

Developing

Natural Resources in Minnesota

A report on the work of the Iron Range
Resources and Rehabilitation Commission
1952 - 1954



HC 1
107
.M6
A342
1952/54

Published by the
COMMISSION ON IRON RANGE RESOURCES AND REHABILITATION
624 State Office Building
St. Paul 1, Minnesota

LEGISLATIVE REFERENCE LIBRARY
STATE OF MINNESOTA

RECEIVED
MAR 1 1955
Legislative Research
Committee

State of Minnesota
Iron Range Resources and Rehabilitation
St. Paul, Minnesota

To the Governor and the Legislature of the State of
Minnesota:

I am herewith submitting to you the biennial report
of the Iron Range Resources and Rehabilitation
Commission.

This is the report for the twenty-fourth biennium,
covering the period beginning July 1, 1952, and end-
ing June 30, 1954.

Respectfully submitted,

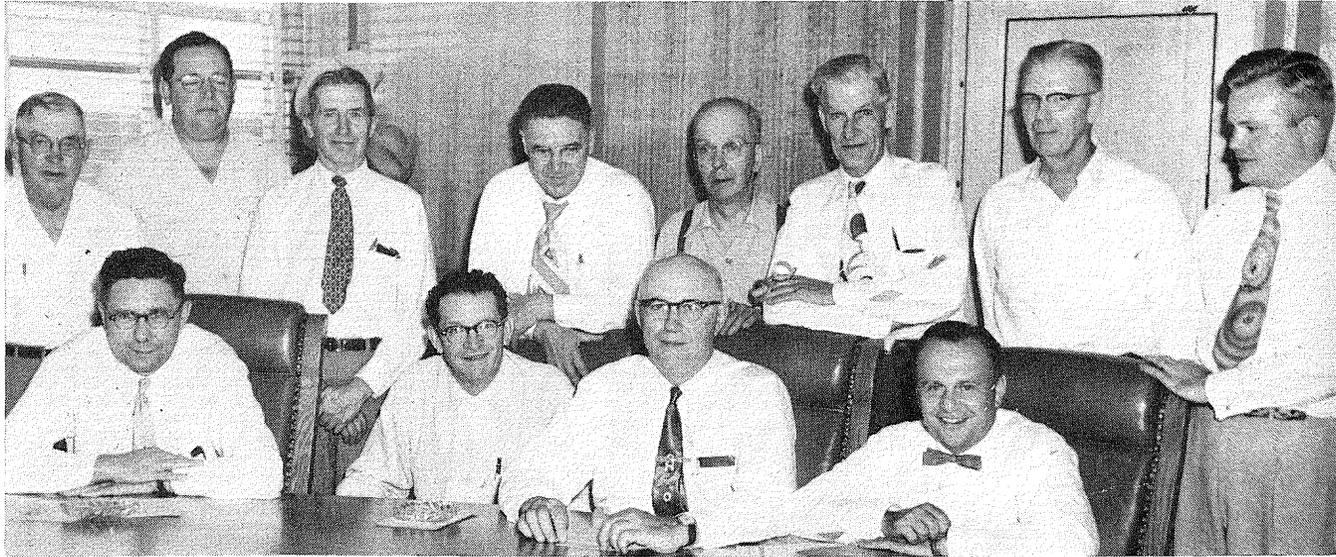
Edward G. Bayuk
Commissioner
St. Paul, Minnesota



LEGISLATIVE REFERENCE LIBRARY
STATE OF MINNESOTA

CONTENTS

	Page
Risk and Challenge.....	5
New Peat Research.....	9
Topographic Mapping.....	20
Wood Plant Reopens.....	22
Water Data Grows.....	23
Truck Farm Growth.....	27
Small Fruit Gains.....	33
Improving Farms.....	35
Bemidji Wood Plant.....	38
Projects in Forestry.....	42
Alfalfa and Clover.....	48
Miscellaneous.....	65
Receipts and Outlays.....	66



IRRRC meetings occasionally are shirt-sleeve sessions. Left to right, seated are: Rep. Emil C. Ernst, Rep. Fred W. Schwanke, Sen. George O'Brien, Commissioner Bayuk; standing, Fred Braden, agriculture fieldman; Peter Brascugli, field representative; Rep. Warren S. Moore; Sen. Elmer Peterson; Sen. Herbert Rogers; Roy E. Gordon, court reporter; August Neubauer, agriculture fieldman; and Bernard M. Granum, forestry project supervisor.

Risk and Challenge

Progress in resource development is not easy to measure. Advancements usually are not seen in weeks or even years. However, in the opinion of your commissioner of Iron Range Resources and Rehabilitation definite forward steps have been taken and this state agency continues to look ahead with confidence.

This report reviews the operations of the Iron Range Resources and Rehabilitation Commission for the last two-year period through the summer of 1954, detailing its various activities and achievements.

Projects, of course, all were considered on the basis of their merits—some with a view to their immediate need, others on the basis of their long-range advantages. Always in the background of any decision was consideration for intent of the law. The Iron Range Resources and Rehabilitation Commission operates in a scope within the legal limitations established by legislative action. When proposals appeared to be in questionable legal status the attorney general's office was consulted.

Basis of the IRRRC

It should be remembered the Iron Range Resources and Rehabilitation Commission was originally conceived in 1941—after a long period of economic depression in the iron mining areas, notably St. Louis and Itasca counties. In all, some 10,000 persons were unemployed. The iron mining areas were sorely hit by the Great Depression as well as by technological advances which brought on labor-saving machinery and consequent diminishing job rolls. Employment in the iron mines dropped in 20 years from 12,000 to 4,500 men.

For the most part, those jobless had no other fields to turn to or found themselves unsuitably trained for other opportunities. Timbering and lumbering, mainstays of earlier years, had dwindled. Much of the cut-over land was considered unsatisfactory for farming and as a whole northeastern Minnesota's agricultural economy was sub-standard.

Tremendous demand for iron ore during World War II, followed by a post-war production boom across the nation, and

more recently taconite development, erased the unemployment situation at least for a time. Timbering, agriculture and industries related to mining were similarly stimulated.

Goals Noted

The drain on Minnesota's iron ore reserves was accelerated, speeding up depletion of a state resource that can not be restored by man. With rich ore deposits disappearing mining companies are turning to low grade ores and difficult-to-mine rock types such as taconite, spending millions to develop economically sound methods of mining and processing them.

So diminishing iron ore reserves and a continuing and future need for a stabilized and better balanced economy in northeastern Minnesota still point up the goals and aims of the Iron Range Resources and Rehabilitation Commission—just as it was when foresighted men fostered establishment of this state agency. Continued improvement of the welfare of northern Minnesota and the state as a whole is at stake.

While legislators had the mine areas and depleted timber regions in mind when the agency was formed, they wrote the law in a manner which permits wide latitude in the functions of the IRRRC, and does not necessarily restrict it, to the iron ranges. For instance, the law provides that:

"When the commissioner shall determine that distress and unemployment exists or may exist in the future in any county by reason of the removal of natural resources or a possibly limited use thereof in the future and the decrease in employment resulting therefrom, now or hereafter, he may use such amounts of the appropriation made to him in this section as he may determine to be necessary and proper in the development of the remaining resources of said county and in the vocational training and rehabilitation of its residents."

Thus it is that all projects, formulated or proposed, are approved or considered, with the intent and the provisions of the law in mind. It permits aid to stricken areas of the state by such activities as:

Promotion of vocational training programs; encouragement of utilization of low grade and difficult-to-mine iron ore; development of wise agricultural programs; promotion of reforestation in the "cut-over" northern Minnesota counties, and expanded use of remaining timber stands; encouragement in developing use

of abundant resources, such as peat; promotion and encouragement of new industries suitable for stricken areas; and in general, encouragement of suitable rehabilitation programs.

The commissioner is guided in his work by an advisory body. This advisory group, the IRRR commission, is composed of three state senators, three state legislative representatives and the state commissioner of conservation. Senate members are appointed by the senate committee on committees, and the representatives by the speaker of the house.

The commissioner holds his office by appointment of the governor and regards himself as primarily responsible to him. Projects or programs covered in this report—some in operation when this commissioner took office, others initiated during his administration—were approved by the advisory body.

Ore Tax Allocated

Funds for the operation of the Iron Range Resources and Rehabilitation Commission are derived from a portion of the state occupation tax on iron ore—a tax based on ore actually mined. The IRRRC receives five per cent of the tax. Here is a breakdown of the tax allocation:

State general revenue fund.....	45%
Permanent school trust fund.....	40%
Permanent university trust fund.....	10%
Iron Range Resources and Rehabilitation.....	5%

The IRRRC administrative office is located in the State Office Building, St. Paul. There the commissioner has his desk, along with that of one secretary. Administrative costs reflected in this report cover salaries of the commissioner and secretary and all other employees responsible to the St. Paul office, as well as expenses for maintenance of the office, including purchases of supplies, materials and miscellaneous outlays, such as for workman's compensation.

In conducting his work, the commissioner has endeavored to operate with the duties and aims of the office in mind, and with the advice and counsel of the IRRR commission. The very nature of the work of this state agency involves of necessity some risk. Experiments are always so. Their success cannot be determined in advance, nor can progress be judged by immediate achievement. Failures, as well as successes, become part of a chart on the progress of any experiment. In effect, failures

become part of a process of elimination, narrowing the road to success.

Challenges Ahead

However, the commissioner sought to exercise extreme practical judgment in all cases, discarding some proposals, holding off decision on others for further study. Wherever possible, private sources have been encouraged to participate or lead the way with IRRRC assistance.

The IRRRC, by the very nature of its established functions, occasionally is confronted with challenges in the form of proposed experiments which no private enterprise would undertake. They are given careful and studied consideration. The IRRRC faces those risks. It is dedicated to the important task of aiding those areas where mineral resources have been and will become depleted and where timber lands are sorely in need of restoration. Thus it is, for instance, that the IRRRC takes an important direct part in encouraging redevelopment of forests. And by legislative decree very considerable sums of IRRRC funds are diverted yearly to the state reforestation programs.

The IRRRC faces challenges in new experiments and new industry proposals which will continue to weigh heavily the ability of the commissioner and his advisers in discriminating among the projects so as to avoid failures.

Members of the Iron Range Resources and Rehabilitation Commission

Senator George O'Brien, Chairman
Grand Rapids, Minnesota
Senator Elmer Peterson, Secretary
Hibbing, Minnesota
Senator Herbert Rogers
Duluth, Minnesota
Representative Fred W. Schwanke, Vice Chairman
Deerwood, Minnesota
Representative Warren S. Moore
Duluth, Minnesota
Representative Emil C. Ernst
Lester Prairie, Minnesota
Chester S. Wilson
Commissioner of the Department of Conservation

New Peat Research

Within another two years Minnesota may have important new clues—and possible success—in the baffling 75-year-old problem of finding profitable use of the state's 40-billion tons of peat, much of it concentrated in the northeast section.

The state's Iron Range Resources and Rehabilitation Commission is now participating in a multi-pronged attack aimed at giving peat the most thorough and scientific sift ever undertaken in Minnesota. Potential chemical value is regarded as one of the most important keys to successful economical use of this vast state resource.

Among the heartening aspects of this program is the hope it holds out for important and inspired new industry development in the state's millions of acres of bog lands, few of which now bring in even as much as a cent of tax revenue. And then, along with new industry, of course, comes additional payrolls to state areas sadly in need of more stabilized economy.

So, it is with those ends in mind the Commissioner, with the consent of the IRRRC advisory body, agreed to encourage and revitalize peat research.

University Joins

Prominent in the peat research picture is the University of Minnesota which received \$58,215.73 from the IRRRC for this work on three fronts—Duluth Branch science halls, chemical engineering on the Minneapolis campus and soils on the St. Paul campus.

Private capital also is playing an important part in peat research in Minnesota as a result of the personal efforts of Governor Anderson, your Commissioner and members of the Iron Range Resources and Rehabilitation Commission. After countless meetings, conferences and negotiation Minnesota and Eastern investors were induced to conduct extensive experiments in the Iron Range area.

Those investors formed the Minnesota Peat Cellulose and Chemical Corp. Dr. August Bosse, prominent German scientist and one of the foremost authorities on peat, was brought to

Minnesota from Berlin to direct research and guide construction of a pilot plant for the corporation.

May Be Forerunner

If the Dr. Bosse tests prove successful economic use of the raw material, the experimental operation will be the forerunner of a \$3,000,000 commercial peat plant. An expenditure of more than \$200,000 is slated to go into the pilot plant.

Equipment for the plant was shipped to the state from Germany and was erected at a site near Chisholm, which was selected by Dr. Bosse after preliminary tests there and at Floodwood, Hill City and Bemidji. Pilot plant operation began October, 1954.

It may be noted for the record here that Maine and other states also sought to induce Dr. Bosse and his backers to conduct peat experiments in their states.

Working in European laboratories, Dr. Bosse developed a process for separating 50 derivatives from peat, including pharmaceutical products and anilin dyes. In Minnesota, in the past, the big problem in finding a commercial use of peat, has been drying the material economically for fuel, poultry litter and nursery purposes. The process Dr. Bosse has developed is not deterred by the high moisture content of peat. Instead, it is considered an advantage.

Preliminary observations by Dr. Bosse were highly encouraging. He believes northeastern Minnesota peat bogs hold the raw material for a chemical industry which could parallel the state's current taconite development.

New Approaches

Directing University of Minnesota peat research are Dr. Edgar L. Piret, professor of chemical engineering; Dr. Clayton O. Rost, retired professor and head of the soils department on the St. Paul campus, and R. Moses Passer, associate professor of chemistry at Duluth Branch.

Peat research is not new. "But," notes Dr. Passer, "despite all of the research that has gone into peat, we're still in the dark on peat's chemical potential. That's largely because much of the past research has centered on peat as a fuel."

