FORWARD

In Developing Natural Resources

STATE OF MINNESOTA

Biennial Report on the Work of the Office of Iron Range Resources and Rehabilitation

1956-1958

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In Developing Natural Resources

STATE OF MINNESOTA

Published by the

OFFICE OF IRON RANGE RESOURCES
AND REHABILITATION

624 State Office Building
St. Paul 1, Minnesota

1956-1958

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STATE OF MINNESOTA

Office of

Iron Range Resources and Rehabilitation

624 State Office Building

St. Paul, Minn.

To Governor Orville L. Freeman and the Legislature of the State of Minnesota:

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

This is the report for the fiscal years ending June 30, 1957 and June 30, 1958.

Respectfully submitted,

Kaarlo J. Otava,

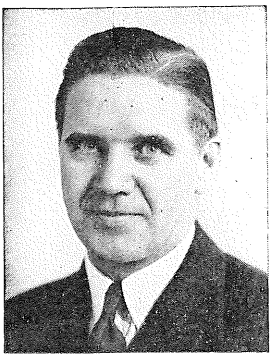
Commissioner

STATE OF MINNESOTA

Iron Range Resources and Rehabilitation Commission

St. Paul, Minnesota

1958



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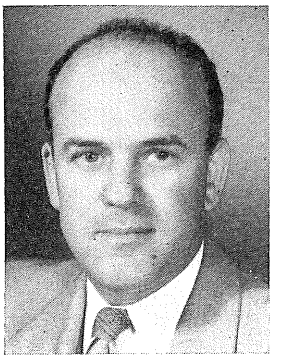

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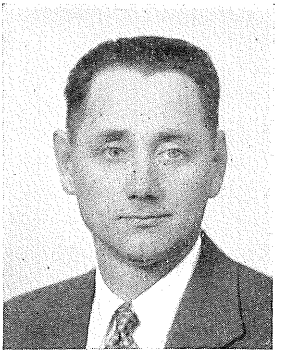

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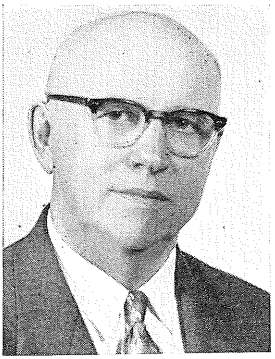

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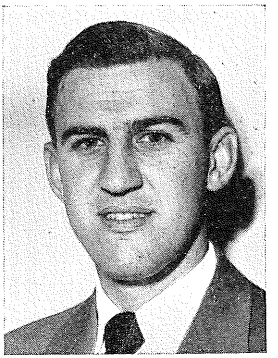

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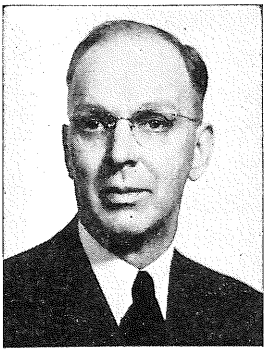

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Our Objectives

Minnesota is a state of vast natural resources, rich soil, water, mineral deposits, forests and wild life. The best quality of forest species of our State has been used in the past so rapidly or unwisely that nature has fallen behind in the process of reproduction. Resources such as iron ore, once removed from the ground, can never be replaced by man.

Mounting unemployment in the 1930's and the rapid depletion of the State's best iron ore reserves were among the factors which induced the legislature in 1941 to create the Office of the Commissioner of Iron Range Resources and Rehabilitation.

At that time St. Louis and Itasca counties, the leading mining areas, had 10,000 persons unemployed. Twelve per cent of the people in St. Louis county were receiving public assistance and employment in the mines had decreased from 12,000 to 4,500. Labor saving machinery was noted as one of the reasons for diminishing employment. Wholesale tax-forfeitures plagued the northern section of our State and the counties were faced with the problem of proper management and the sale of these tax-forfeited lands.

In 1943 the legislature set up the advisory body (commission) to guide and assist the commissioner in his work. This commission is required to recommend or disapprove or make modifications of all of the expenditures proposed by the commissioner. While the legislature, with the mining areas and the timber regions of the State in mind when this agency was created, wrote the law in a manner which permitted a wide latitude of functions for the IRRRC, it did not restrict it necessarily to the Iron Range. The basic law setting up the powers and duties of the commissioner 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."

