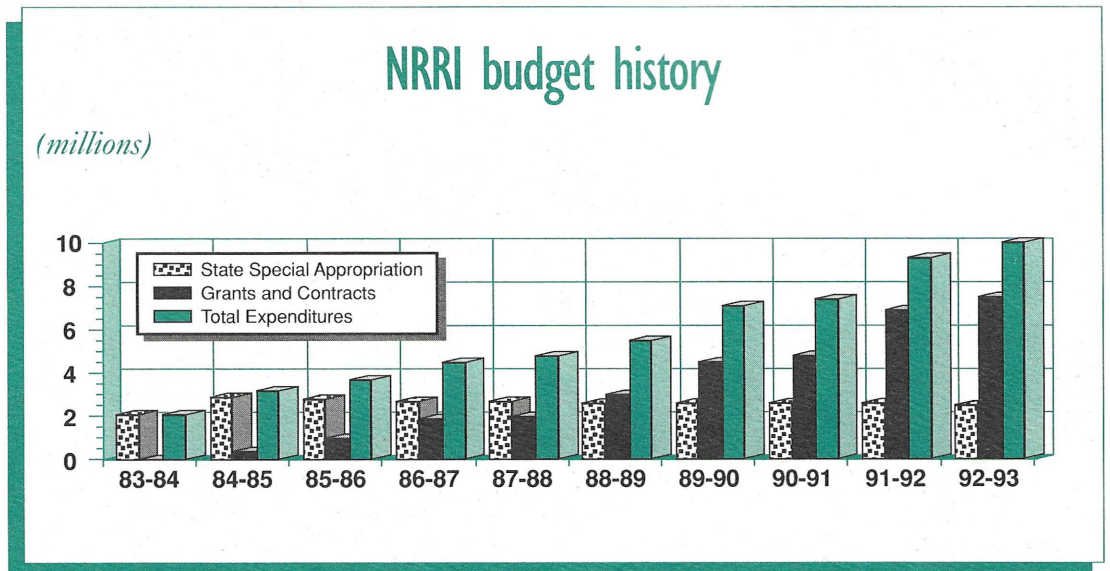
Looking at milestones of the past, turning toward continued growth

As we near completion of our \$2.5 million Phase V renovation and approach NRRI's tenth year, I have been reflecting on how far NRRI has come in such a short time. Looking back at some historical records, a chart that detailed the financial status of the Institute five years ago caught my attention. It indicated that activity at the Institute has doubled from almost \$5 million to about \$10 million per year.

But financial measures do not tell the whole story of NRRI's growth.

NRRI has been an active participant in renewed discussions on taconite industry problems, including the Taconite Enhancement Committee and Governor's Task Force on Mining, which emphasize the importance of research in determining the long term health of the industry. The Minnesota Legislature has responded by setting up an endowed fund for mineral research by NRRI at its Coleraine laboratory. The fund is based on income from new royalties from mineral leases on State land. While interest from the fund will provide only nominal research support of about \$75,000 in the first year, the amount will increase annually until about \$1.5 million per year is available in 10 to 15 years.

Recently, I had an opportunity to participate in a very positive meeting of State and industry forest managers at NRRI. The research dis-



cussed was our Center for Water and Environment's cooperative effort with the Minnesota Department of Natural Resources on songbirds. An important thrust of the research is to learn which species might be threatened later, in order to determine and implement forest management practices which prevent spotted owl-type scenarios.

As reported in the previous issue of *NRRI Now*, BHP announced that it was undergoing final economic analysis of an ilmenite mining and processing operation that would employ about 200 on the Iron Range. By providing information, technical support and research, the Institute and others have expended a great deal of effort to stimulate development of non-ferrous mineral prospects.

While many NRRI efforts to encourage job growth

Financial measures do not tell the whole story of NRRI's growth.

are long term by nature, other events seem to directly point to NRRI's value to the area.

For example, Cirrus Design Corporation recently announced that it will headquarter its aircraft design and manufacturing company in Duluth to initially employ 60. During its site study, the company reacted quickly and positively to the prospect of

assistance from the Institute on researching and testing composite materials.

Something more intangible than financial measures, but very real, has been happening. Perhaps it's a maturation process, or just the result of diligent efforts to establish research capabilities and to build relationships. In any event, we are interacting with our constituents in more meaningful ways.

NRRI's base State Special funding, which provides support services to the overall Institute effort, has decreased by 20 percent due to cut-backs and inflation. These realities will frame the challenges for the Institute in the next five year period and will have to be carefully addressed.

Michael J. Lulich

Michael J. Lulich
Director

New AIDS inhibitor identified with UMD-NRRI software

From toxicology to pharmacology: Chemical prediction spans fields



The development of POLLY was broad-based. Basak and scientists at the University of Calcutta contributed to mathematical theory; Vincent Magnuson and Donald Harriss (UMD Chemistry) helped design the software; Gerald Niemi (NRRI), Magnuson and Ronald Regal (UMD Statistics) contributed knowledge of how to compute molecular similarity. Collaborators include NRRI's Robert Hunter, Greg Grunwald and Peter Bye; and others from the University of Minnesota, Twin Cities and Duluth, Drake University and Texas A&M.