University investigators are attempting a new approach to learn something about the unique chemical structure of peat.

The University of Minnesota, Duluth Branch, project has three objectives.

1. Build as complete a library as possible on all of the available literature on peat. A punched card system is being installed to make immediately available every bit of information that has been uncovered on peat or its derivatives.

2. Assist the chemical engineering department to obtain adequate quantities of peat carefully selected for soil conditioning value of its derivatives. One UMD effort is aimed at a quicker process for extracting these derivatives, generally referred to as humic acids. Recent results suggest that a feasible process may be at hand.

3. Conduct basic research on peat with a free hand to explore any of the approaches that show definite promise.

As part of the UMD project, 48 laboratory samples from bogs at Floodwood, the Cotton-Canyon district, the Sax-Forbes-Zim district, Central Lakes and Rice Lake were obtained and examined to find a source of uniform consistency and quality. The first large quantity was taken from a Rice Lake bog.

Tests Made

The University of Minnesota soils department in St. Paul made tests of the soil-conditioning elements of peat on crops during the summer of 1954, including plots at the Northeast Experiment Station in Duluth.

University researchers are using three methods to investigate peat chemically:

1. Use of solvents at varying temperatures to extract and separate the substances that make up peat.
2. Use of chemical reagents under a variety of conditions.
3. Controlled oxidation.

Investigators are confident that peat's chemical value can exceed that of its major commercial uses at present. So, with state and private researchers at work in a new concentrated effort, profitable commercial use of Minnesota peat may be envisioned in the not too far distant future, and your commissioner considers IRRRC encouragement of these projects as indeed a worthwhile contribution toward attaining benefits for peat area communities and all of Minnesota.

Similar views are shared by O. A. Sundness, Duluth, vice president of the Snyder Mining Company. He and State Representative Fred W. Schwanke, Deerwood, were Minnesota's dele-

gates at a week-long International Peat Symposium in Ireland in the summer of 1954. Mr. Schwanke is a member of the Iron Range Resources and Rehabilitation Commission and Governor C. Elmer Anderson selected Mr. Sundness to accompany him to the conference because of the mining executive's long and intense interest in peat.

Mr. Sundness' interest in peat goes back to his first arrival in northern Minnesota in 1909. Mr. Sundness was at that early date intrigued by the fact that northern Minnesota had iron ore and a potential fuel in its peat bogs if engineering skill could but overcome the costs of eliminating the high water content.

Early Interest Shown

Mr. Sundness followed with interest the investigations begun in 1906 by James J. Hill, The Empire Builder, when he sent Max Toltz of Toltz, King and Day, a Chicago engineering firm, on a world tour to investigate peat utilization in other countries. Mr. Toltz's report indicated that an excellent quality of coke could be made from peat in addition to which all chemicals derived from coal could be recovered as a by-product. Mr. Toltz's investigations did not, however, solve the problem of harvesting the peat economically.

It was not until 1920 that Mr. Sundness became actively interested in working with peat. At that time he collaborated with H. H. Hindshaw in testing and analyzing his samples. Mr. Hindshaw was at that time conducting a study for Frank Wildes, then head of the State Division of Lands and Minerals. Considerable material was published at that time by State Auditor Ray P. Chase, F. A. Wildes and Mr. Hindshaw, but the high cost production problem was still unanswered.

In the late thirties and early forties Mr. Sundness collaborated with representatives of the Junior Chambers of Commerce in northern Minnesota in fostering the establishment of the Iron Range Resources and Rehabilitation Commission which was originally conceived to develop new industries in the areas where mines were fast being depleted and the forests already gone.

Men at that time active in this movement were John Blatnik of Chisholm, then a State Legislator, Paul Kochevar and Helmer Olson of Hibbing, George Bozich of Buhl, Armando DeYoannes of Virginia, Howard Siegel and John Bayuk of Eveleth, John Hoene of Duluth, Melvin Ranta of Chisholm, and others. When this Commission was set up, Mr. Herb Miller was appointed as

the first Commissioner and Mr. Sundness served as a member of a 12-man advisory committee on mining under the chairmanship of E. W. Davis.

Activities Noted

During the war Mr. Sundness was appointed by Governor Thye to serve as one of the Minnesota members of the Minnesota-North Dakota Resources Planning Commission and was later reappointed by Governor Youngdahl. This Commission was to study and investigate the possibility of beneficiating Minnesota low grade ores by means of using gas derived from North Dakota lignite coal and was under the chairmanship of Dr. Lloyd Ryerson of the University of Minnesota.

In 1945 Mr. Sundness was appointed by the Engineers Club of Northern Minnesota to serve as chairman of the northern St. Louis county peat committee. R. L. Fitzgerald was at that time appointed by the Duluth Engineers Club as chairman of the southern St. Louis county peat committee and it was the joint action of these two committees that was instrumental in getting first peat studies started by the Iron Range Resources and Rehabilitation Commission.

Mr. Sundness compiled a comprehensive report on his observations at the international peat symposium. This exceptionally fine report is on file in the office of the Iron Range Resources and Rehabilitation Commission.

Mr. Sundness noted significantly that Minnesota is not alone in its interest in peat development. The meeting in Dublin was attended by 220 delegates representing 18 countries. "This surprisingly large interest," he said, "indicates that other countries are far more cognizant of the potential values in their peat bogs than the United States is at the present time."

Sundness Comments

Mining executive Sundness concluded his report with the following comment and recommendations:

Minnesota has approximately 60% of the peat reserve in the United States. Professor E. K. Soper made a very comprehensive survey of Minnesota peat bogs in 1919. In his publication, "*PEAT DEPOSITS IN MINNESOTA*", he estimates that Minnesota has 6,835,000,000 tons of dry peat, occurring in deposits more than

five feet thick. With a 30% moisture content, this tonnage would be equivalent to 3,500,000,000 tons of steam coal with 13,000-B. T. U. heat value, or, approximately as much coal as has been received at Duluth-Superior harbor since shipments began. The counties of Saint Louis, Beltrami and Koochiching contain nearly five billion tons of the total tonnage in the state.

With such a large peat reserve, ranking as the fifth country in peat-bog acreage in the world, it seems, in the light of what other countries are doing, only reasonable and logical that Minnesota should inaugurate an *intelligently planned* and a *continuing program* of study and research, looking toward the *economical recovery* of the potential values *known* to be present in her peat bogs. Emphasis is here placed on "economical recovery." The cost of the product with which Minnesota's peat must compete, and the higher labor costs, as compared with other countries, must here be kept in mind.

It is very easy for the layman to become enthusiastic about the multiplicity of products available from dried peat, and the various uses to which it may be put; however, when practical consideration is given to the fact, that in order to produce one ton of dry peat from ten tons of raw peat, nine tons of water must be eliminated, it has a sobering effect. In order to produce fuel of 33% moisture content, similar to lignite coal, 8½ tons of water must be removed from 10 tons of raw peat of 90% moisture content, in order to produce 1½ tons of such fuel.

This comment is not to be interpreted as being pessimistic. It is made solely for the purpose of calling attention to the fact that a major problem exists in unlocking the potential values which are stored in Minnesota's peat bogs. The inventive genius of American Industry seems to be inexhaustible, and, when directed with determination toward recovering the values in these peat bogs, might well result in developing another major industry. In order to make a logical attack on the problem, the following recommendations or suggestions are presented:

1. Since most of the peat bogs are located on lands belonging to the State of Minnesota, and since it would be the beneficiary in the receipt of royalty from peat production, or the sale of such lands, the State should set up an authority charged with the responsibility of collecting, on a continuing basis, all of the literature and information on peat production in other countries.

If possible, such authority should have available for its use limited sums of money for simple experimental purposes, conducted under intelligent, technical supervision. Possibly such authority could be set up within some of the present State departments or the University of Minnesota; however, the best results would accrue if such authority were an independent office.

2. Peat production for industrial fuel should be thoroughly investigated. While Ireland with its \$12-\$15 coal and 44c per hour labor rate is successfully producing peat for fuel, it should be remembered that Minnesota has \$10 coal and a \$1.62 labor rate, and, fuel oil and gas are now on her doorstep.

However, it should also be remembered that Minnesota is nursing an infant Taconite Industry. As of today, approximately 5 KWH of electric power are consumed in the production of one ton of ore from St. Louis County. In the new Taconite Industry, it is variously estimated that from 75 to 100 KWH will be consumed to produce one ton of taconite pellets.

Northern Minnesota's available water power is already harnessed. Any increase in electrical production must come from coal or gas. If fuel from peat could be produced at a cost competitive with other fuel for electrical production, it would be of tremendous benefit to this industry, in addition to establishing a new industry and additional payrolls. Conditions in most countries in Europe are not suitable for the hydraulic mining of peat, the so-called "Hydro-Peat Process." It is recommended that the various ramifications of this process be studied, if a Peat Authority is set up in Minnesota.

3. The BeVant Mining and Refining Company of Duluth are said to have developed a process for converting non-magnetic taconite to magnetic taconite by use of peat. If this process is feasible, it will make tremendous quantities of presently worthless taconite into a valuable asset for the State of Minnesota and elsewhere. This process should be studied and evaluated as to its economic possibilities.

4. Dr. August Bosse, a German scientist, has recently set up an experimental pilot plant, financed by private capital, in Chisholm, Minnesota, for the purpose of producing cellulose from peat. From the cellulose they expect to produce plastics and explosives. Scotland reached the conclusion that it was not economical to produce cellulose from peat, but Dr. Bosse may

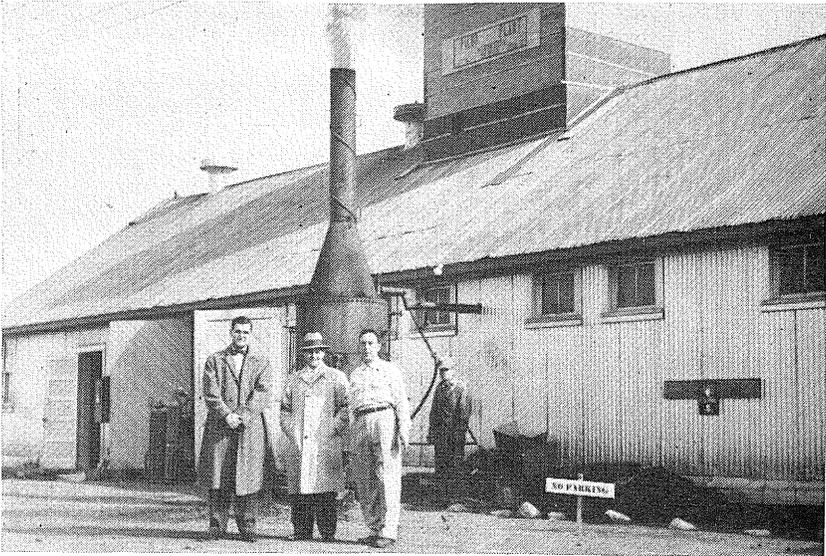
have a different approach. He has this advantage—he works with the raw peat and spends no money on a drying process, which is the presently expensive stumbling block to peat production. The experiment should be watched and given any reasonable assistance requested.

5. Since the Bureau of Quebec, Canada, has recognized the high cost of drying peat as a deterrent to their peat utilization, their progress in working with raw peat for production of chemicals should be studied, and possibly the present work being done by Dr. Passer, University of Minnesota, Duluth Branch, could be coordinated with theirs.

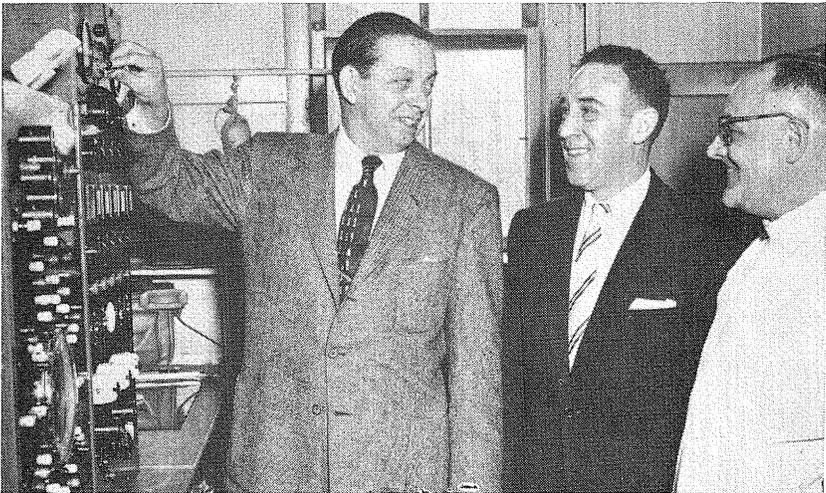
6. Since France, Austria and Italy are producing an apparently acceptable fertilizer from their peat, their process should be studied and evaluated for the purpose of retaining the life in Minnesota soils, and, possibly rejuvenating the soils in our dust bowl areas like Kansas and Nebraska. Doctor Piret, of the Chemical Engineering Department, University of Minnesota, will undoubtedly have some contributions to make on this angle in the not-too-distant future.

7. Peat Moss production for litter and horticultural purposes is apparently a prosperous and growing industry in Canada. Minnesota has a plant for such production—presently idle—located at Floodwood.