There has been considerable misunderstanding as to the kind of projects this agency can initiate. Attorney general opinions in the past years have pinpointed the types of projects IRRRC can participate in and consequently many requests for projects have to be turned down. In general, these projects must be something new or in the form of research.

All projects therefore are approved or considered with the intent and the provisions of the law in mind.

The very nature of the work of this State agency involves a degree of research. Experiments are always so. However, the commissioner and his advisers, the commission, weighs each proposal with the utmost care to determine its potentials and thereby avoid failures.

First projects started by the IRRRC were development of low grade ore, forest surveys and land management assistance to counties, vocational training programs, and the establishment of new industries to develop new uses for the natural resources of the area. Many projects have since been added and some of the existing programs greatly expanded.

Legislative acts of the 1957 sessions designed to improve the department's activities include:

An act relating to the powers and duties of the Commissioner of Iron Range Resources and Rehabilitation Commission; amending Minnesota Statutes 1953, section 298.22, by adding three new subdivisions thereto.

The above act represents the first comprehensive effort by the legislature to overhaul this department since 1941. One of the main deficiencies of the department under the old law was that the department had no authority to buy, sell, or condemn real estate. This limitation existed in spite of the fact that the department had built pilot plants in a number of areas in northern Minnesota.

The State in past years had built these plants through a method whereby the physical structures were classified as personal property. This legal fiction stood untested by the courts. The Department recognized the need for additional powers and duties to legalize existing projects and as an aid to future projects that the Department had under consideration. The act

also authorizes the Department to enter into long term leases. This phase of the new legislation will be helpful in establishing new business in distressed areas.

An act relating to the repurchase of land after its forfeiture to the State for taxes; amending Minnesota statutes 1953, section 282.41, as amended.

(This legislation was drawn up at the request of the Eighteen County Committee of Northeastern Minnesota for the purpose of protecting the State investment in tax forfeited lands.)

The Department was instrumental in passing the above legislation. This bill was proposed because of the Department's knowledge of systematic land-grabbing by organized groups. An investigation by this Department determined that many recent lawsuits had been initiated against county and school districts holding tax forfeited lands. The organization involved had succeeded in some cases in breaking old tax forfeitures on the basis of insignificant and technical errors made by the county auditors and treasurers from 20 to 30 years ago.

Such cases were usually initiated by a nominal payment of real estate taxes up to the point of foreclosure. The new law provided that all delinquent taxes and assessments, together with penalties, interests, and costs which would have accrued if such land had not forfeited to the State, must be paid.

The law further provides that such redemptions would be permitted only after the adoption of a resolution by the board of county commissioners determining that undue hardship or injustice would result if such repurchase were not allowed. This provision in the law will practically eliminate most of the cases of people coming in and trying to break tax forfeitures.

Miscellaneous Acts

A number of miscellaneous legislative acts were proposed and passed. One of these was for the purpose of expediting the sale of the abandoned pilot plant at Floodwood for purposes of securing a new industry for that community.

Another bill authorized the transfer of an easement at the Super-Wood pilot plant in Duluth. This transfer of the easement was to permit an expansion of the Super-Wood plant to four

times the original capacity. It results in a greatly expanded market for aspen pulpwood, and also increases the labor force at Super-Wood two-fold.

Another bill authorizes the commissioners to renegotiate a contract between the State and the Nu-Ply Corporation in Bemidji. This request authorized the Commission to grant a one-year moratorium to Nu-Ply contingent upon the company securing a federal loan from the Federal Small Business Administration or some other source.

(This was done in order to give the Nu-Ply Corporation an opportunity to get the plant operating after numerous production and financial difficulties had closed the plant down.)

Administration

During the past year the department started work in a new field in connection with our forestry program. A utilization and consultant service for small timber producers and small woodlot owners was started with one man doing the work.

He gives technical help and advice to small wood products manufacturers and woodlot owners. This program is to be expanded as soon as qualified men can be secured to fill the additional positions. There has been an apparent shortage of qualified foresters but due to the new salary increase it is expected that such positions can be filled in the near future.