Recently, the Upjohn Company used a computer software program named POLLY designed by UMD-NRRI scientists to discover a new family of HIV inhibitor compounds. The promising compounds are entirely different from the AIDS-fighting drug AZT.

As an exciting application of NRRI's work, the use of POLLY in AIDS research resulted from our development of mathematical theories and computer software for general applications.

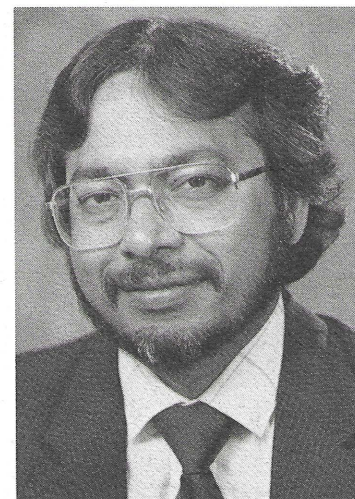
NRRI biochemist Subhash Basak explained, "We develop mathematical theories and software general enough to be applied in a wide variety of situations such as molecular design (e.g., fuels), discovery of new drugs and risk assessment of chemicals.

"We began with environmental applications, but soon our technology was being used in other areas such as drug design. In turn, pharmaceutical applications are generating ideas for hazard assessment. This highly networked,

national effort is truly a cross fertilization among various disciplines," said Basak.

At NRRI, our work began 10 years ago when we started collaborating with the U.S. Environmental Protection Agency to develop mathematical theories for chemical risk assessment. Theory and computer software, rather than cost-prohibitive lab work, is used to predict the toxicity of chemicals before they can be considered for development by U.S. companies. Pharmaceuticals followed suit, learning that the same theoretical tools and software can help them design new drugs.

Drug companies first noticed NRRI's expertise in chemical prediction in 1987 when Upjohn implemented POLLY in its drug discovery protocol. Then in 1990, the National Institutes of Health awarded NRRI a \$1 million grant to develop a computer hardware and software system that would help evaluate chemicals for anti-epileptic properties, the first step in designing new drugs to treat a specific type of the disease. This work is ongoing, as the Institute works to screen over 16,000 chemicals by December 1993.



Subhash Basak

"[Basak's] work has had a significant, positive impact on the drug discovery efforts of the Upjohn Company. In addition, it has spurred our interest in the whole area of molecular similarity," said Michael Lajiness, Upjohn Company information scientist.



Why use theory rather than practice to assess chemicals?

It's cheaper, more practical and results in less animal testing than traditional lab work.

The U.S. EPA requires risk assessment of new chemicals before they are manufactured. However, available data is limited, and more than half the 3,000 chemicals submitted to the EPA have no test data at all. There are about 60,000 chemicals that need to be tested for toxicity; 3,000 are added to this list annually. Worldwide, more than 12 million chemicals are known, with 500,000 more discovered each year. Animal testing of one chemical for carcinogenicity costs over \$2 million.

Environment *North*



Forests & Wildlife

Monitoring bird populations

To assess the relative abundance and habitat requirements of forest birds, our scientists are continuing to monitor bird populations in the Chippewa, Superior, and Chequamegon National Forests and sites along the St. Croix River. In its third year, the project is part of a long term program sponsored by participating forests, North Central Forest Experiment Station, U.S. Fish and Wildlife Service and the Legislative Commission on Minnesota Resources.

According to NRRI ornithologist JoAnn Hanowski, "While it's too early in the program to see any trends, our 1991-92 data showed decreased numbers of species that migrate short distances, such as white-throated sparrows and yellow-rumped warblers. This decline may be the result of last year's early summer frost."

"There probably was nest failure, since some birds were observed migrating south in July. Frost also could have killed nestlings, too young to regulate their own body heat while parents were searching for scarce food," said Hanowski, who leads the project with our Center for Water and the Environment director Gerald Niemi.



Monitoring data from 1800 sampling points, or about 600 forest stands, will be incorporated into a broader study of the effects forest change on birds. Funded since July 1991 by the LCMR, the project is led by Niemi, NRRI forest ecologist David Mladenoff and Lee Pfannmuller, director of Ecological Services for the Minnesota Department of Natural Resources.

In addition to censusing numbers of birds, researchers are examining nest success of forest birds in different stands. At large study areas in the Superior and Chippewa National Forests, nest searching in June and mist netting in June and July will yield data on where birds are having the best nest success.

How well do certain species do in different forest habitat types and sizes? Do some need large areas? Answers to these questions will be incorporated into management guidelines that aim to maximize wildlife biodiversity.

Lakes, Rivers & Streams

Developing biocriteria

To help resource managers assess water quality, our scientists are developing biocriteria — assessment standards based on evaluations of natural communities such as fish, invertebrates and algae, and how they are affected by land use.