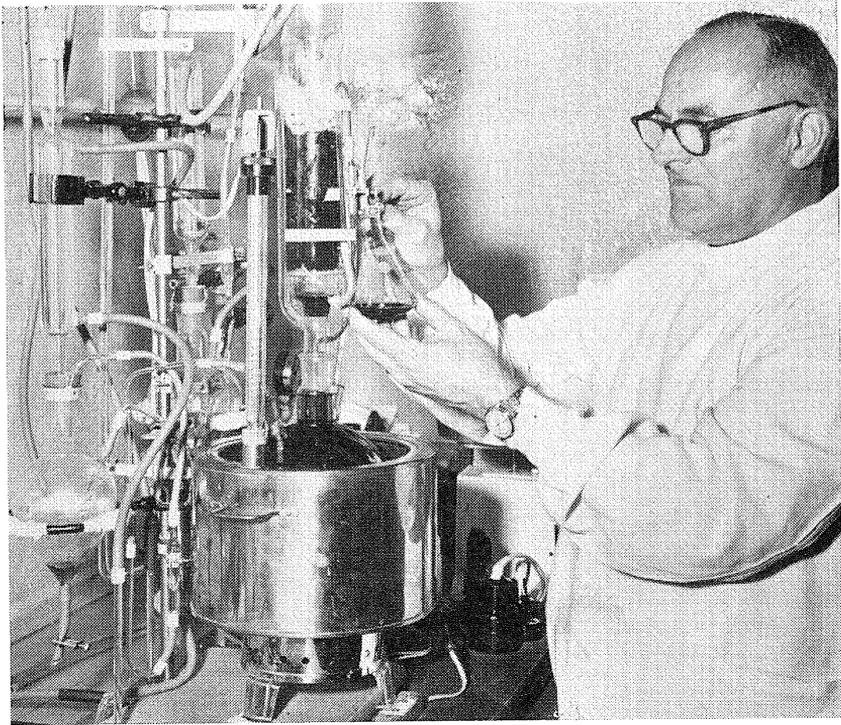
In conclusion, it must be recognized that this report can only deal with rather meager details of a very large subject. The problem is not a single one, but, Minnesota's peat reserves are large, the values in them are known to exist, hence the stakes are challenging. Therefore, Minnesota should embark on some coordinated plan to study and utilize, if possible, this resource.



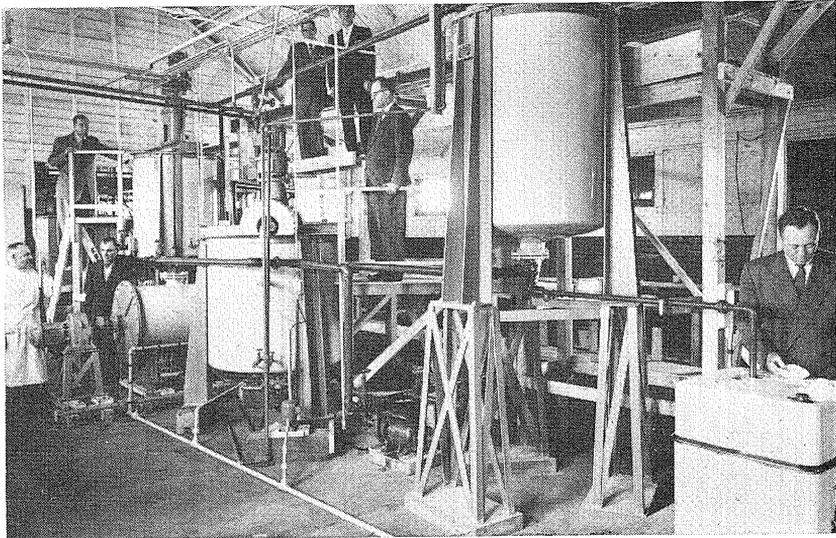
In this plant at Chisholm the Minnesota Peat Cellulose & Chemical Corp. is conducting peat experiments, seeking chemical derivatives. In the foreground are John Gornick, Jr., Chisholm, chairman of the north-eastern Minnesota Junior Chamber of Commerce rehabilitation committee; IRRRC Commissioner Bayuk, and Edward Glaser, New York, a corporation director.



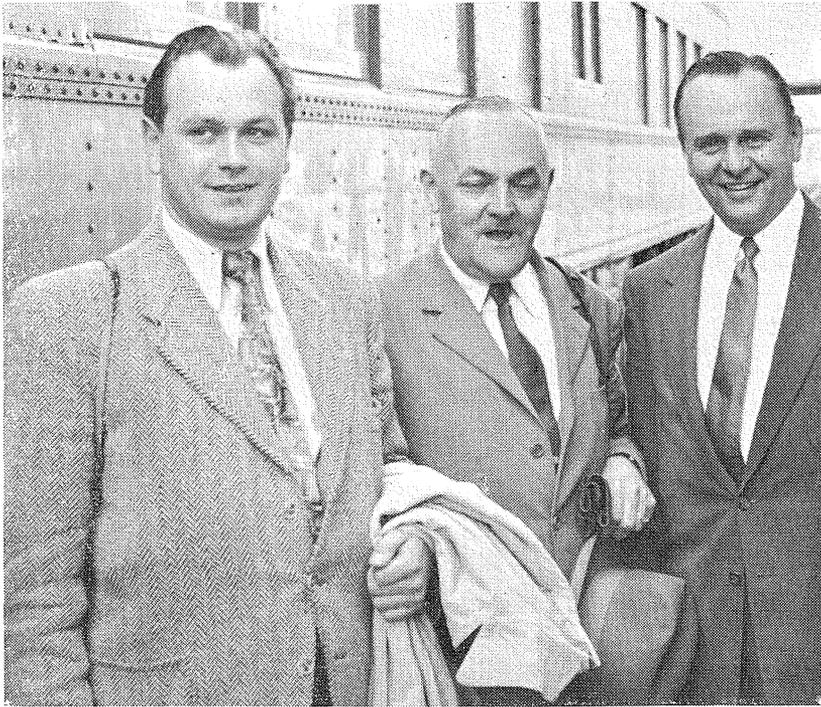
Governor Anderson pulls switch starting operation of Chisholm peat research Laboratory. Looking on are Mr. Glaser and Scientist Bosse.



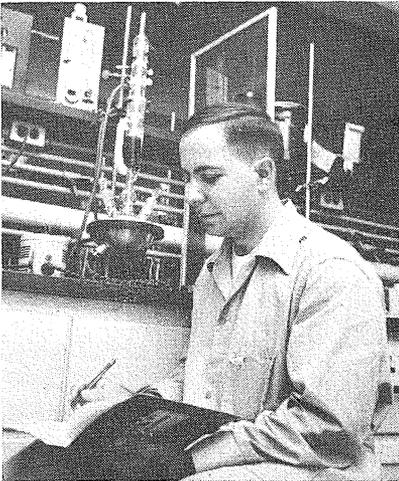
Dr. Bosse, German scientist, at work in the Chisholm peat research plant.



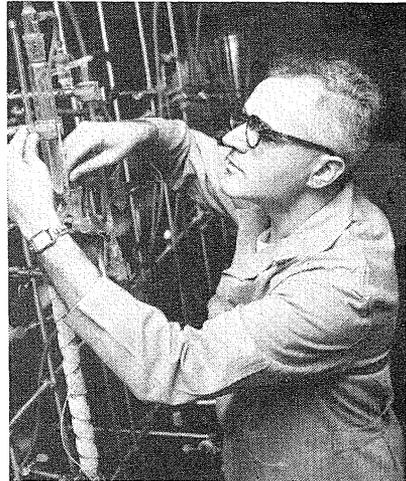
Interior view of peat research laboratory at Chisholm.



German peat experts arrive in Duluth. Left to right, Gunther Neumann, Dr. Bosse and Commissioner Bayuk.



Graduate student records peat research data at Duluth branch of the state university.



Dr. Moses Passer, associate professor in chemistry, directs the UMD peat experiments.

Topographic Mapping

Topographic mapping is a precise and painstaking art of representing on a map the physical features of a locality or region. The features include all natural terrain conditions, such as lakes, hills, swamps and wooded areas, and also such man-made cultural improvements as buildings, roads, bridges and dams.

The maps are essential tools in the planning of soil erosion control, flood control, water use and conservation, highway routing, subdivision platting, industrial location planning, sewage disposal, drainage, radar and television location and construction, and recreational guidance.

The state appropriated \$30,000 for topographic mapping in 1949 and has continued to make additional appropriations since then. These funds are matched dollar for dollar with federal funds. The Iron Range Resources and Rehabilitation Commission has contributed to the program, allocating an additional 30 to 54 thousand dollars each year for the work.

Range Emphasized

The IRRRC has placed emphasis on the mapping of the Iron Range area to aid in the extensive iron ore and taconite development, as well as the prospecting for other mineral resources.

This evident state interest and support has stimulated additional topographic mapping by the U. S., entirely paid from federal funds. Such mapping is an expensive process in terms of money but not in view of the variety of benefits derived over the years.

Noteworthy progress has been achieved in the last several years. When the state mapping advisory board held its first meeting in May, 1949, Minnesota ranked close to the bottom of all states in the proportion of its area covered by topographic maps. Only seven and eight-tenths per cent or 6,576 square miles of Minnesota's 84,068 square miles had been adequately mapped. Now an additional total of nearly 6,000 square miles has been covered by published maps. By the end of 1954 as much of our state will have been mapped in four and one-half years as was mapped in the previous 53 years. Now in progress is additional mapping almost equal in land area to all maps published to date.

U. S. in Picture

Since July 1, 1950, the entire Mesabi Range district has been

mapped and many of the final maps have been published. The remainder are in the final stages of preparation and publication.

Funds of the Iron Range Resources and Rehabilitation Commission have played an extremely important part in advancing topographic mapping Minnesota. No better use could have been found for the funds used in this program.

It should be emphasized that for every dollar of Commission funds the federal government has furnished another dollar. Furthermore, the cost of engraving and printing the maps is borne entirely by the federal government so that state funds bear only about 40 per cent of the total cost of the final map.

The value of these maps in the long range development of northern Minnesota is inestimable. Other important areas, the Vermillion district, for example, are still unmapped and the Commission should consider extending the program to other areas as quadrangles now under way are completed.

Maps Now Available

Following is a summary of the status of all work in which Iron Range Resources has shared:

Published Maps. 7½ minute quadrangles comprising about 51.5 square miles each. Scale 1 inch = 2000 feet.

Bovey	Kinney (Mountain Iron)
Calumet	Pengilly
Buhl (Hibbing N. E.)	Palo (Sparta N. E.)
Eveleth (Eveleth N. E.)	Gilbert (Sparta N. W.)
Kirk (Eveleth N. W.)	Silica (Swan Lake S. E.)
Hibbing (Hibbing N. W.)	Virginia
Keewatin	

Total about 670 square miles

In process of editing and publication. 7½ minute quadrangles.

Cohasset S. E.	Pokegama Lake N. E.
Cohasset S. W.	Pokegama Lake N. W.
Nashwauk	

Total of about 227 square miles

Field work in various stages of completion. 15 minute quadrangles comprising about 206 square miles each.

Argyle	Isabella River
Crooked Lake	Kane
East End	Tofte
Greenwood River	Warren

Total of about 1652 square miles.

Wood Plant Reopens

A long search for a suitable operator for the state-owned wood processing plant at Deer River culminated in January of 1954 when Karl P. B. Rasmussen, St. Cloud, signed an agreement with the Iron Range Resources and Rehabilitation Commission.

The wood drying and finishing plant resumed operation in February and is now producing steadily. It employs about 18 men on a full-time basis and has created additional opportunities for loggers and woodcutters in Itasca and Cass counties.

Mr. Rasmussen leased the plant under a lease-purchase arrangement worked out by the Commissioner and approved by the IRRR commission. The state will receive the appraised value of the plant, \$156,803, over a 20-year period. Monthly payments range from \$150 the first year to \$750 at the beginning of the sixth year. Regular payments are being made.

The Deer River plant had operated a total of 27 months since it was constructed by the state through the IRRRC six years ago.

Plant Background

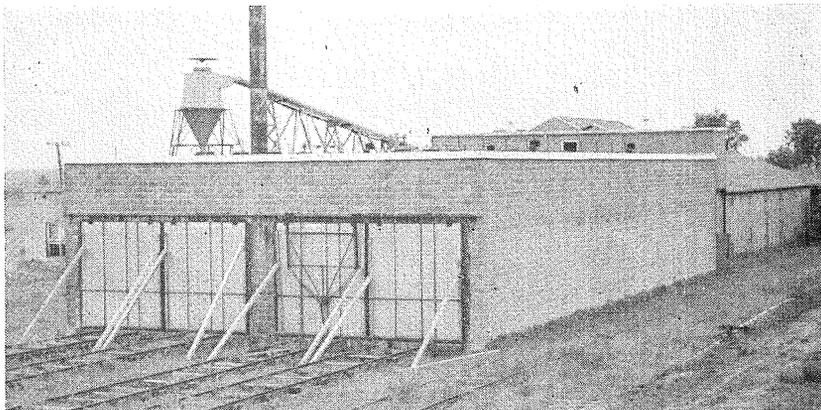
Construction began in the spring of 1947 and the building was completed and ready for operation in November of 1948. It cost \$240,431. Purpose of the plant was to encourage rehabilitation of the lumber industry in northern Minnesota and to stimulate development of factories utilizing smaller and faster growing trees for their products. The Chippewa Wood Processing Association, Inc., had agreed to execute a contract to operate the plant and repay the state for money invested in the plant and equipment.

When the plant was completed it developed that no operational contract had been executed. Robert E. Wilson, then the IRRRC commissioner, held that the firm was not legally qualified to operate in accordance with terms of the proposed agreement.

Pending final determination of the situation, the plant was temporarily turned over to James Reid, plant superintendent, for operation on his own responsibility. This arrangement continued for seven months, and the plant was closed July 1, 1949. On January 1, 1950, Mr. Reid resumed operations for 60 days.

The plant then remained idle until it was leased by the Burns Manufacturing Co. on November 15, 1950. After 18 months that

firm ceased operations and later terminated its contract with the state. The plant had remained idle since July 1, 1952, until Mr. Rasmussen took over.