The work of agricultural fieldman has been reviewed time and again and it was finally decided that his work would be to take charge of the new farm management program. It was felt by the commissioner that the work that the agricultural fieldman previously had been doing was a duplication of the work of the county agents.

Administrative changes have not only resulted in improved services to the people, but have resulted in a savings to the State of Minnesota.

It may also be noted that the commissioner has ordered our water survey people, in addition to making the regular survey in northeastern Minnesota, to aid communities in that area in the finding of new sources of water. Our water survey people have found a new source of water for the Village of Mountain Iron, have helped find new sources of water for the City of

Virginia and are aiding Hibbing and Chisholm in locating new sources of water, in addition to having aided the taconite industry in locating water for its needs. This has been a big financial help to the Range communities and has cost this department very little additional, due to the fact that half of our water survey costs are borne by the federal government.

KAARLO J. OTAVA
Commissioner, Office of Iron Range
Resources and Rehabilitation

Forest Resources

FOREST SURVEYS

Forest surveys of 18.1 million acres of commercial forest lands have been recently completed by the IRRRC. County forest resources reports have been published for Aitkin, Becker, Beltrami, Carlton, Cass, Clearwater, Cook, Crow Wing, Hubbard, Itasca, Lake, Pine, St. Louis, Lake of the Woods, and Wadena Counties.

Area reports have been published for the Red River Valley, southeastern Minnesota and southwestern Minnesota. A central Minnesota report will be published in the near future.

Resurvey work has been started in Crow Wing, Hubbard, Cass and Beltrami counties. As the resurvey is completed for these counties it will be continued in all of the areas previously surveyed to bring the facts up to date. We eventually hope to have the survey current and to be able to keep the information current on a continuing basis.

LAND-USE PLANNING

Approximately 4,800,000 acres of land in northern Minnesota have reverted to public ownership for non-payment of taxes. These lands are held in trust by the state and are administered by the various county boards. In many of the northeastern Minnesota counties, more than 25% of their total land area is tax-forfeited lands.

At the time this program was started these lands were considered a liability to the county and resulted in a considerable loss of revenue to all political subdivisions concerned. The opposite is now the case. Actually some counties are now receiving more revenue from these lands, through proper management, than if the lands were on the tax rolls.

During the past several years the land management program costs have averaged six cents per acre per year. Of this total amount 1¾ cent has been paid by the IRRRC. Technical assistance in the management of tax-forfeited lands has been provided by IRRRC to counties of northeastern Minnesota.

IRRRC foresters assist county land commissioners by making an inventory of all tax-forfeited land and preparing a management plan in such detail as prescribed by the county land commissioner.

Most plans will include a cutting budget for the next 10-year period, a type map of areas to be cut with cutting methods indicated, maps of areas to be planted, plans for areas to be given special fire portection, plans for treating stands to be thinned, released, pruned, disked.

IRRRC foresters assist in the classification of lands for management purposes. This work will include the establishment of different county management areas with detailed intensive management plans for these areas, areas of individual management, areas to be sold, traded or otherwise disposed of to provide more economical management of county property.

TIMBER STAND IMPROVEMENT

A total of $30,000 of IRRRC funds was spent on the timber stand improvement program which gave employment to approximately 60 students in northeastern Minnesota during the summer of 1957. This program, although started on an experimental basis, has proven to be of great value to our forested areas of Minnesota.

The work was started in four counties, Beltrami, Crow Wing, Itasca and St. Louis. This program involves such work as thinning, pruning and cutting brush to aid the new timber growth.

County foresters of the IRRRC supervised and carefully instructed the boys on how the work should be done. The boys were not only given gainful employment during the summer months but received training in silvicultural practices. In a few years, the cultural work they have accomplished will result in an increased growth of timber and an improvement in the quality of timber products.

In the summer of 1958 the program employed two groups of 115 boys in northeastern Minnesota, each group for a period of five weeks. This program is also providing improvement work in the state parks in northeastern Minnesota in addition to the work in the county forests.