"In the past, water quality assessment considered only the chemical and biological characteristics of a water body," said Lucinda Johnson, who along with Carl Richards and George Host leads the biocriteria development effort.

"This technique examines the role of land use and land cover in regulating the physical habitats for fish and insects. It not only allows managers to evaluate water quality, but also offers solutions for the restoration of biological communities," said Johnson.

The research team is constructing and analyzing a

set of computer-generated maps featuring streams, lakes, land use and land cover in central Michigan. Funded by a \$248,000 grant by the Environmental Protection Agency, the project integrates Geographic Information Systems mapping technology with conventional physical, chemical and biological assessments.

Preliminary study results confirm that the proportions of forested, agricultural and urban land-use types create predictable changes in stream communities. This relationship between land use and water quality makes the biocriteria method transferable to other areas.

"These standards will add consistency to water quality evaluation, monitoring and regulation efforts. Resource managers can apply the biocriteria to stream watersheds over the Upper Midwest," said Richards.

"Forest songbirds are abundant and diverse in Minnesota. With appropriate planning for their needs now, the state is in an excellent position to avoid the problems that have occurred in other parts of the U.S."

Gerald Niemi
director, Center for Water & the Environment

Wetlands

Role in water quality

Aquatic microbiologist Joseph Schubauer-Berigan is leading a study of two St. Louis River wetland sites to better understand the intricacies of riverine wetland ecology.

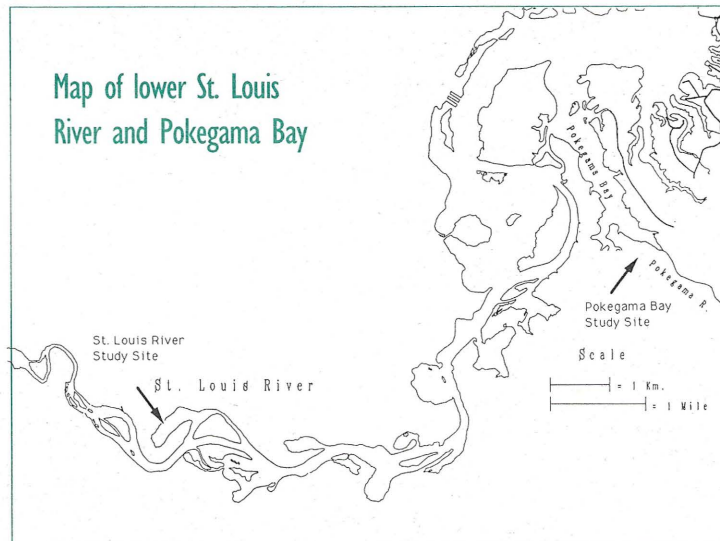
“This is a study we’re conducting to learn about how these wetlands function, especially the chemical and physical interaction of plants, sediment, bacterial and nutrient processes,” said Schubauer-Berigan.

Funded by a two-year, \$200,000 grant from the U.S. Department of Agriculture, the research team is analyzing water, sediments and soils from 75 sample points in each wetland study area. Rates of sedimentation, concentrations of nutrients, bacterial processes in the soils and water quality will be determined.

Study areas were chosen for their similarities, with one exception: sediment type. Both wetlands feature variable water depths and natural levees; red clay dominates the Pokegama River, while sand and silt are found at the Fond du Lac site. Each sediment type is associated with different chemical processes and contribute to each wetland’s unique ecosystem.

After collecting sediment cores from across the wetlands, samples are being analyzed for nutrient content and rates of microbial activity.

Core samples of riverine wetland sediments are collected and analyzed for their physical and chemical properties. NRRI scientists are investigating how sediments, plants, bacterial and nutrient processes drive wetland ecology. This and future studies may shed light on how pollutants are stored and transformed in wetland sediments.



Wetlands along the St. Louis and Pokegama rivers feature different sediment types that affect the ecology of each area in unique ways.

Some sites were sprinkled with white clay early this spring, to serve as a point of reference for next spring’s sampling when researchers check sediment accumulation over the course of the year. Scientists are also anchoring bottles underwater to collect and measure sediment that settles to the bottom.

Wetland scientist Carol Johnston is examining sedimentation and sediment nutrient processing over the span of the study areas. Wetland scientist Scott Bridgham is analyzing soil chemistry in order to identify wetland areas most important to maintain for their positive influence on water quality.

Environmental Remediation

Great Lakes sediments

A research team led by Robert Ludwig (Coleraine Minerals Research Laboratory) recently completed phase one of a U.S. EPA funded investigation for the remediation of contaminated sediments from Great Lakes Areas of Concern. This phase of the project included sediment sample characterization involving chemical and particle size analyses and a bench-scale separations test program.