This is the dry kiln of the Deer River wood processing plant which resumed operation in February. It employs 18 men on a full-time basis and has created additional opportunities for loggers and woodcutters.

Water Data Grows

Minnesota, on the threshold of a new era of industrial and agricultural expansion, is confronted with the fact that such expansion may be limited by a lack of basic data on water resources.

In the Mesabi Iron Range area the largest potential use of water is by the mining industry for the beneficiation of taconite. In addition, the increasing population resulting from the expanding economy will require large amounts of water for municipal, industrial, and domestic purposes.

In the northwestern part of the State, serious deficiencies in water supplies, both as to quantity and quality, have become evident. It is apparent that if additional water supplies are not located, future expansion of the area will be seriously curtailed.

To meet the need for water data, the Iron Range Resources and Rehabilitation Commission initiated an investigation of the surface-water resources in the Mesabi Iron Range area in 1942 in cooperation with the United States Geological Survey. On July 1, 1953 the program was rounded out by including the evaluation of ground-water resources and the study of quality of water.

Surface Water

Little information was available regarding the potential water supplies of the Iron Range prior to 1942. Surface-water investigation was started because it was realized that large-scale investments would not be made unless such data were available.

At the beginning of this biennium (July 1, 1952) the following gaging stations were being operated under this cooperative program:

- Dunka River near Chisholm
- Dunka River near Babbitt
- Embarrass River near Embarrass
- Partridge River near Aurora
- St. Louis River near Aurora
- So. Kawishiwi River near Ely
- Sturgeon River near Chisholm

In addition to these stations, the gaging station on the Poplar River at Lutsen was included in this program beginning July 1, 1952.

Three additional gaging stations were constructed in the fall of 1952 to provide more data for the area east of Ely. These stations are located at Bear Island River near Ely, Isabella River near Winton, and Stoney River near Babbitt.

Cost of operating all of the above gaging stations and construction of the three new ones totaled \$17,100 for the fiscal year 1953, which cost was shared equally by the Commission and the U. S. Geological Survey.

Study of potential storage sites and probable points of water use in the spring of 1953 indicated that more water facts were needed, and the following additional gaging stations were constructed and placed in operation in the fall of 1953:

- Embarrass River at outlet of Esquagama Lake
- Swan River near Warba (Mississippi River drainage)
- East Swan River near Toivola (Lake Superior drainage)
- West Two River near Iron Junction

Because of deficiencies in water supplies in parts of Kittson, Marshall, and Roseau counties for municipal, industrial, domestic and agricultural uses, a complete water-resources investigation was inaugurated in the last half of the biennium.

Under this program, the following nine gaging stations were established in the fall of 1953, and continuous records have been collected since that time:

- Middle River near Strandquist
- Snake River at Alvarado
- Snake River at Warren
- Tamarac River near Stephen
- Tamarac River near Strandquist
- No. Branch Two Rivers at Lancaster
- So. Branch Two Rivers near Lake Bronson
- So. Branch Two Rivers near Pelan
- Thief River near Gatzke

In addition to records at the above gaging stations, supplemental measurements of flow are being made at strategic points to aid in the interpretation of ground-water occurrence and quality.

Expenditures for surface-water investigations for the Iron Range area for the fiscal year 1954 totaled \$19,610, and for the area in Kittson, Marshall, and Roseau counties \$29,720, costs of which were shared equally by the Commission and the U. S. Geological Survey.

Stream-flow data being collected under this program will provide a sound economic basis for engineering design and for wise and orderly development of other resources. The value of the records depends to a great extent on their length and continuity because only long-term, continuous records will define the vagaries of stream flow.

It is expected that some additional records may be needed to supplement those already being obtained, and gaging stations to obtain these should be established as soon as a probable area of development can be foreseen.

Ground Water

Ground water occurs on the Iron Range in the Biwabik iron formation and in the glacial deposits. In view of the fact that water supplies developed from the iron formation are in danger of disruption because of mining, it was decided to study only the glacial deposits.

Through the wholehearted cooperation of the mining companies in furnishing drill-hole data, maps were constructed for the eastern half of the Range showing the configuration of the buried bedrock surface and the thickness of the glacial drift.

These maps can be used to determine the general direction of movement of ground water, the locations of ground-water basins, and the locations of valleys in the bedrock where glacial or preglacial rivers may have deposited water-bearing sand and gravel. Maps showing the thickness of the glacial drift can be used to locate the more promising areas for ground-water exploration.

In general the glacial drift thickens to the south. There are several areas where the glacial deposits exceed 100 feet in thickness and where there is a trough or depression in the bedrock. One of the largest of these is between Virginia and Mountain Iron.

Field work has been started to map the geology and to collect all available information on existing wells such as depth, occurrence of water, types of materials drilled through, water levels, yield, and quality of water.

It will be necessary to do some test drilling and pumping to aid in mapping the sub-surface geology and to determine the hydraulic characteristics of the water-bearing formations.

Reconnaissance

Because residents of Balkan Township, St. Louis County, have experienced considerable difficulty in developing adequate domestic supplies of ground water, a reconnaissance investigation was started in that area. The investigation includes a study of the geology, an inventory of existing wells, collection of water samples for chemical analysis, and measurement of water levels wherever possible.

In Kittson and parts of Marshall and Roseau counties in northwest Minnesota, an investigation was started to inventory the water resources both as to quantity and quality. Ground-water supplies are generally meager in this area and the quality is poor in many places. Water supplies are needed for municipal, industrial, agricultural, and domestic use. In view of the fact that sugar beets are one of the most important crops, the establishment of sugar-beet refineries would bolster the economy of the area considerably. This project was started because of the

lack of data on water resources and the fact that sugar-beet refineries cannot be established without an adequate water supply.

Geologic mapping of the larger sand and gravel deposits has been started and the first of eight deep test holes was commenced on June 3, 1954. A well inventory is being made and it probably will be necessary to drill a considerable number of shallow test holes to determine ground-water conditions in the glacial deposits.

Total cost of cooperative ground-water investigations for the period July 1, 1953—June 30, 1954 was \$40,150 and that of the quality-of-water program \$5,400. All costs were shared equally by the Commission and the U. S. Geological Survey. About 25% of the cost of the ground-water program was for the Mesabi Iron Range area and the remainder was for the Kittson-Marshall-Roseau counties project.

In view of the fact that mining activities eventually will affect many of the ground-water supplies on the Iron Range and that additional supplies will be needed in connection with the expanding economy, a systematic inventory should be made of the ground-water resources south of the Range.

Truck Farm Growth

Encouraged and stimulated by the Iron Range Resources and Rehabilitation Commission, land use for truck gardening has been expanded to new heights in the last two years. Happily, much of the land returned to production was that which had lain idle for years in northeastern Minnesota.

Mucklands previously considered too wet for farming, barren, cutover timberlands, and tax-forfeited lands, are well on the way toward rehabilitation into some of the state's richest farm land—producing what many consider to be the highest quality truck gardening crops ever grown.

Prominent in this rehabilitation picture is the Sax-Meadowlands-Fens area which has taken on new and enthusiastic life in a project which was attempted and finally abandoned some

30 years ago by others in northeastern Minnesota. Today this area displays with pride vast acreages of the finest vegetables, growing bounteously in new and tremendously fertile soil.

Lead Taken

One of the heaviest single users of the garden products is Duluth's Chun King Sales, Inc., which earlier had received assistance from the Iron Range Resources and Rehabilitation Commission for expanding production. The state is being repaid monthly for this assistance

Chun King, packer of Oriental-American foods, was buying huge quantities of products from its home area and importing from other states tons and tons of additional supplies for the Duluth plant. So it took the lead in developing the truck gardening program to provide a suitable, dependable and readily accessible source of supply for its packing activities.

Now, after seven years of experimentation with the possibilities of this area in cooperation with local farmers, Chun King, through its associate firm, Wilderness Valley Farms, Inc., has just completed an extremely successful crop growing season.

Proper drainage, land irrigation, clearing of land and plowing and discing were among the problems. But most difficult of all was the problem of finding crops best suited to this soil and climate, considering the short growing season, the long days and cool nights. Dusting and spraying by airplane was necessary to control insect damage.

The 1953 season was marked by disaster as unseasonal rains caused the total loss of some 100 acres of onions and some 80 acres of celery. But in the face of that loss, Chun King stepped up its program in 1954 and achieved success with crop diversification. The harvest produced what national experts described as some of the finest quality vegetables grown anywhere in the United States.

Crops Listed

The crops included head lettuce, romaine, escarole, cabbage, sweet peas, brocolli, cauliflower, Chinese cabbage, and celery.

That project alone not only provided a ready source of supply for Chun King but stepped up rehabilitation of some 3,000 acres of mucklands and cutover timberlands for garden crops, including finest quality head lettuce that looks and feels as large and hard as cabbage heads, brocolli and romaine the size and quality of which one seldom sees, Chinese cabbage averaging eight to 10 pounds each, and celery that grows to 10 to 12 pounds per stalk.

Another part of the program includes growing of cultivated blueberries, large plantings of sweet peas, radishes, tomatoes, sweet red peppers and carrots.

On the basis of these latest successes it appears reasonable to conclude that northeastern Minnesota is making additional strides toward recognition as one of the finest areas for growing quality vegetables—all of which holds out increasing economic stability for Duluth, the Iron Range, their neighboring areas, and the state as a whole.

Once-barren fields now produce finest head lettuce in the rehabilitated truck garden land near the Iron Range. Chun King Sales, Duluth, has pushed the truck garden program beyond the experimental stage. Much of the crops are used by Chun King in the manufacture of Oriental-American foods.





Bumper crops of romaine are the results of experimental farming in rehabilitated truck gardens north of Duluth.



Men and women work in the fertile truck garden fields.



Rehabilitated mucklands of Sax-Meadowlands-Fens area produce choice cabbage.



Truck gardening requires many hands before the products go to Duluth and other markets.



Vast acreages of celery thrive in the rich soil of the rehabilitated mucklands.



Showing use of summer mulch in raspberries to conserve moisture and prevent weed growth.

Small Fruit Gains

Interest in growing berry fruits has increased in St. Louis county in the past two years. Primary reasons for this are:

Increase in prices, better selection of planting sites, better methods of weed control, and better spraying programs for insect and disease control. Also, various experiments have indicated the best methods of winter protection, a problem of vital importance in this climate.

Raspberry production increased approximately 20 per cent in 1953, and prospects for further increases appear excellent.

About 5,000 new raspberry plants were set in the spring of 1954, and had more planting stock been available, several thousand more plants would have been set.

Plants Are Scarce

Scarcity of plants, both in 1953 and 1954, prompted several growers to start plant production. This has resulted in more than three acres now in such production plantings. If expectations are realized it is hoped that everyone desiring to grow small fruits will be supplied from these plantings.

It is also possible that St. Louis County will be able to supply the entire State of Minnesota with planting stock in the near future.

Nursery stock is being carefully inspected in St. Louis county to insure growers a good market for all the plants they are able to grow.

Plantings Upped

Strawberry planting has found favor in St. Louis County and has increased steadily. Much of the land not suitable for raspberry production lends itself to strawberry planting. The winters do not damage the plants heavily, which is also a factor in their favor.

There is good profit in growing strawberry plant stock and many of our northern St. Louis County farmers, who have sandy soil, are increasing their strawberry plantings.

Several test plots of new varieties as well as some seedlings are under trial planting conditions at the present time, and they look promising as a source of commercial planting stock for the Iron Ranges and other northern Minnesota areas.

Hardy Fruits Need

It seems that everyone who owns a home has the urge to plant a few apple trees. However, the biggest problem in tree fruits

is that there are so very few varieties that are winter-hardy, as well as early maturing enough to be worth the effort of planting in this area.

To eliminate this situation, six test plots have been planted in St. Louis County during the last three years. These plots have more than 20 varieties, some of which are not yet named, obtained from the State Experiment Station at Excelsior.

Each spring several other varieties are grafted on to these trees which will, we hope, give us the long awaited answer of the variety capable of withstanding our severe winters, and still producing a good quality fruit during the short growing season.

Holds Out Promise

Every year information is requested on the growing of hybrid blueberries. To help provide this information to the public, the Iron Range Resources and Rehabilitation Commission in 1953 authorized the purchase of a few plants for the start of a test plot.

However, because the planting was so small, 150 more plants were purchased, of four varieties, in 1954. These plants were set at the St. Louis County Work Farm. A site was selected, and peat was added to the soil before planting. The soil was treated to increase the acid content to the proper level and recommended fertilization practices are being followed.

To date, the blueberry test plot is healthy and vigorous, and if it survives the winter without too much damage, we should know within two or three years whether or not we will be able to profitably grow hybrid blueberries in this area.

Activities Noted

Activities were conducted in the promotion of fruit growing by Fred W. Braden, agricultural fieldman for the IRRRC:

103 public meetings.

560 home visits.

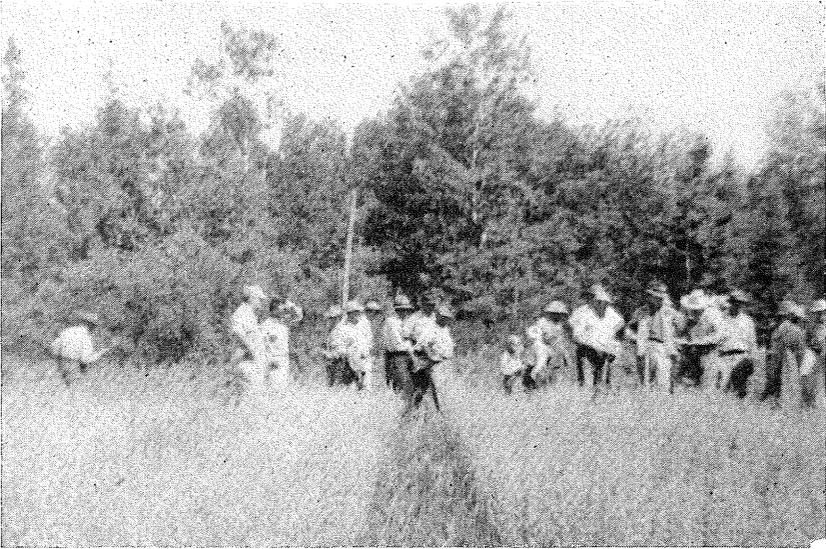
8 fruit tree pruning demonstrations.