TREE PLANTING

A stepped-up program of land restocking with forest species such as Norway Pine, White Pine, Jack Pine, and Spruce has been promoted through cooperative tree planting programs with counties in the cut-over sections of the state and also through aids to natural regeneration with the use of mechanized equipment.

Five and one-half million tree seedlings have been planted in the last three years by IRRRC in northeastern counties. In the 1958 season approximately 1,750,000 trees were planted by the counties under the IRRRC program.

The only deterrent to further expansion of this program at this time has been the lack of seedlings for planting stock.

UTILIZATION AND CONSULTANT SERVICE

Our current studies of the forest resources of Minnesota reveal large quantities of potential raw material for our forest industries. Recently the IRRRC has provided a consultant service for timber users. This service will provide, especially the small contractors and loggers, knowledge gained by research agencies together with marketing information.

Utilization men also have been provided for by this department to develop new uses for timber products and to assist industry in using more of Minnesota's timber products. For example, a northern Minnesota firm, making wood spools for electric cable, obtained the services of one of our men to develop a spool that would meet federal requirements, using aspen wood. This firm is now making large quantities of spools from aspen for commercial use by the power industry.

MARKET PRICE QUOTATIONS

For years market price quotations have been published for livestock, grain, poultry, butter and eggs. For the last three years this department has felt that there was a need for a timber products market price quotation service, which we feel would render a great service to our timber producers, especially our small contractors and farmers. It would not only give them a better idea of the value of their product but would assist them in getting new and better markets.

This type of service is now being arranged for through our forestry program. Forest market price data will be gathered by our foresters and assembled into a report. In general, this report will give the market price at mill or loaded on the car at various loading locations for the different timber products.

This program is now well underway and our first pricing bulletins have been issued. This service provided, in the first bulletin, prices for pulpwood. It is planned to issue a bulletin every three months, and in each bulletin include additional forest products prices. Eventually the whole field of forest products will be covered by our market bulletins.

SECTION CORNER RELOCATION

More than 900 miles of section line have been re-established by surveyors who re-established more than 4,000 section corners. Iron pipes were used in the established corners because they will last much longer than the wooden stakes used by the surveyors in the 1890's.

This project, sponsored by IRRRC, is on a 50-50 cost basis with cooperating counties. Itasca county is the largest user of this service. This program, it is reported, has proven valuable to all landholders, including county and state. Expansion of this project is expected as more counties make the necessary arrangements to participate.

St. Louis county, this past year, expanded this program and it is hoped that Lake county and some of the other counties also will provide matching funds to expand this work.

FORESTRY RESEARCH

In the last three years this department has carried on a research program to protect our forests from insect invasion and disease. Other research has added knowledge in plantation management, aspen site analysis, jack pine brush relationships, aspen defoliation damages, aerial photo film and scales, forest survey techniques, pine seed production, plantation release by use of herbicides, plastic overlays on lumber, tree genetics and grafting to provide superior species of pine, and tent caterpillar control.

Research in plantation management is done by the Headwaters Research Center and financed in part by the IRRRC under a cooperative agreement with the director of the Lake States Forest Experiment Station.

Aerial Simulation Project

Field examination of 570 mil-acre plots sprayed with herbicides in the summer of 1956 was carried out in July 1957. These plots had included two species of common brush, hazel and mountain maple, three concentrations and three volumes of herbicide and five different application periods. The large amount of data represented has been analyzed and the following conclusions are the result:

In hazel, the less expensive 2,4-D gave much better kill and lower resprouting than 2,4,5-TP. Two pounds of herbicide acid equivalent per acre was much better than either one pound or ½ pound, but the volume of herbicide, one, two, or four gallons of solution per acre, made no difference. Of the five application periods tested, mid-July was best, kill and resprouting tapering off to low levels in mid-leaf (early June) and late August sprayings.

The results with mountain maple were largely negative. Of the three seasons tested, mid-July, early August, late August, the first was best and, as in hazel, two pounds of acid gave the best results and volume of solution made no difference. However, in no case was the initial kill satisfactory. Further work will therefore be necessary using other herbicides than the 2,4,5-T and 2,4,5-TP tested, both of which gave unsatisfactory control of this species.