Standard mineral technology is being used to remediate coarse sediments. For some sediments, as much as 90 percent by weight of the original bulk material can be isolated as clean sand and returned to the environment. The remainder contains hazardous waste organics which need proper disposal. Toxics such as PCBs are associated with the organic component of contaminated sediments.

The next phase of the project focuses on developing different remediation techniques for fine sediments containing large amounts of silts and clays. Researchers continue to grapple with problems posed by the large amount of waste water that requires clarification before being returned to the lakes.

MIN *Industry*

Forest Products

Hardwood veneer flooring

In the quest for new products with potential to create jobs, NRRI researchers have developed another winning item: a beautiful, economical alternative to solid wood plank flooring that looks and wears like the real thing.

"We're ready for a Minnesota manufacturer to step in and take over," said Roy Adams about the hardwood veneer flooring produced and tested at NRRI. Adams directs our BioProducts division, which includes wood products, forestry and peat programs. "In terms of environmental sense and what's required to manufacture it, we think it's a really cost-effective idea," he said.

The flooring is made from oriented strandboard covered with hardwood veneer, then tongue-and-groove cut and finished. Prospective manufacturers can choose to assemble and cut the flooring on site, or send it out for tongue-and-groove machining. A built-in vapor barrier eliminates the need for separate vapor barrier installation.

According to one of the developers, NRRI scientist Ken Roos, production is environmentally friendly. "We use a dry process with no liquid resins. Also, plant emissions are very low," said Roos, who teamed up with NRRI hardwood specialist Pat Donahue to design the product. The oriented strandboard and ve-

EVERY YEAR
IN THE U.S....

311 MILLION
SQUARE FEET
OF FLOORING
IS INSTALLED...

58 MILLION
SQUARE FEET
IS SOLID WOOD
PLANK FLOORING.

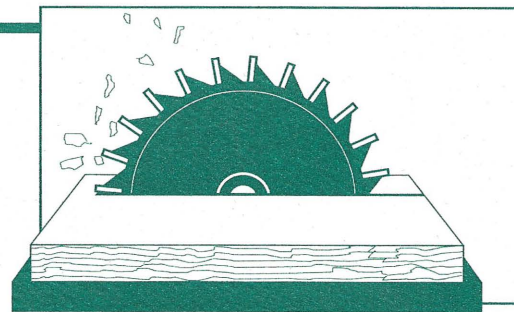
neer combination makes forest resources go further.

Initial testing proved the strength and quality of the hardwood veneer flooring to be comparable to solid plank. Current field testing will continue into 1994 to assess product installation at commercial and residential sites. Meanwhile, our Business Group staff members Kathy Forslund and Jim Skurla are preparing a business prospectus.

About 2500 square feet each of oak and maple flooring were donated for testing: oriented strandboard from Potlatch, Inc., Grand Rapids; overlays by Dyno Overlay, Hayward, WI; finishing by Valspar, Minneapolis, and machining by Lexington Manufacturing, Coon Rapids. The project is funded by the University of Minnesota Office of Research and Technology Transfer Administration.

Forestry

Short rotation potential



Short rotation forestry (SRF) is a method of growing hybrid poplar trees as a crop on agricultural land. Already practiced in the Northwest U.S., SRF could also produce wood for forest products and fuel in the Midwest.

"It will take the efforts of a lot more people for short rotation forestry to achieve its potential in Minnesota. A major question remains as to what yields can be expected," said NRRI forester/soil scientist Bill Berguson, who leads our contribution to SRF research.

"Plantations are just old enough to begin to produce reliable yield data. We need to wait for the trees to grow, develop more hybrids and learn how soils contribute to yield," said Berguson.

Many groups are working to advance SRF, including the Agricultural Utilization Research Institute (AURI); the University of Minnesota, Crookston; the U.S. Forest Service, Grand Rapids; other government agencies and industries.

The wood products industry views SRF as a potential tree supply for oriented strandboard (OSB) mills. According to the American Plywood Association, demand for OSB by 2003 will require 10 new U.S. factories. Each plant would generate 300 new jobs, including spin-offs.

Utility companies value SRF due to its potential to produce biomass for energy. The National Energy Policy Act of 1992 provides a tax credit of 1.5 cents per kilowatt hour to companies that generate electricity from renewable resources such as trees.

According to Tom Houghtaling, Supervisor-Land and Property at Minnesota Power in Duluth, "SRF is of major interest to Minnesota Power. We're monitoring research closely, so that if and when it becomes economically feasible, we are part of the effort." Working with a broad spectrum of environmental and economic groups to lay the groundwork, Houghtaling participates in the National Biofuels Round Table, established by the National Audubon Society and the Electric Power Research Institute, Palo Alto, CA.