Meetings were held with community clubs, garden groups, and 4-H clubs.

Slides were used for illustrating talks on the growing and care of small fruits.

Home visits were made concerning soil tests, selection of planting sites, checking for diseases, insects, and recommendations for control of them.

Fruit tree pruning demonstrations were attended by about 200 persons.



Studying grain plots on Hill Brothers farm west of Cook.

Improving Farms

For several years studies have been made of varieties of potatoes adaptable to northern Minnesota. Trial plots have carried from thirty to fifty varieties, most of them new to the potato grower. Object has been to find out what type will do best under local conditions.

Through this work two varieties have become well-known. They are the Cherokee and the Kennebec. These are now very popular among the potato growers and especially among the small producers and gardeners because of their resistance to disease, avoiding the necessity of buying expensive spraying and dusting machinery. Those two varieties also have good cooking qualities besides being high yielders and usually stand among the top five of all varieties tested.

Grains Studied

For the first time this year, IRRRC is giving help in the study of grain varieties in St. Louis County. Because of low farm incomes, and especially among those in the dairy business, these

farmers are aiming to raise most of their own feed and thus cut expenses. It is hoped that through these studies some information can be found that will be of help to dairy people in reaching that goal. Emphasis is being placed on oats and barley.

Because of the need for improved pastures and additional forage for dairy cattle, interest in weed control has increased. Through IRRRC help it has been possible to purchase chemicals for this purpose and weed control plots will be established in Pine, Kanabec, St. Louis, Carlton and Lake counties. In these demonstrations polybor Chlorate and weedone will be used. The results should be of value to farmers in weed control work and ultimately should tend to reclaim more acres for crop production.

Because of the excellent quality of rutabagas grown in the cut-over area, production of this crop has increased because of the activities of IRRRC along these lines. Big Stone Canning Company of Ortonville contracted for 300 tons in 1954 in Itasca County.

Fertilizers Tested

Various kinds of fertilizers have been applied to potatoes on one farm in St. Louis County to determine the value of their uses in potato production. Because of the low price of potatoes, it is important to produce high yields at the lowest possible cost. Increasing the amounts of fertilizers may bring this about.

The cut-over area is primarily a forage production section of the State and at the present time the most efficient consumer of this forage is sheep. Representatives of IRRRC have long recognized this and an effort is being made to reestablish flocks in the northeastern part of the State. In 1952 more than 600 western ewes were brought in and in the fall of 1953 an additional 400 ewes were brought in from the west. These were divided among farmers and 4-H club members and many new flocks were started. It appears 1954 will be another active year along this line.

Milk Marketing

Main source of income for many of the cut-over farmers is the dairy cow. A special attempt is being made to assist them—considering the price they receive is about 75% of parity. At the same time there is the change that is taking place in meeting requirements for Grade A milk. To assist in this change-over,

application has been made by the milk handlers in northern Minnesota for a testing laboratory. The services of this laboratory when once established, will give the farmer quick and first hand information as to the quality of his product and he will be shown the way to correct conditions if necessary. By producing high quality milk, local producers will be in a better position to keep markets which they are losing to producers out of the State.

Work To Be Done

More crop acres in the cut-over area is still a crying need. In some instances this is a case of clearing more land, in others it is a case of reclaiming some land already cleared but in need of drainage and in still others it is weed and brush control. But never before has there been such a demand for help in reclamation work. Several applications for help are already in the hands of the Commissioner, and others are in process.

There are very definite reasons for this. On the whole, farm income has been dropping and more so in the northern part of the State. Dairy products are down to 75% of parity and most farmers in this region have no other crop to turn to to make up for this loss of income.

So every effort is being made by them to cut costs and to raise most of their feed requirements. In this respect they need help and IRRRC can be of tremendous help to these farmers. The economic situation on some of the farms is approaching an acute state.

One other project in the planning stage is the marketing of potatoes. This is a worthy project and should be encouraged because the excellent quality of potatoes grown in northeastern Minnesota has already been established. It is now a matter of getting the volume and setting up a marketing agency. Storage facilities are already available.

Bemidji Wood Plant

Minnesota history is spotted with sorrowful tales of "ghost sawmill towns"—that is, communities where large-scale mill operations ceased years ago when big timber was exhausted. To help revive and retain these important industries the state has been pushing forest redevelopment, a program in which the Iron Range Resources and Rehabilitation Commission is cooperating wholeheartedly

But nature moves slowly. Trees don't grow up overnight. So the IRRRC continues to be vitally interested in assisting in the establishment of new industries which can make immediate use of so-called low grade timber, particularly in the cut-over lands of northern Minnesota. Those regions often are unsuitable for successful farming and experience difficulty in attracting other types of industry.

Plan Presented

Therefore, the Commission listened with special interest when representatives of Bemidji—once a booming sawmill town—presented a plan for making immediate use of adjoining vast stands of aspen (poplar). Bemidji, already firmly established as an important summer tourist and vacation center, wanted a producing industry to help stabilize its economic structure.

The plan proposed construction of a plant to manufacture plywood board, using low grade timber as base stock. After long study and numerous conferences the Commission agreed to grant assistance. In June of 1954 the Commission approved a contract with the Nu-Ply Corp., of Bemidji, to build a \$350,000 pilot (experimental) plant for production of plywood from native timber. Construction is now underway.

The agreement provides that Bemidji residents will put up about \$150,000 in addition to \$100,000 by the corporation. The contract provides the corporation will deed land to the state for construction of the plant. It then will be leased by the state to the corporation for a period of 10 years, with a minimum payment by the corporation of \$35,000 a year.

Before the end of the 10-year period the corporation has the option of purchasing the pilot plant.

Elmendorf Research, Inc., an Illinois corporation, owns the patents covering the process for converting the native woods into a new type of plywood. The research firm has licensed the Nu-Ply corporation to use the patents.

The Bemidji plywood project is the result of a community effort in the fullest sense of the word. Spearheading the drive was the Bemidji Civic and Commerce Association new industry committee, headed by Leonard R. Dickinson, a state senator and long a successful timber operator in Beltrami county.

Its members were aware that about one-third of all timber volume in Beltrami county is aspen-birch. One of their first steps was to visit the Superior Wood Products Co. plant in Duluth which successfully produces a hardboard using aspen as a base. The Duluth plant was established with IRRRC assistance.

Civic Promotion

After months of leg work and research the Nu-Ply corporation was formed. A. C. Nasvik, Bemidji, is president and general manager; Lloyd K. Johnson, Duluth, Vice president and Ray W. Bruess, Duluth, secretary-treasurer.

The corporation leaders determined that Bemidji and adjacent area was capable of supplying the necessary raw material and labor to warrant a capital investment of between one-half and three-quarter million dollars for the plywood plant.

When company officials expressed willingness to invest \$100,000 of their own money toward the enterprise a remarkable civic promotion followed. In a relatively short time some 200 residents raised \$150,000 as their part of the investment.

The plant will be built on the south shore of Lake Bemidji, site of one of the "ghost sawmill firms," the old Crookston Lumber Co.

Architect for the building is C. H. Smith of Duluth and the equipment engineering is by the Industrial Development Co. of Tacoma, Wash. The Northern Pacific railroad will build a spur line to serve the plant.

Operation Plans

Operation of the pilot plant is scheduled to begin in the spring of 1955 and eventual employment of about 70 men is

indicated. The program calls for an estimated output of 30,000 to 40,000 square feet of plyboard per day when the production line is in full operation.

The plant building is planned in two sections, one for the board production operation, the other for veneer production. Machinery will include a 119 ton press capable of forming 20 panels in a single operation.

Raw material requirements, very largely from small producers, is expected to stimulate logging activities in Beltrami and adjoining counties to a large extent. Labor will be recruited from the entire Bemidji area.

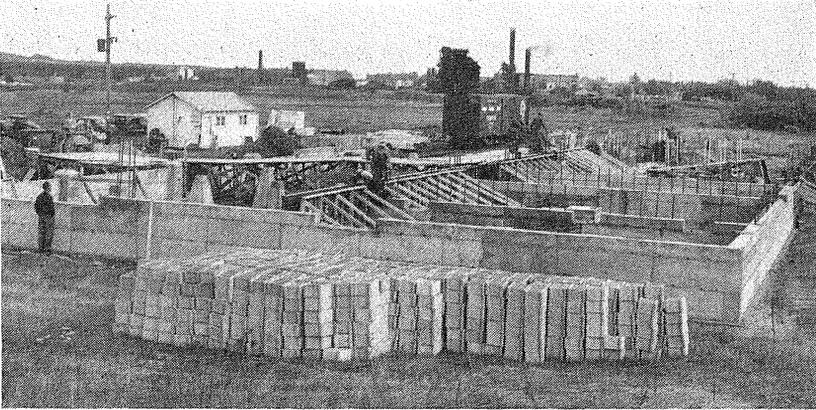
The Commission agreed to assist in this plywood project only after long deliberation and cautious and careful weighing of all factors, including the legal aspects. The project comes well within the scope of the functions and duties of the Iron Range Resources and Rehabilitation Commission, offering as it does hopes for additional utilization of Minnesota's timber resources, particularly in the so-called lower grades of which there are abundant and immediate supplies.

Process Checked

As in all experimental projects some element of risk is involved, but chance was reduced as much as possible by the great amount of study and research and observation which preceded the final decision to assist the project. Experts actually observed the successful operation of other similar projects. Even markets for the product were determined beforehand.

Its success appears further enhanced by the tremendous enthusiasm back of the whole program, as evidenced by the wholehearted spirit of a large number of Bemidji residents who dug deep into their pockets to join with larger private investors in setting up the project.

Such expressed enthusiasm, together with the carefully drawn program and the excellent opportunities it appears to offer for new use of available timber, deserves mention. If the project is successful—as it appears it will be—then the state's part will have been justified because it will be fulfilling a need for new industry, increased payrolls and in general help to make a more stabilized economy for the Bemidji area and the state as a whole.



Construction begins on a new pilot plant at Bemidji where a patented process will be used to convert native woods into a new type of plywood. The project was the result of a community effort.



This is an old photograph of a Bemidji sawmill which passed out of existence long ago when desirable timber was exhausted. The new Bemidji plywood plant will stand on the site of the old sawmill on the south shore of Lake Bemidji.

Projects in Forestry

Within the framework of the law which created the Office of Iron Range Resources and Rehabilitation, this agency sponsored numerous projects in the field of forestry.

These projects cover most of the field from tree planting and forest management to research, utilization, and production of products from our forests. The efforts of this office in behalf of Minnesota's forest resources have been very helpful in developing the resource.

This office has had considerable influence in developing a strong local interest in the care and management of public forest lands. Technical assistance together with other aid is provided in developing the forest resources of many forested counties in Minnesota.

Incentives Noted

Forest survey reports published after extensive field investigations tell all interested in Minnesota's timber resources just where we stand. County by county the important timber producing areas have been given attention. Stabilizing Minnesota's forest industries and development of the forest resource have provided the incentive for these studies.

The IRRRC has investigated many products, manufacturing processes, and methods of utilizing Minnesota's timber resources.

Forest survey field work has been completed for the entire state. This activity is now on a maintenance basis to keep data current without large expenditures of funds. We intend to cover all of the state in Forest Resource publications. There will be 20 publications in addition to a summary of all the information for the state.

Reports Published

Ten of these have been published, two are at the printers, one is being prepared for the printers, and three have been written and are being reviewed. Office work for the remaining reports has not been completed as yet.

Twenty reports will cover the entire state; 16 northeastern counties (principal forested counties) will have separate reports,

and the remainder of the state will be in large sections—Southeast, Southwest, Central, and Red River Valley. A complete state summary will be published soon.

Completion of present program for releasing reports follows by special analysis of the data. Study of survey methods is scheduled for this year (54-55) preparatory to setting up a plan of continual inventory system.

Land Use Planning

Land classification and land development have been emphasized during the past year. Considerable progress has been made but there is still a long way to go in this important work. The uncertainties of tax titles have seriously complicated the job of getting action on advice given county boards concerning their timber lands.

Rapid progress is being made in the project of replacing lost section corners in northern Minnesota. A section corner is a legal marker designating a definite location. Land is located, partitioned, described, sold, rented or occupied with reference to a section corner.

Most of the original wooden survey posts or bearing trees established by the U. S. government land surveyors in the 1870's, 1880's and 1890's have been rotted out or destroyed by fire, and subsequent replacements have been made by surveyors and cruisers at random. As these markers disappear, locating land becomes increasingly difficult.

Funds Matched

To partially alleviate these problems the Iron Range Resources and Rehabilitation Commission has been matching funds dollar for dollar with Itasca, St. Louis, Becker, Koochiching, Crow Wing, and Lake counties in the costs of re-establishing lost corners.

Cruisers and foresters, under supervision of county land commissioners, locate lost or obliterated corner locations and replace wooden corner markers with permanent steel pipes. These pipes, with aluminum caps, are set in the ground at section corners, at quarter corners and meander corners bordering on lakes and rivers.

The legal survey description of the location, supplied by the U. S. Official Survey, is stamped on the top of the aluminum cap. This provides a lasting and legally accurate location marker, aiding not only county land departments but adjoining owners, whether private, state or federal.