Total expenses incurred by the Station in remeasuring the plots and analyzing the data were:

Labor and supervision	$2000.00
Transportation	40.00
Travel expense	200.00
Supplies	20.00
Total	$2260.00

In view of the large amount of interest in these tests, a detailed paper describing the equipment used and its operation was

presented at the North Central Weed Conference at Des Moines, Iowa, and will be published in an early issue of Weeds.

Cull Aspen Spraying

Over-mature and cull aspen occupy a large acreage of good productive forest land in Minnesota. Unless these trees are cut or otherwise removed, they prevent the establishment of fully stocked aspen suckers or interfere with the growth of conifers.

The Station has therefore undertaken tests of the possibilities of using aerial foliage sprays to kill back the old trees and thus promote suckering in this species. Present indication from these studies, which are being made in cooperation with the Superior National Forest, are that the above ground portions of the unwanted trees and the brush understory can be killed back by foliage applications of 2,4-D thus opening up the site for vigorous sucker production. (See picture). All the tests so far have been made with fuel oil as a carrier for the herbicides. Additional work is planned to see if water or oil and water cannot be substituted with an appreciable savings in cost.

90-YEAR-OLD over-mature aspen which has been logged leaving a heavy stand of cull trees. Stand at left has been sprayed with chemical herbicides one year earlier to kill culls and induce aspen suckering; stand at right is unsprayed.

Aerial Ground Preparation

A third year examination was made of this white spruce-red pine plantation which was put in on brushy land at Babbitt in the spring, 1955, subsequent to its spraying with herbicides from aircraft the preceding summer at a cost of about $6.00 per acre. The number of planted conifers needing release here is appreciably less than it was a year ago—12 vs. 20 percent, and the plantation can therefore be considered established.

Disking, had it been physically possible here, would have cost $15 to $20 per acre, and the area would likely have required at least one release operation. The savings resulting from the aerial spraying were therefore considerable. The results of this study have been published as Technical Note No. 502.

Firebreak Maintenance

The large amount of planting being done in Minnesota has emphasized the importance of firebreaks as a protective device. To be effective, however, such firebreaks need regular maintenance to prevent the development of grass and other flash fuels, and this is expensive. In an attempt to reduce maintenance costs the Station has been cooperating with the State Division of Forestry on an exploratory study of chemical soil sterilants and other grass-killing herbicides.

Results at the end of the second year indicate that one of the sterilants, Ureabor, is very effective, the plots remaining entirely free of vegetation for this period. Since this promising treatment is costly, a comprehensive test is planned for the coming year in which Ureabor will be compared to annual or biennial applications of less effective but much less expensive chemicals. Preliminary results were published in the Station's Technical Note Nos. 515 and 516.

Aerial Release of Planted Spruce

Aerial application of herbicides for brush control got under way on a sizeable scale in Minnesota during the summer of 1953. During that summer the Station worked with the Superior National Forest on a job of high release of planted white spruce from good site paper birch. Although this spraying showed good to excellent initial defoliation of the birch, many of the trees have since made partial recovery. In July 1954, this species

showed 70 percent of the trees to be dead or severely defoliated, but four years later only 55 percent of the trees were in these classes.

The spraying, however, has still been of considerable benefit for only 25 percent of the planted spruce need release where birch is the dominant cover. On the other hand, 85 percent of those under aspen, which was not injured by the spraying are overtopped.

Aerial Preparation of Lowlands

Large areas of lowland once occupied by good stands of black spruce or other valuable swamp conifers are now covered with alder and willows. One approach being tested to get such lands back into production is to spray the brush with herbicides, following this by planting with black spruce and tamarack. This method has so far been applied on three small tracts in cooperation with the State Division of Forestry and the Minnesota and Ontario Paper Company.

Conclusions Drawn

The following conclusions may be drawn from the results to date. Because killing back the brush may encourage the development of a heavy growth of swamp grasses and sedge, only large transplant stock should be used in swamp planting. The trees should be planted on hummocks rather than in depressions where they may be subject to drowning. That furrowing followed by planting the trees on top of the plowlay may be the answer to swamp planting is shown by the following table. This gives the survival at the end of the third year of a black spruce plantation in Aitkin county put in on lowland sprayed from the air during the previous summer.