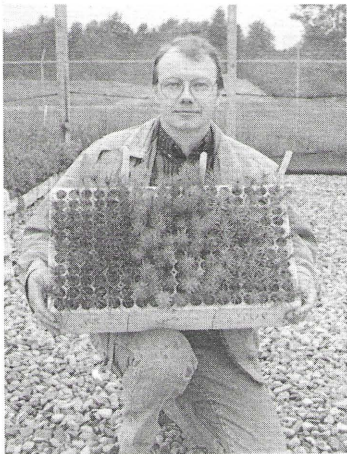
With further research and incentives for farmers who would establish the plantations, SRF may represent an alternative use for 2 million acres of agricultural land that is currently out of production.

NRRI's role will be to continue to examine how soils and climate contribute to tree production. Our SRF research is funded by the Legislative Commission on Minnesota Resources and the Agricultural Utilization Research Institute.

Peat

Compost for superior trees

NRRI's work to determine the best growth medium for trees could potentially help supply millions of superior seedlings to the forestry industry. While a mixture of Sphagnum moss peat and vermiculite is standard, soil



scientist Kurt Johnson contends that peat compost added to the mix helps produce significantly better seedlings.

"Peat-based composts share the same beneficial properties as moss peat, including a high water holding capacity and optimum pH range," said Johnson. "Also, they are biologically active, contain slow-release organically bound nutrients and suppress certain plant diseases."

Itasca Greenhouse, Inc., Blandin Paper Company and Fafard/Minnesota Sphagnum, Inc. are also participating in the study. Funding is provided by Minnesota Technology, Inc. and by in-kind contributions from project cooperators.



NNRRI's Craig Maly and Kathy Hanson (right) team up with employees of the Blandin Tree Nursery to prepare containers for planting with seedlings. Top: Scientist Kurt Johnson holds a container of red pine, white spruce and white pine. Researchers are measuring the effect of peat compost on the different species.

Peat-based composts are biologically active, contain slow-release organically bound nutrients and effectively suppress certain plant diseases.



Minerals & mining

Taconite program objectives

Times are changing for the U.S. taconite industry. Mini-mills are competing with the integrated steel producers to provide steel for the country, and NRRI will assist both.

"Through research and development, we're ready to help the Minnesota taconite industry," said Thys Johnson, director of NRRI's Center for Applied Research and Technology Development. "The taconite industry will be around for at least the next three to four decades, but they may be required to produce a different product, which we're ready to help develop. Our objective is to help the taconite industry in Minnesota."

While mini-mills use scrap iron for a portion of its materials, they also need clean iron units. With this in mind, Coleraine Minerals Research Lab (CMRL) is developing a better quality taconite pellet with a lower silica content and higher quality of strength.

"By the turn of the century, the steel industry will need not only taconite pellets for integrated steelmaking, but also for clean iron units in the direct reduced iron method of steelmaking," said CMRL director Rod Bleifuss. "Minnesota's taconite industry must be prepared."

A major focus of the project is to determine if compost enhances greenhouse production of containerized seedlings. With a better survival rate than bare root seedlings, the containerized variety require less time and space.

Several peat-based turkey litter and hog manure compost mixtures are being tested in growth trials of white spruce, white pine and red pine at Itasca Greenhouse, Inc., Cohasset, MN. Preliminary results indicate that the mixtures richest in compost yield taller trees.

In another growth trial at Blandin's Nursery near Grand Rapids, our scientists are testing the effect of compost on the growth of black and white spruce tree seedlings in outdoor nursery plots prepared with several rates of peat-based turkey litter and hog manure compost. Seedlings will be measured throughout the summer.

Future research includes growth trials using a hybrid aspen species planted extensively as part of Blandin's reforestation program.

In Business

Direct mail

Not as easy as it appears

"Our 800 phone number was advertised by mistake as the number for Elvis stamps on TV," said Ginny Forti of Sunrise Gourmet Foods in Hibbing. "A couple months later another TV ad featured our number for tickets to the L.A. Open. Right now, our 800 number is unlisted!"

Like Forti, other entrepreneurs discover that direct mail is not as simple as they imagine. Advance planning and capital are prerequisite.

"Before clients ever get to make a sale, they need a business plan, financing and a target market identified," said business development specialist Jim Skurla, who helps clients with loan applications and market assessments.

Along the same lines, business development specialist Kathy Forslund said, "Identifying your market is one of your first priorities along with pricing of your services and products. You need to be sure that your pricing covers your product costs, overhead, phone and your shipping expenses."

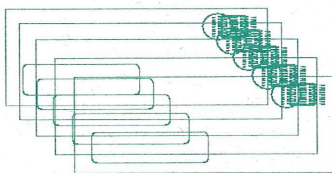
Forti has some of her own advice to offer. "Rule Number One is keep an extra copy of your mailing list," she said. "Having our computer malfunction and losing the most current mailing list really caused us problems." Forti also runs a bakery in Hibbing where retail trade generates referrals for her mailing list.



"Having specialty items, like potica, brings back many memories for customers. It can be difficult to keep the conversation short as they recount family gatherings instead of placing orders."

Ginny Forti
Sunrise Bakery,
Hibbing

"You need to be sure your pricing covers your product costs, overhead, phone and shipping."