Tractor Speeds Work

The addition of a tractor to our equipment has simplified and greatly increased the amount of reforestation work that can be done. Disking to prepare a good seedbed and an extensive program of tree planting are adding productive acres to our forest each year.

In the past seasons two million seedlings were planted on county lands with tree planting machines loaned to the counties by Iron Range Resources and Rehabilitation.

Forestry research to find answers for some of the problems encountered in our program of developing Minnesota's forest resources has given considerable stimulus to research in several important fields.

Plantation management, aspen sites, and potentials of various soils to produce quality aspen, brush invasion on pine sites and the effect of defoliation on our timber stands have been the most important studies inaugurated in this program.

New Program

This series of studies is a new program and during its first year has proved to be very productive. Each time research finds a solution to a problem, whether it be in management, marketing, or the development of a new product, our entire state benefits by the application of such findings. We have concentrated our efforts on problems of prime importance to the managers of tax-forfeited lands.

Through wise and proper use, these lands can again achieve the production they enjoyed before they were cut and abandoned to public management. It is hoped that research will assist in finding all the possible short cuts to increase the productiveness of Minnesota's forests and that our people may prosper through expansion of our forest industries.

Moulded from Aspen

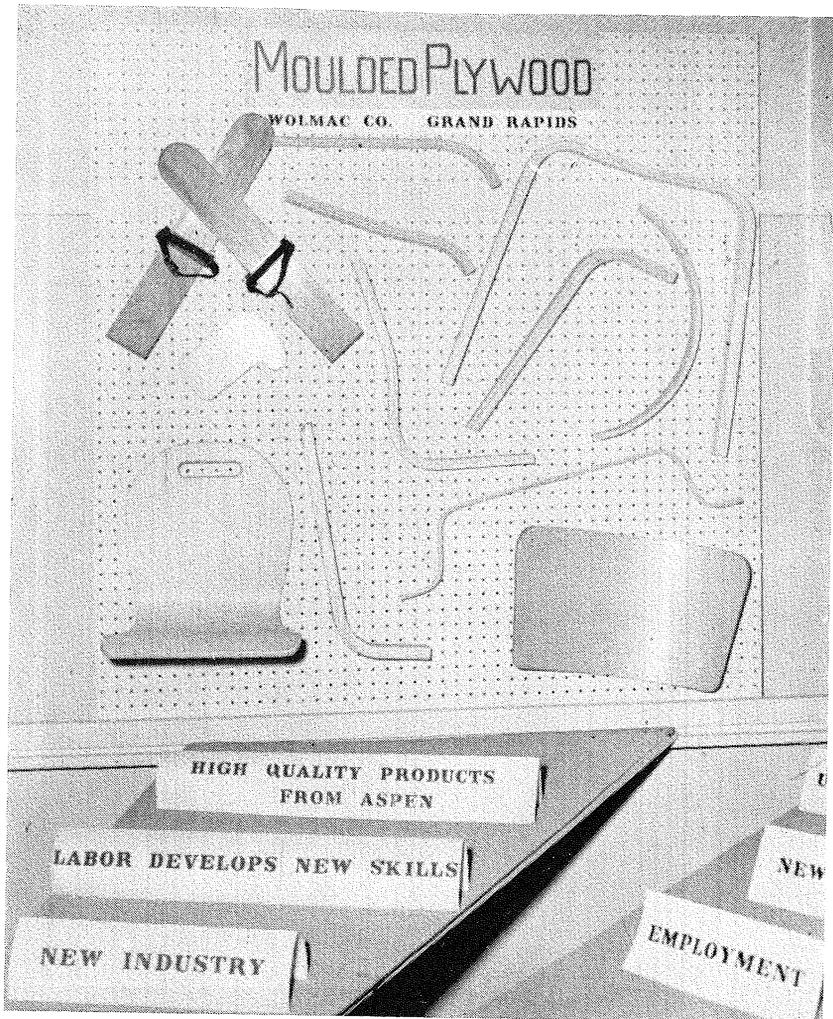
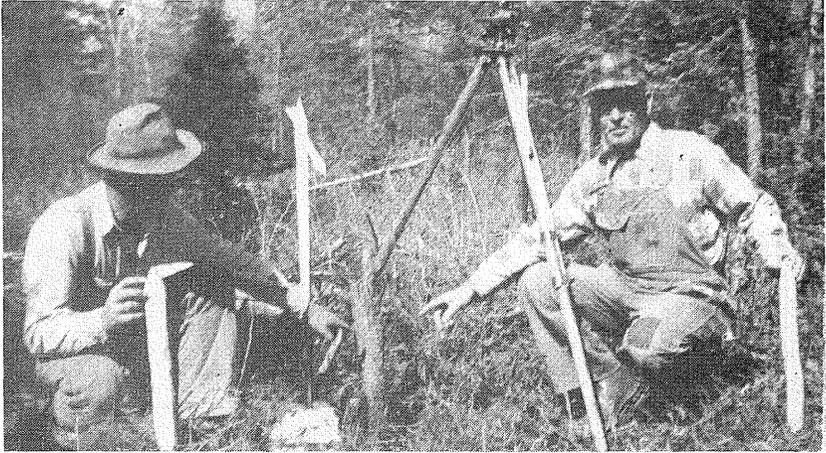


Exhibit showing high quality products moulded from aspen (poplar) at Grand Rapids.

Surveyors at Work



Survey crewmen point to a remnant of corner post placed in 1887 by federal surveyors.



Decayed corner post is replaced by iron pipe with marked cap. At right in picture, note bearing tree in poor condition.

Making Hardboard



Portraying process of making hardboard from aspen in Superior Wood Products plant, Duluth. Pulpwood is chipped, fibered, chemically treated, pressed and heated.

Alfalfa and Clover

At the time of the last report to the Governor and the Legislature (report for the biennium July 1, 1950 to June 30, 1952) one year had passed since the Iron Range Resources and Rehabilitation Commission made available funds for an expanded program of research on seed production of forage legumes. In that year research already under way on injurious insects and their control, cultural procedures for alfalfa, and diseases of alfalfa was continued and expanded.

Such work on new lines of research—pollination, sweet clover weevil and its control, soils and fertilizers, and control of weeds—as could be undertaken in this first year was largely observational and exploratory. The present report summarizes the accomplishments of the two years which have followed (July 1, 1952 to June 30, 1954).

Work Expands

When research on seed production began in Minnesota, work was undertaken on two crops, alfalfa and alsike clover. With the expansion permitted by the Commission a start was made with work on a third crop, sweetclover. In 1953 studies were started on a fourth crop, red clover.

Satisfactory seed production is not possible without cross pollination, and bees are the most effective means of obtaining cross pollination. Correction of all other factors that affect seed production will not necessarily lead to the production of seed unless the flowers are pollinated by bees.

In view of the recognition over the past two years that pollination is still our most important and most basic problem, increasing amounts of time and staff effort have been devoted to solution of the problems of pollination.

Pollination

Initially, work was concentrated on pollination of alsike clover and alfalfa—the part played by wild bees in the pollination of alfalfa, the species involved and their biology, pollination of

alsike clover by means of the honeybee, and a study of the possibilities of the honeybee for pollination of alfalfa.

Up to the time this research program began evidence available suggested that the honeybee was *not* an effective and reliable agent for pollinating alfalfa in Minnesota even though in California and in sections where the honeybee does not have access to other flowers it apparently *is* an effective pollinator of alfalfa.

Although wild bees have been found to be efficient pollinators of alfalfa, it has become increasingly apparent that wild bee pollinators are not sufficiently constant in occurrence and abundance to be relied on. In spite of evidence in the past that the honeybee has not been very efficient, the conclusion has been reached that improvement of pollination of alfalfa should be sought in the honeybee, and that every effort should be made to determine if and how this beneficial insect could be used to pollinate.

Special Problems

Currently, three staff members are engaged in work on pollination, while the special problems of pollination of alfalfa are being tackled from several different angles.

One staff member is working full time on pollination—half time on pollination of alsike clover by means of the honeybee and half time on some aspects of pollination of alfalfa with the honeybee.

Another staff member is devoting half time to other aspects of work on the pollination of alfalfa with the honeybee. A third staff member who formerly worked half time with injurious insects of alfalfa is now devoting this time to pollination of red clover by means of the honeybee, it being deemed inadvisable to work further on injurious insects of alfalfa until more progress had been made on the problem of pollination of this crop.

Active cooperation is maintained between entomologists and plant breeders and work is in progress to evaluate clones of alfalfa for attractiveness to pollinators. Thus, in the development of new varieties of alfalfa, it is planned to incorporate attractiveness to bees. Through cooperation between entomologists and soil scientists, the possibility of soil nutrients affecting pollination through abundance and attractiveness of flowers of the various legume crops is being studied.

Lines of work undertaken with the respective crops over the past two years are the following:

- ALSIKE CLOVER: Injurious insects and their control.
Pollination with the honeybee.
Soils and fertilizers in relation to seed production.
Inter-relation of insect control, pollination, and fertilization in seed production.
- ALFALFA: Injurious insects and their control.
Determination of the wild bee pollinators of alfalfa and determination of their relative importance.
The biology of the more important wild bee pollinators.
Study of the potentialities of the honeybee for pollination of alfalfa.
Studies to induce increased tripping of flowers by honeybees.
Row and broadcast seeding.
Row and broadcast seeding in relation to fertility levels.
Inter-relation of insect control, pollination, and fertilizer in seed production.
Leaf spot diseases.
Black stem disease.
Control of weeds.
- SWEETCLOVER: Sweetclover weevil and its control.
- RED CLOVER: Control of injurious insects.
Study of pollination by honeybees.
Fertilizers in relation to seed production.
Inter-relation of insect control, pollination, and fertilizer in seed production.
Anthracnose disease.

Close cooperation between the various workers has been maintained even though the particular workers may be associated with different departments. A team approach to the various problems has been used throughout the investigations. The work has been directed and co-ordinated by an inter-departmental

technical committee of seven with representatives from the four cooperating departments.

Threshing Machine

At the outset of these seed production studies the need for a machine to thresh thousands of samples from experimental plots was recognized. A sum of money was set aside in 1951-52 to start construction of such a machine. Plans of several legume seed threshers at other stations were studied and four persons traveled to Ames, Iowa to study a machine similar to the one being considered by the Minnesota group. Because machines of this type are not available on the commercial market, it was necessary to develop plans and have the machine constructed in the University Farm Service and maintenance shop on the St. Paul Campus.

The machine was constructed in 1951 and 1952, and a few additional features were added during the year 1952-53. It was used to thresh all experimental plot samples in 1952 and 1953, with results even more satisfactory than anticipated.

Almost 3,000 one-square-yard samples were threshed in 1952 and about 2,500 were threshed in 1953. In addition, seed increase lots of experimental varieties from other projects were threshed both years. Alfalfa, red clover, sweetclover, alsike clover, and ladino clover have all been threshed satisfactorily with this machine.

Research men at other stations are interested in constructing similar machines and one station has requested pictures of the machine and suggested a few modifications in order to construct a similar machine.

Breeding Studies

The 1952-54 studies on cultural practices were a continuation of those reported in 1950-52. Two hundred and fifty-two plots of alfalfa were seeded in 1950 at eight locations; however, stands were satisfactory at only six. The factors affecting seed production studied at each place included row versus broadcast seeding with rows 36" apart, dates of clipping, and differences in varieties.

Results in 1952 and 1953 indicate that in the extreme northern part of the state clipping at any time was detrimental to seed production. At Morris, clipping was advantageous, and it is recommended that farmers in the central and southern part of the state take the first crop for hay and produce seed on the

second crop. Seed yields were lower from row than from the broadcast seedings. However, row seedings permit cultivation for better weed control and for roguing.

Additional studies are now under way of narrower (21") row spacings for seed production. Where seed yields were good, the three varieties did not appear to differ appreciably in seed yields. This indicates that either Ranger, Ladak, or Grimm will produce satisfactory seed yields under favorable conditions.

The scarcity of pollinating insects continues to hamper studies of this type causing very poor seed yields.

Results obtained from greenhouse studies indicate that alfalfa clones differ in attractiveness to honeybees. These studies are being continued in the field to determine whether or not wild bees also prefer some clones to others. If so, it may be possible to produce alfalfa varieties that are more attractive to the pollinating insects.

The development of leaf spot-resistant varieties has received encouragement with the isolation of alfalfa clones that appear resistant to black stem and common leaf spot, two important alfalfa diseases in Minnesota.

Diseases of Alfalfa

Prior to the research reported here little or nothing was known about the destructiveness of foliage diseases of alfalfa or methods of controlling them. Black stem, caused by *Ascochyta imperfecta*, is probably the most widespread and destructive, followed by common leaf spot, *Pseudopeziza medicaginis*, and *Stemphylium* leaf spot, *Stemphylium botryosum*.

Black Stem infects all parts of the plant, causing severe defoliation, and it destroys virtually 100 per cent of the seed if severe infection occurs at the flowering stage.

Greenhouse experiments demonstrated that *Stemphylium* leaf spot caused 80 per cent of the leaves to drop from plants within 30 days after infection occurred, and seed production in the same experiments was reduced by approximately 50 per cent.

Disease Fight

Although no experimental data are available to illustrate the losses from common leaf spot, observations indicate clearly that the organism causes 75 per cent or more of the leaves to drop from the plants when infection is severe.

Efforts to control these diseases by the use of sprays and dusts have failed completely. Clean cultivation and burning fields in the spring will delay the diseases but will not prevent them. Furthermore, cultivation injures plants and predisposes them to root and crown rots; burning destroys valuable organic matter and is dangerous because fires can get out of control. Therefore, these practices are not recommended.