Treatment	Class of Stock	Survival Percent	Average Height Feet	Release Need Percent
Furrowed	2-1	80	1.5	20
	3-0	62	1.1	65
Not furrowed ...	2-1	22	1.2	82
	3-0	10	0.9	100

The advantages of transplant stock are also demonstrated by another plantation put in after aerial spraying of lowland brush in Koochiching county. At the end of the fifth year, 2-2

stock had an average survival of 36 percent compared to 12 percent for two-year-old seedlings.

Tamarack also shows possibilities in swamp planting, 2-0 seedlings in this same plantation averaging 43 percent survival at the end of the fifth year and 2.4 feet in height. The black spruce transplants on the other hand, were only 1.3 feet in height; these had suffered considerable loss of growth from hare nipping.

Fertilization, Pine Plantations

As a part of the growing interest in Christmas tree culture in the state, the Station has had requests for information on the value of fertilizers in promoting tree growth and improving quality. A small exploratory study was therefore designed and installed this past spring in a red pine plantation on the lands of a tree farmer in Carlton county. This received an application of 45 pounds per acre of nitrogen, phosphorus, and potash, singly and in combination. Its growth and development will be followed for a five-year period.

Thinning, Plantations

In order to learn more about the growing space needed for intermediate-aged red pine, a thinning study was put in the Birch Lake plantations on the Superior National Forest in the fall of 1957. These, the oldest successful plantations on the forest, were established in 1916. Replicated blocks of about one acre each were thinned from above, from below, and from above and below to basal area levels ranging from 30 to 150 square feet. The job was done by means of a timber sale and yielded 945 cords of merchantable products, with a stumpage value of $3,825 or about $45 per acre thinned. The marking, supervision and plot work involved required the expenditure of $1,900 of Station funds.

Pine Seed Study

A red pine seed production study was initiated by the Headwaters Research Center, financed in part by the office of Iron Range Resources and Rehabilitation under a cooperative agreement with the director of the Lake States Forest Experiment Station dated November 8, 1957.

A bumper crop of red pine cones was produced in the fall of 1957. An excellent opportunity was thus presented to obtain in-

formation on the amount of seed produced per acre and the time of year during which it is dispersed. Accordingly, a total of 44 seed traps, each 1/4000-acre in area, was set out in different types and ages of red pine stands on the Cutfoot Experimental Forest, just prior to seed fall. The seed collected in these traps has been removed at two to three week intervals ever since and will be collected regularly until dispersal ceases.

Although dispersal is still incomplete, some interesting results have already been obtained. Through the end of March, a managed stand of 90-year-old red pine had produced a total of 2,100,000 seeds per acre or about 40 pounds, most of which was viable. On the other hand, that from a similar aged stand in an unmanaged natural area amounted to 320,000 seeds per acre while a 50-year-old managed stand showed only 85,000 seeds per acre.

DEFOLIATING INSECTS

Control of defoliating insects in Minnesota's forests is annually becoming more important. Information on losses due to tree mortality and to reduction in growth in conifer types is scanty, and data similar to that collected in the recent forest tent caterpillar epidemic and published by the Office of Iron Range Resources and Rehabilitation is sorely needed.

Two cooperative projects have been carried on since 1955:

(1) silvicultural practices to prevent or reduce heavy defoliation by the spruce budworm and resulting tree mortality or reduction in annual growth,

(2) the effect of defoliation of jack pine by the jack-pine budworm. Progress in these investigations has been made possible in part by financial assistance from the Office of Iron Range Resources and Rehabilitation.

The Spruce Budworm

An integral part of the research on the spruce budworm, necessary for an intelligent approach to the problem of applying silvicultural practices, has been the biological and ecological studies under way since 1955. They are long-term studies to correlate budworm populations and natural control factors with stand characteristics. Much valuable data on the life history and

habits and on environmental influences has been gathered. Parasitism, for example, increased noticeably in sampling areas over that reported in 1956.

In planning the establishment of permanent plots for studying the relation of biology to silvicultural control measures the knowledge gained from the biological and ecological research was invaluable. Data from these risk evaluation plots will determine the relation of the following tree and stand characteristics to budworm susceptibility.