"I only send catalogs to customers who request them at my retail store," said Jay Erckenbrack of Minnesota Wild, a specialty food product company. "That's my secret for a tremendous response of 50 percent orders from my catalog mailings!"

Erckenbrack has purchased ads in gourmet food magazines and found that his response did not cover the cost of the ad. He also tried

some Minnesota magazines—responses at least covered ad costs. Forti's best advertising took the form of articles in the *Los Angeles Times* and *Midwest Living*.

Both Forti and Erckenbrack would like to sell products wholesale to established national food companies for retail sale in their catalogs. Both entrepreneurs will keep their direct mail businesses scaled down.

MN lab database

SBI students get the job done

UMD Small Business Institute (SBI) graduate students Peggy Blalock, Penny Dieryck, Tim Vienneau and Cezary Witzczak recently compiled a database for resource managers and all who need facts on Minnesota environmental testing services.

"Even though our lab at NRRI isn't set up to perform a referral function, we always like to provide information to resource managers and serve the public in the best way possible," said Rich Axler, analytical laboratory supervisor.

Axler and researcher Chris Owen determined the need for a general access environmental lab database that could be updated, including listings of expertise and geographic region. Business Group director Lee Jensen knew that the ambitious project of creating such a database perfectly fit the SBI program goal of engaging students in outreach business experiences. Jensen recommended UMD professor Joyce Grahm's graduate marketing class, which included SBI members Blalock, Dieryck, Vienneau and Witzczak.

"This was a great opportunity for the students and for us to provide more complete information to those seeking specific services of Minnesota labs," said Owen.

The database will soon be available for public and private sector use.



If you would like your name added to the CED mailing list, please call us at 726-7946.

Invention success

Wound measurement tool

“I would not be at the point I am right now without the assistance and information I received from the University,” said Janet Webber, nurse, inventor and entrepreneur.

Webber is currently trying to patent her wound assessment tool, which she developed with the help of various services including those provided by our Machine Shop engineers and technicians, and business specialists from NRRI and Minnesota Technology, Inc., Virginia Regional Office.

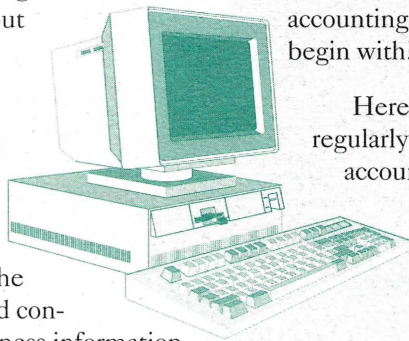
“I would not be at the point I am right now without the assistance and the information that I received from the University,” said Janet Webber, nurse, inventor and entrepreneur.

As a nurse, Webber knew that accurate measurement of wounds was difficult because there was no standard tool to measure them. As an inventor and innovator, Webber had a good tool design idea but needed help carrying out her plans. NRRI Machine Shop foreman Gene Betts made the prototype and contributed business information and experience.

Webber also sought assistance from Lee Jensen, director of NRRI’s Business Group, to conduct searches for existing products. Jensen helped arrange focus groups of potential users who could provide input toward Webber’s product refinement efforts.

“Janet’s challenge is to keep focusing on this idea to closure before developing the next idea. We’re directing her towards large companies who are interested in working with her,” said Jensen.

“I have whole-hearted admiration and respect for the assistance I have received from NRRI and Milt Toratti of Minnesota Technology Regional Office in Virginia,” said Webber.



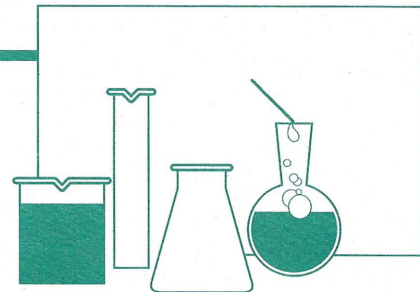
HAVE YOU CONVERTED TO COMPUTER ACCOUNTING?

For many entrepreneurs, converting to computer accounting is a goal that seems blocked by an overwhelming feeling of uncertainty. According to Anand Naimpally, Center for Economic Development assistant business development specialist, many business owners wonder: How can I start computer accounting, since my books aren’t well organized to begin with?

Here are a few practical tips from Naimpally, who regularly assists businesses in their computer accounting efforts.

- 1 Get your books in order before choosing a computer accounting system. Incomplete information will further complicate your effort.
- 2 Understand your needs for a computerized system:
 - What do you want the system to do for your business? Produce reports or journals?
 - How much money will you spend on the accounting system? Prices vary considerably and can range from \$60 to \$1,000.
 - Who will be responsible for maintaining and understanding the system?
- 3 Research accounting software that will meet your needs, not far exceed them. For example, Quicken suits a small business; Great Plains does not.
- 4 Choose a professional to set up the system, or select an employee with good accounting knowledge to assist the process.
- 5 Learn how to use the accounting system in order to maximize the information available; i.e., generate financial statements, cash flow analyses, etc.