The only feasible method of control appears to be the development of disease-resistant varieties. To this end, approximately 50,000 individual plants have been tested and examined in the last eight years for their reaction to foliage diseases. Thirty-two plants proved to be resistant to common leaf spot, and 17 are resistant to black stem. Fourteen of them are resistant to both diseases.

These plants are being propagated vegetatively and are being crossed with each other in various combinations to develop disease resistant progenies that can be used as commercial varieties. Three synthetic varieties have already been established with the most resistant clones as parents. If these synthetic varieties prove to have sufficient leaf spot resistance and have desirable agronomic characters, they could be used directly as commercial varieties.

Weed Control

There is very little information in the literature that can be applied to the weed problems of northern Minnesota. Investigations in this project have, of necessity, been exploratory in order to discover leads. Principal effort to date has been directed at control of quackgrass and cockle in alfalfa. A large number of chemicals has been screened and methods of application have been studied for the few that showed promise. At the conclusion of the 1954 season, 1,863 experimental plots will have been established and studied.

Of the chemicals tried, TCA has been most effective on quackgrass. It is applied in the fall on plowed ground. Alfalfa may be sown the next spring. For cockle, MH-40 (maleic hydrazide) is very promising. At 4 to 5 pounds per acre it stops growth of the cockle, preventing blossoming and seed production without any apparent serious injury to alfalfa.

Its effect on alfalfa seed production, if any, is not known at present. Dalapon, new in 1954, also looks promising for cockle

control. It would be much cheaper than MH-40. New herbicides appear each year so that the screening process and study of application methods should continue.

Clover Weevil

Minnesota has been a leading producer of sweetclover seed but sweetclover weevil is seriously threatening production by destroying new seedings.

Sweetclover weevil was not known in Minnesota prior to 1933, but it has become numerous and has destroyed many new stands of sweetclover in the state since that time. These losses seriously affect the agriculture of the state, for sweetclover, in addition to being a valuable seed crop, is an agent of soil improvement, and is of value as an animal feed and a source of honey.

Little was known about the activities of the weevil in Minnesota and what might be done to reduce the losses caused by it here, when a study of the weevil was initiated in January, 1952. This new part of the project included laboratory and greenhouse studies during the winter months and studies under field conditions in the summer.

Results Published

Major results of these studies have been published in University of Minnesota Extension Folder 180, which contains descriptions and pictures of the insect and its various kinds of injury to sweetclover, its life history and seasonal activity, and suggestions for chemical control.

Chemical control has been a major objective in the studies conducted in 1952 and 1953. Many insecticides have been tested at different rates of application, and application by ground sprayers and by airplane has been compared.

The insecticides and rates of application found in these experiments to be most effective in reducing weevil injury were: heptachlor or dieldrin, $\frac{1}{2}$ pound per acre; aldrin, $\frac{3}{4}$ pound per acre; toxaphene or chlordane, 2 pounds per acre; DDT, 3 pounds per acre.

New seedlings need protection against weevil injury early in the spring when the seedlings first emerge. Insecticide applications may be necessary again in mid-summer when a new generation of adult weevils emerges from the soil.

Possibilities of using weevil parasites, cultural practices, or resistant varieties of sweetclover to reduce loss of new stands

of sweetclover have been investigated to a limited extent and some of these studies are being continued.

Injurious Insects

During the past two years, investigations have been continued on:

- (1) control of injurious insects on alfalfa.
- (2) control of injurious insects on alsike clover.
- (3) effects of fertilizer treatments on populations of injurious insects of alfalfa and alsike clover. Preliminary studies were begun on the resistance of different alfalfa clones to injurious insects.

It has been demonstrated that the most important injurious insects of alfalfa can be controlled by proper use of insecticides. When injurious insects were abundant, a single application of insecticide has increased alfalfa seed yields as much as nine times.

The use of insecticides on alsike clover has given consistent increases in seed yields. In one 1952 experiment, the check plots yielded 121 pounds of seed per acre, plots receiving a bud-stage application of DDT yielded 257 pounds per acre, and plots receiving both a bud-stage application of DDT and a flower-stage application of toxaphene yielded 321 pounds per acre. In the 1953 experiments, use of insecticides increased alsike clover seed yields by 100 to 200 pounds per acre in every experiment.

Information on how to recognize the most important injurious insects of alfalfa and alsike clover has been made available to county agricultural agents and seed growers. Recommendations have been made on the choice of insecticides, rates of application, and timing of applications.

Fertilizer Checks

Early observations indicated the possibility that fertilizer applications on alfalfa might affect populations of *Lygus* bugs and alfalfa plant bugs. In extensive observations during 1952 and 1953, applications of phosphorus and potash were found to have no apparent effect on the abundance of either *Lygus* or alfalfa plant bugs in the season following the application. Such evidence as has been obtained on the effect of phosphorus and potash on these insects was obtained in the second year after treatment.

Fertilizer applications on alsike clover, however, resulted in lower populations of the alsike clover seed weevil in the season immediately following application wherever the fertilizers produced an increase in plant growth. Fertilizers had no apparent effect on populations of plant bugs; however, pea aphids occasionally became more abundant in fertilized plots than in the checks.

Some sampling techniques for evaluating resistance of alfalfa plants to injurious insects were studied in 1952. In studies at Rosemount in 1953, different alfalfa plants were rated according to severity of leafhopper injury, and counts of leafhoppers were made on the plants. Results indicated that plants of different clones may show different types of symptoms.

Alfalfa Pollination

Satisfactory yields of alfalfa seed can be obtained only when pollen from flowers on one alfalfa plant is transferred to flowers on another alfalfa plant. This transfer of pollen poses a special problem because the sexual parts of the flower which bear the pollen are enclosed between two petals.

The pollen is not available to insect pollinators unless these structures are exposed by an action known as tripping. In this action, the sexual parts of the flower, which are under tension, are released and break out from between the petals that enclose them.

As the flower is tripped, pollen is deposited on the insect which trips it and cross pollination results when this pollen is deposited on the female portion of another flower tripped by the insect.

Certain wild bees are effective trippers of alfalfa and they cross pollinate alfalfa flowers as they go from one plant to another.

Studies were made in northern Minnesota to determine the kinds, availability and efficiency of wild bees that pollinate alfalfa. These studies indicated that the two most important wild bees that pollinate alfalfa were the leafcutter bees and bumble bees. Leafcutter bees tripped an average of 97.5 per cent of the flowers they visited while bumblebees tripped an average of 34 per cent of the flowers they visited.

Leafcutter bees were found living in nests in soil or wood. Bumblebees nest on the ground. It has not yet been practical to propagate wild bees, but it is possible to protect them by not disturbing their nesting sites.

At times wild bees may be present in sufficient numbers to produce profitable alfalfa seed crops, but seasonal variations in the numbers present and lack of control over these bees stress the need for a more dependable source of pollination.

Bees Studied

Honeybees are being studied as a possible source of reliable pollination because they are effective pollinators of alfalfa in some areas of United States and they can be moved in large numbers to desired locations.

During 1952 and 1953, honeybees were moved into fields and their activities on alfalfa were observed. In 1952 the bees observed tripped only 17 of 5,293 flowers visited, or an average of about 0.4 per cent. They tripped an average of 0.7 per cent in 1953.

The absence of competing crops, such as sweetclover, in 1953 was apparently responsible for an increase in the number of bees that remained in the alfalfa fields and in the increase in the per cent of flowers tripped.

Seed yields on the experimental fields were 36 pounds per acre or less in 1952 but the yields ranged from 250 to 392 pounds per acre in 1953. These results suggest that under some conditions the honeybee has promise as a pollinator of alfalfa in Minnesota.

One line of study undertaken during the past two years is an attempt to increase the effectiveness of honeybees as pollinators of alfalfa by changing their behavior. Preliminary results indicate that the pollinating activity of honeybees during these tests was increased. These results suggest that manipulative procedures might be used to make the honeybee a more effective pollinator of alfalfa.

Clover Pollination

Observations in 1950 and 1951 indicated that there are not enough wild bees in northern Minnesota to pollinate alsike clover adequately. In 1952 studies were initiated to determine if honeybees could be used to pollinate alsike clover. Honeybees were placed on the borders of alsike clover fields at rates of zero, two, four, and eight colonies per acre. In 1953, honeybees were used at rates of zero, two, and four colonies per acre. Small areas in the fields were caged to keep out bees. Half of each field was sprayed with DDT at 1½ pounds actual DDT per acre to control the injurious insects.

Results of the 1952 work indicated the effectiveness of honeybees in pollinating alsike clover. Ninety-three per cent of the bees observed in the experimental fields were honeybees. Bumblebees and digger bees contributed to the pollination of the crop but to a lesser extent. Increased concentrations of honeybees resulted in progressive increases in seed yields.

Results of the 1953 experiments again indicated the effectiveness of honeybees in pollinating alsike clover and the need for locating honeybee colonies near seed fields. Ninety-seven per cent of the bees visiting the experimental fields were honeybees.

Native bees contributed relatively little to the pollination of alsike clover. Caged areas yielded only 20 pounds of seed per acre, while yields with four colonies of honeybees per acre were 448 pounds per acre in one field and 532 pounds per acre in a second field.

On present evidence, two to three colonies of honeybees per acre are recommended to assure adequate pollination of alsike clover.

Insect Control

Preliminary work was begun in 1953 on pollination of red clover with honeybees and on the control of injurious insects in preparation for more extensive experiments during the 1954 season.

Two similar, five-acre fields of medium red clover were selected in Clearwater county, and the second crop was grown for seed. Half of each field was sprayed with DDT at a rate of 1½ pounds actual DDT per acre. Twenty colonies of honeybees were located at one field and the second field was left without honeybees.

By using honeybees for pollination and controlling injurious insects with one application of DDT applied during the late bud stage, the seed yields were increased from 129 pounds per acre to 540 pounds per acre.

This preliminary work indicates that honeybees are promising as pollinators of red clover in areas where competing crops such as sweetclover are not present. The yield increases resulting from one application of DDT indicate the importance of injurious insects and the desirability of making further investigations on these insects and their control.

The effects, alone and in association, of such factors as control of injurious insects, pollination, and fertilizer have been studied in several fields of alsike clover, alfalfa, and red clover during the 1952 and '53 seasons.

Fields Studied

Seed yields in most of the alfalfa fields in 1952 were nil or poor mainly as a result of insufficient pollination, even though most of the fields were located in areas where wild pollinators were present.

One field, located at Crookston, was used to study the possibilities of the honeybee as a pollinator of alfalfa. In 1952, this field yielded negligible amounts of seed, 36 pounds per acre in the best fertilizer treatment. Most of the bees flew to sweetclover a quarter of a mile away instead of to the alfalfa.

In 1953, three fields were studied. Two, located in areas where wild bees were available, yielded 136 and 241 pounds per acre in the best treatments (1,000 lbs. per acre of 0-20-20 fertilizer with injurious insects controlled). The third field, that at Crookston with honeybees, yielded 392 pounds per acre in the best treatment (500 lbs. per acre of 0-20-20 with injurious insects controlled) compared with 189 in the unsprayed, unfertilized plots.

In 1953 sweetclover was not available to the honeybees and they gave more attention to the alfalfa. These results suggest that in the absence of competing crops, the honeybee has promise as a pollinator of alfalfa.

Results from 1952 and 1953 fields of alsike clover in which injurious insects were controlled with DDT and pollination was provided by means of the honeybee have been uniformly good.

They are summarized in the following table:

**Yields From Pollination, Insect Control, and Fertilizer
in Alsike Clover**

	Yield without pollination (in pounds)	Yield with pollination but without insect control or fertilization	Yield with pollination and insect control but without fertilizer	Yield in best fertilizer treatment with pollination and insect control
1952.....	15	102	154	691
1953.....	20	187	326	685
1953.....	20	368	586	808

The fertilizer treatment with the highest yields in the first and second fields was 1,000 pounds of 0-20-20 and in the third field was 1,000 pounds of 0-20-40.

The 1952 field was sown to barley in 1953. The residual value of the fertilizer which produced the highest yield of seed in 1952 produced almost twice the yield of barley in 1953—from 32 bushels in the check plot to 62.5 bushels per acre in the best fertilizer treatment.

The increase in yield in the following crop is a result of the residual value of the fertilizer applied to the seed crop. This indicates that other aspects of the agriculture of the northern counties will benefit in addition to increases in yield of seed when the results of the investigations on seed production are applied in producing seed.

Yields Increase

Preliminary results from investigations on red clover of fertilizer and insect control with pollination provided by honeybees show increases in yield from 404 pounds per acre in the unfertilized plot to 632 pounds per acre with 1,000 pounds of 0-20-0. In another study, yields without insect control and without honeybees were 129 pounds per acre, while yields with insect control and honeybees for pollination were 540 pounds per acre. These preliminary results from insect control, pollination, and fertilizer suggest that the outstanding results obtained through the combined effects of these three factors with alsike clover, should eventually also be obtained with red clover.

Summary

Greatest progress towards rehabilitating the seed production industry has been made with alsike clover. Progress of the research together with recommendations are given in a multilithed publication "A progress report of research on alsike clover seed production in Minnesota," 19 pp., February, 1954, which has been distributed to the seed growers.

A solution to the problem of maintaining a stand of sweetclover by controlling sweetclover weevil has been obtained. Recommendations are given in an extension folder, "Sweetclover weevil and its control," extension folder 180, February, 1954. Results of this work will benefit not only seed growers but all farmers in the state who use sweetclover as a green manure crop.

Marked progress towards solution of the seed production problems of red clover has been made. There is every reason to expect that seed production of red clover can be reestablished as it has been with alsike clover.