Inside *NRRI*



Minerals research

Coleraine looks to the future

The future of NRRI's Coleraine Minerals Research Laboratory (CRML) is based on the premise that blast furnace/coke oven methods of steelmaking will be a major factor in the domestic steel industry for another two or three decades. The program is also responding to the growth of U.S. mini-mills, which will provide Minnesota-made direct reduced iron and scrap for steelmaking.



As one step along the way to producing high quality titanium concentrate, Pete Niles uses an electrostatic separator to isolate metallic minerals from non-conductive material in ilmenite-rich samples.

Better pellets

CMRL assists the domestic steel industry in its efforts to produce better taconite pellets by reducing silica levels, adding flux and improving processing parameters. CMRL's research goals include reduction of costs, improvement of quality and increased productivity at established plants to help the industry maintain its position as a source of pellets for the blast furnace.

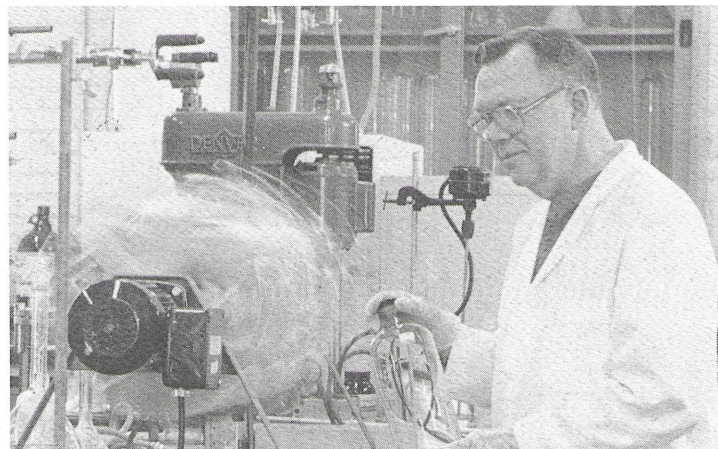
Currently Minnesota produces 40 million tons of pellets for the domestic steel industry. That total will decline over the next 20 years to about 30 million tons. Some production loss can be recovered if the state's plants convert to production of low silica concentrates for manufacture of direct reduced iron (DRI).

Direct Reduced Iron (DRI)

Mini-mills presently supply 38 percent of the market and may grow to 50 percent by the end of the century. These mills primarily use scrap iron to produce steel, but they also require clean iron units to maintain quality because scrap iron also contains copper, nickel, chromium and other metals which contami-

nate the steel. DRI could be produced from Minnesota taconites that can provide clean iron units required for steel quality at the mini-mills.

CMRL is also investigating new processes for making DRI which have potential in Minnesota as well as the established DRI processes such as Fastmet, Midrex, Corex and Iron Carbide.



John Ludwig uses an extraction device to determine whether sample material is classified as hazardous waste.

Environmental Remediation

Due largely to Congressman James Oberstar's efforts, CMRL received a contract to apply standard minerals processing techniques to clean contaminated Great Lakes harbor sediments.

Currently, sediment disposal costs range from \$400 to \$800 per cubic yard for removal and storage of the material. At a fraction of the cost, using mining techniques, researchers can extract contaminants and return a significant portion of the cleaned sediments to the harbors.

Other environmental remediation projects include the removal of lead from battery processing sites and blasting sands, and utilization of waste paper mill sludge and fly ash to manufacture lightweight aggregates.

CRML funding (35 percent) comes from direct research contracts with industry. The remainder is a combination of money provided by the Minnesota Department of Natural Resources through such organizations as the Iron Ore Cooperative and Minerals Diversification Fund. Other funding sources include the IRRRB, American Iron & Steel Institute, the Legislative Commission on Minnesota Resources, and federal agencies such as the Environmental Protection Agency.

How is NRRI funded? FOCUS ON MINNESOTA TECHNOLOGY, INC. APPLIED RESEARCH PROGRAM

Ecologists enhance entrepreneurial effort

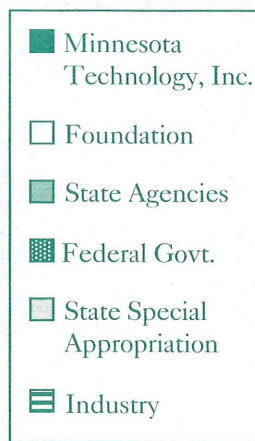
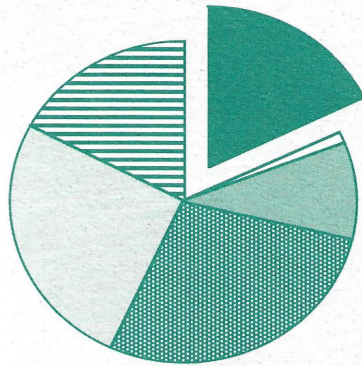
New anti-deer browse formula

With predator damage to crops in the billions of dollars worldwide, it's no surprise that an enterprising Minnesota company is looking at ways to control the problem.

NorTech Forest Products of Eden Prairie is preparing to market an anti-browse compound that safely deters animals without harm to plants or soils. Company president Bob Gilbertson, who makes horse products under the name Nordic National, thought a modification of his anti-cribbing (prevents chewing on stalls) formula could be applied to crops to protect them from deer, rabbits, porcupines and other critters. He tried it and it worked.

To proceed with business development, marketing and manufacturing operations, Gilbertson contacted Milt Toratti at Minnesota Technology, Inc. Regional Office in Virginia for assistance. Toratti facilitated a meeting with NRRI forest ecologist John Pastor, who studies the effects of moose browsing on forest composition for the National Science Foundation.

"John Pastor has been our research leader since day one," said Gilbertson. "As a result of NRRI's research efforts, my product lead time has been condensed by almost 50 percent."



The Minnesota Technology, Inc. applied research program has become NRRI's single most effective tool for bringing the benefits of applied research to regional clients.

The main goal of the program is to develop new and improved products that will result in new business or business expansion. In the forest and peat products areas, it has allowed us to facilitate the networking efforts of Minnesota companies.

The following are examples of applied research projects funded through NRRI by Minnesota Technology, Inc.: our work with American Shield and BHP in preparing for its new titanium processing operation on the Iron Range; assistance to Mat Inc., Floodwood, in developing successful peat and wood fiber oil sorbent products; contributing to the Minnesota Pollution Control Agency's and Minnesota Aquafarms' understanding of mine pit limnology; assisting Husky Panel System with development of its insulated half logs to be manufactured at a new plant between Duluth and Two Harbors.

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At first, Pastor was skeptical. "Anti-deer browse compounds generally do not work as well as advertised," he said. "Brad Dewey and I set up comprehensive large-scale testing to ensure validity. Fortunately, costs were kept down because our moose browse project made techniques and equipment readily available."

Several sites were established, one at a plantation near Scandia covered with walnut, oak and pine. Early last sum-

mer, the seedlings were sprayed. Half the seedlings were resprayed in the fall to determine whether one or two applications provided optimal annual performance. Last fall, another test site on three stands managed by Rajala Lumber in Grand Rapids received a second application with the cooperation of Tim Capestrand, Rajala's woodlands manager.

Early results indicate that the treatment effectively deters deer with no adverse

impact on plants or soils. The spray dries in two hours, does not wash off and requires no extensive application equipment.

"The work of NRRI and the Minnesota Technology Virginia Regional Office has saved approximately \$100,000 in start-up costs," said Gilbertson. "With EPA approval, I'm ready for a possible fall product launch."

Project Highlights

Minerals research endowment

As part of the Higher Education Appropriations Bills, the Minnesota Legislature established an endowed mineral research account of the Permanent University Fund (PUF). This account, which is expected to grow to about \$25 million, receives income from new royalties earned by State mineral leases. Half the funds will be allocated to NRRI and our Coleraine Minerals Research Laboratory. Initially at \$75,000, the funding is projected to grow in 10 years to provide about \$1.5 million annually for mineral and related research including environmental remediation.

Waste water treatment study

Elf ATOChem of North America contributed a \$59,220 gift to NRRI. Aquatic biologists Rich Axler and Chris Owen will use the gift to evaluate an herbicide for controlling algae in waste stabilization ponds, and to determine its role in water quality degradation.

New global warming study

A four-year, \$800,000 grant from the National Science Foundation is funding the work of a NRRI research team led by wetlands scientist Scott Bridgham. The group is simulating global warming in troughs of transplanted peatlands (*See Wetlands, p. 5*).

Water quality prediction

Biologists Carl Richards, Lucinda Johnson and George Host received a \$499,700 grant from the U.S. Environmental Protection Agency to develop standard ecocriteria for predicting water quality of regional streams and watersheds. The ecocriteria will feature chemical and physical conditions as well as biological information about fish, invertebrates and algae.

SBA loan package seminar

The UMD Center for Economic Development and the Minnesota Bankers Association recently held a seminar to familiarize lenders with the Small Business Administration loan package program. Forty regional bankers participated.

Treated OSB siding

Chemical Specialties, Inc. matched \$10,000 in NRRI funding to manufacture treated oriented strandboard for applications requiring decay and insect resistance. The project is part of an effort by our wood products engineers to enhance the life cycle of wood-based composites.

Oil sorbent wood fiber pads

Mat Inc. of Floodwood and our peat scientists have developed an oil sorbent wood fiber pad. Prototyping services will be provided by NRRI as Mat Inc. prepares for production of 5000 units per month.

The Natural Resources Research Institute was established by the Minnesota Legislature in 1983 to foster economic development of Minnesota's natural resources in an environmentally sound manner to promote private sector employment.

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NRRI Now is published quarterly to provide information about our programs and projects. For details call 218/720-4294.

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