Problems of seed production of alfalfa are greater than with any of the other crops. Nevertheless, good progress has been made with all aspects of the problem. A multilithed publication summarizing progress of the work to date has been prepared and distributed to the farmers. It is "A progress report of research on alfalfa seed production in Minnesota," 17 pp., February, 1954. The crucial and difficult problem of pollination of alfalfa is being approached from several angles, and gratifying progress is being made with it.

The program of work on the four crops proposed for the future will continue along the lines which have been pursued during the past two years. The special problem of pollination of alfalfa will be handled along the following specific lines:

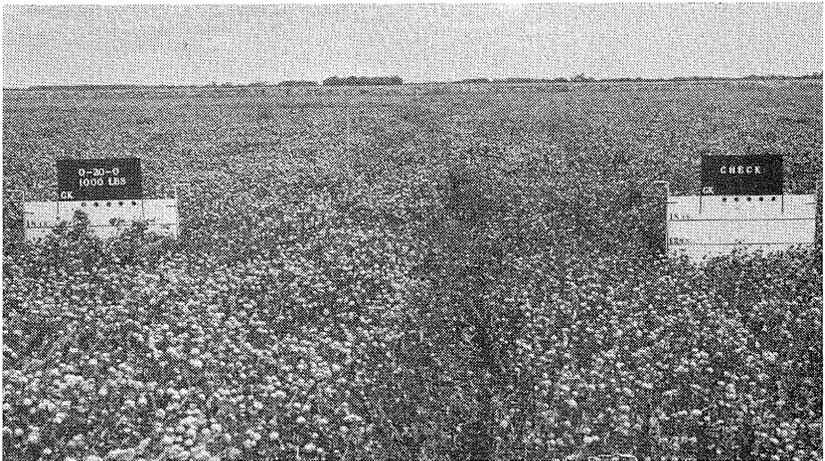
1. A study of competing crops which interfere with pollen gathering in alfalfa
2. Inducing pollen gathering and tripping in worker honeybees
3. Evaluation of the tripping potentialities of different strains of honeybees leading to the breeding of honeybees for pollination of alfalfa
4. Evaluation of different clones of alfalfa for attractiveness to honeybees and incorporation of attractiveness into new varieties of alfalfa being developed.

New lines of work which could be undertaken on the various crops if and when funds permit are the following:

1. The relation of cutting date to pollination of red clover
2. Soil nutrients in relation to pollination of alsike clover and red clover
3. Evaluation of varieties of red clover for attractiveness to honeybees for pollination
4. A study of pollination of sweetclover
5. Soil conditions in relation to seed production of the respective forage legumes
6. Reduction of harvest losses through improved mechanical harvesting.



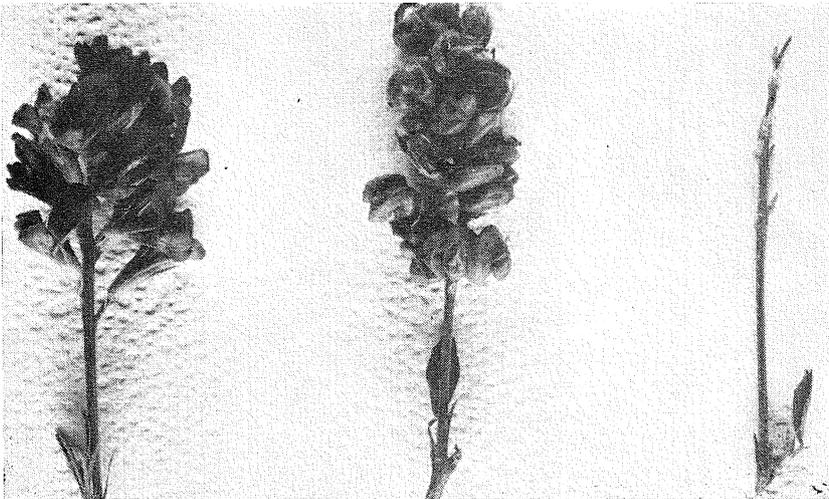
Counting bees per square yard in alsike clover field — a study on the pollination of alsike clover with honeybees.



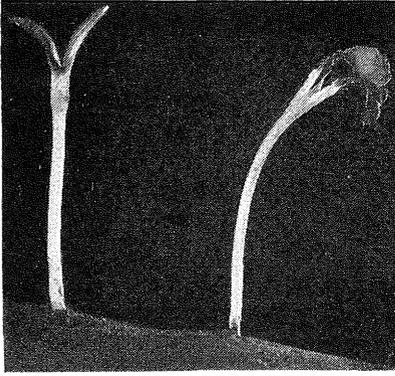
Showing differences in growth and flower production of alsike clover with fertilizer. On the right an unfertilized plot with maximum growth up to 12 inches. On the left a plot fertilized with 1000 pounds of superphosphate (0-20-0) with maximum growth 22 inches. Gus Kveen farm, Roseau.



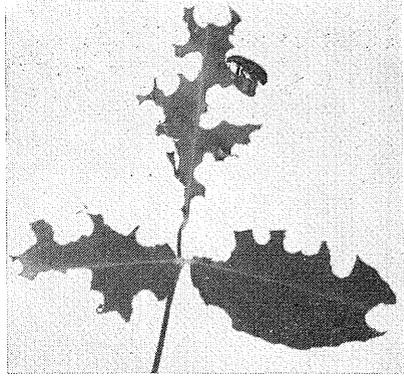
Marking honeybees, by spraying them with pigment, in studies on the honeybee for pollination of alfalfa.



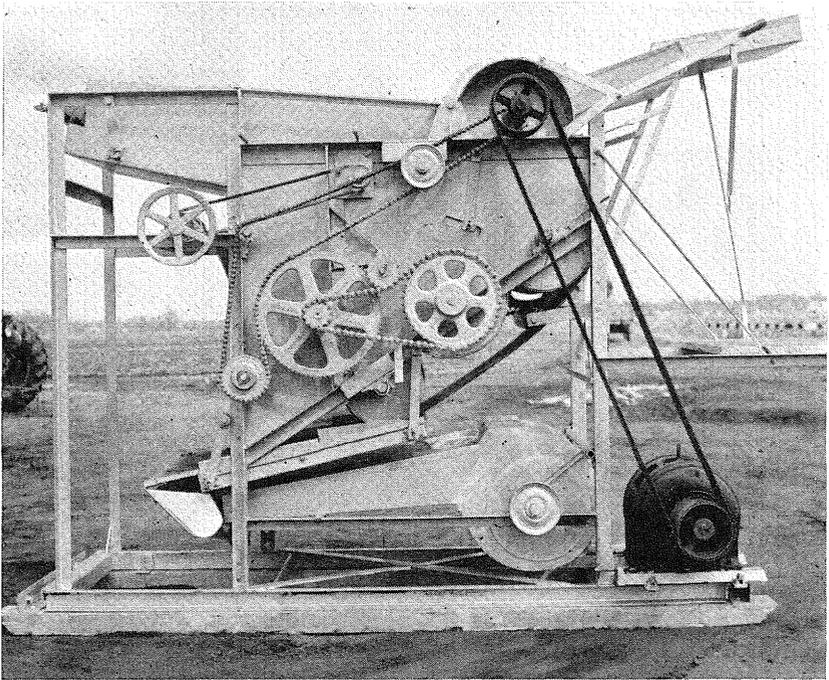
Showing the effect of pollination and lack of pollination on alfalfa flowers. Left, a raceme of flowers; center, a group of curled seed pods resulting from pollination; right, a stem from which flowers dropped through lack of pollination.



Injury by weevil to seedlings of sweetclover. Left, healthy seedling; right, injured seedling.



Weevil at work, illustrating typical injury to leaves of sweetclover.



Threshing machine constructed for threshing square-yard samples of alfalfa and the clovers from experimental fields.

Miscellaneous

A plan to purchase a warehouse of the Arrowhead Canning Co., Grand Rapids, was upset by an opinion of the Attorney General's office which questioned certain legal aspects of the proposed transaction. And in view of the opinion, the state's Commissioner of Administration declined to act on an IRRRC purchase requisition. Because of the question of statutory authority he recommended that the "Legislature convening in January, 1955, be appraised of the situation for their proper determination and action." The state, through the IRRRC, invested \$64,751 in the cannery pilot plant. Of that amount \$4,000 has been repaid by installments of \$125 per month since December 1, 1951. Under the new plan, which would have increased the state's investment to \$118,426, a suggested lease would repay the state's total investment in the pilot plant and warehouse in 20 years. Payments would start at \$350 a month and gradually increase to \$700 a month.

Appointed

August Neubauer, Virginia, former St. Louis county agricultural agent, was appointed IRRRC agricultural field representative on July 1, 1952, filling a vacancy caused by the death of Ernest P. Gibson. Much of his work is being concentrated on improving and increasing production of seed potatoes in northern Minnesota, along with encouraging truck farming, promoting land clearing programs and developing forestry management practices.

Training Center

A proposal to establish a training center in Virginia, with IRRRC assistance, for physically handicapped persons was ruled out by the Attorney General who held that this agency's funds could not be used for such purpose.

Milk Testing

A proposal, backed by Iron Range area farmers and dairies, to establish a milk testing laboratory at Hibbing with IRRRC assistance was held up for further study.

Marl Survey

The Commission held up for further study a request from Minnesota Marl Products Co., St. Paul, for IRRRC assistance in making a survey of marl deposits and erecting a pilot plant.

Extensive deposits of marl are said to exist in northern Minnesota, particularly in Itasca county. Marl, found in lake basins, bogs and in marshy areas once covered with water, is used for many purposes, including production of cement and fertilizer.

Future Outlays

The Commission approved the following expenditures during the year, beginning July 1, 1954: \$230,000 for forest development; \$54,000 for topographical mapping; \$69,525 for water surveys; \$40,000 for legume seed research and improvement; \$5,495 for agricultural development; \$42,027 for administration; and \$45,000 to the University of Minnesota for peat research, \$15,700 of that allocation going to the Duluth branch of the university. All are for projects already under way.

Blocked

Plans to lease the state-owned peat experiment plant at Floodwood, idle for four years, to the Minnesota Peat Cellulose and Chemical Corp., were blocked by a 1953 state law. That law directs the plant be sold by bid and prohibits leasing it. The corporation then selected Chisholm as the site for its peat research.

Credits

Receipts from IRRRC projects credited to the general revenue fund totaled \$57,455 in the period 1952-1953 and \$58,826 for 1953-54. Among those were: Arrowhead Seed Growers Co-op., Cook (seed warehouse), \$2,083; Chun King Sales, Inc., Duluth, \$24,311; Superior Wood Products, Inc., Duluth (hardboard manufacturer), \$76,562; and Wolmac Co., Grand Rapids (vener wood dryer), \$2,300.

Receipts and Outlays

Receipts

	1952 - 1953	1953 - 1954
TAXES		
5% of Occupational Tax on Iron Ore.....	\$942,199.88	\$1,379,095.05
TRANSFERS IN		
Recovery of unobligated balances of transfers out in prior years:		
Department of Conservation:		
Division of Forestry	6,970.42	4,515.96
Division of Lands and Minerals..	9,507.53	5,985.40
Division of Waters	1,425.40	1,500.16
TOTAL RECEIPTS.....	\$960,103.23	\$1,391,096.57

Receipts From IRRRC Projects Credited to General Revenue Fund

	1952 - 1953	1953 - 1954
RESTITUTIONS		
Workman's Compensation.....		\$ 7,300.33
USE OF PROPERTY		
Equipment rentals.....	\$ 7.00	1.00
INTEREST ON DELINQUENT COLLECTIONS....	15.99	
STORES FOR RESALE		
Arrowhead Canning Company, Grand Rapids, Minn. (Rutabaga Canning).....	1,500.00	1,375.00
Arrowhead Seed Growers Coop., Cook, Minn. (Seed Warehouse).....	1,083.33	1,000.00
Chun King Sales, Inc., Duluth, Minn. (Chinese-American Foods).....	14,311.54	9,999.96
Milkhouses	224.86	
Superior Wood Products, Inc., Duluth, Minn. (Hardboard Manufacturers)	39,812.50	36,750.00
Wolmac Company, Grand Rapids, Minn. (Veneer Dryer)	500.00	1,800.00
Wood Processing Plant, Deer River, Minn.....		600.00
TOTALS	\$57,455.22	\$58,826.29

IRON RANGE RESOURCES AND REHABILITATION

Expenditures and Transfers

	1952 - 1953	1953 - 1954
PROJECT		
Administration	\$ 33,532.19	\$ 34,103.16
Agriculture:		
Farm Development	5,270.14	6,649.05
Small Fruit	4,985.25	4,799.82
Legume Seed Investigations	35,000.00	40,000.00
Forestry Development	155,082.54	181,110.90
Future Farmers of America Camp	2,556.37	
Peat Processing Plant, Floodwood, Minn.	2,951.26	2,928.08
Peat Research (Chemical Products from Peat).....		12,500.00
Wood Processing Plant, Deer River, Minn.	976.38	1,927.60
Topographic Mapping (U. S. Geological Survey)	40,000.00	40,000.00
Water Investigations (U. S. Geological Survey)....	8,555.00	47,103.11
TOTAL EXPENDITURES	\$288,909.13	\$371,121.72
TRANSFERS OUT:		
University of Minnesota (Beneficiation of manganiferous and low-grade ores).....	\$ 80,000.00	\$ 83,050.00
Department of Agriculture		5,000.00
Department of Conservation:		
Division of Forestry	300,000.00	371,036.00
Division of Forestry (Nursery Project)	35,000.00	
Division of Lands and Minerals		
Testing Low-grade ores	31,323.00	30,996.00
Other	15,299.00	50,612.00
Division of Waters	6,180.00	
Legislative Interim Committee on Forestry....	25,000.00	
TOTAL TRANSFERS OUT	\$492,802.00	\$540,694.00
GRAND TOTALS	\$781,711.13	\$911,815.72