These plots will be sprayed annually until the present epidemic declines; then the growth accretion in the treated plots and the check plots will be analyzed to determine loss figures.

The first replication of the proposed series of pilot plant cuttings was completed on lands owned by the Minnesota and Ontario Paper Company near International Falls. A second replication was installed on the Superior National Forest near Grand Marais. The post-logging check and the 1957 defoliation estimates were made on the Minnesota and Ontario Paper Company cutting area. The post-logging check on the Grand Marais operation was made in the summer of 1958.

A third replication will be located near Isabella and will be cut as soon as possible. To supplement the information from these stands, plans are being developed to establish plots in areas already cutover to reconstruct the stand on the basis of stump measurements and relation of the residual stand to incidence of budworm attack.

The Jack-Pine Budworm

This insect is considered the most serious defoliator of jack pine in Minnesota. Periodically it causes noticeable defoliation for several years, and sometimes a considerable amount of top killing occurs. Generally speaking, serious infestations develop in stands where there are heavy crops of staminate flowers in which the budworms feed and develop before attacking the foliage.

Previous research has indicated that well-stocked, vigorous stands are least likely to support heavy budworm populations; staminate flower production is not so abundant in these stands and budworm populations do not tend to increase.

In cooperation with the School of Forestry and the Division of Entomology and Economic Zoology of the University of Minnesota, studies have been made to determine the effect of defoliation on growth during the period of defoliation as well as the after effects.

Much of this work has been completed and the data has been analyzed. Preliminary observations have been made and published as Minnesota Forestry Note 56 entitled "Preliminary Observations of an Enquiry into the Effects of the Defoliation of Jack Pine by the Jack-Pine Budworm" by Kulman, Hodson and Duncan.

The Minnesota studies showed that jack pine exhibits growth patterns—the vertical sequence gives the best picture of the effect of defoliation. This method gives an estimation of the percent of decrease in the growth over that which should have been expected if the growth had been normal; it does not give an evaluation of the volume loss.

The second phase of the study deals with the actual loss of increment in the trees as a result of defoliation. Growth loss is negligible as a result of very light defoliation, but it is quite significant with medium defoliation. Growth loss becomes apparent the second year following initial noticeable feeding. Mortality of jack pine, as a result of defoliation by the jack pine budworm, is not so serious a problem as that of balsam fir following repeated heavy defoliation by the closely related spruce budworm. However, considerable top-kill does result and this undoubtedly affects the growth. Jack pine apparently has the ability to recover volume lost by increased growth following the decline of the infestation.

CHARCOAL RESEARCH

This department is actively working in efforts to discover new uses for Minnesota's forest resources, including the low-grade woods. Experiments in charcoal production as a means of utilizing low value forest types have been conducted as an IRRRC project at St. John's University, Collegeville, Minnesota. A wood burning kiln was built there for the experiments.

Purpose of this project is to determine the best way to produce charcoal from all of the different species available and also

to determine the type of kiln for charcoal production at the lowest possible costs. A report on this experimental work is now in the process of being published.

We are now trying to establish a sizeable charcoal industry in northeastern Minnesota. We have been working with various groups in various areas of northeastern Minnesota to try to find someone who will start a local charcoal industry. Prospects for this seem very favorable.

Farm Income Study

The IRRRC initiated a farm management program in 1956, the first of its kind in northeastern Minnesota. This project, started at the request of farmers and county agricultural leaders, was developed to include ten northeastern counties.

Objective of the farm management program is to gain an insight on problems peculiar to the area and then to determine what can be done to help solve those problems. Because this study has been going on for only a short while, it is a little too soon to determine definitely what the situations are. However, some conclusions can be noted.

The study is being made with the farmers keeping farm records. Then Iron Range Resources and Rehabilitation analyzes these books at the end of the year. For the year 1956, only 28 books were analyzed. For the year 1957, 82 books were sent in for analysis. For the year 1958 we expect at least 100. These, however, will not be analyzed until early in 1959.

As the program continues and the farmers become more acquainted with the account book and more adept in keeping books, the analysis work becomes easier and the results become more definite. Another factor in the value of the interpretation is that an effort is being made to keep the same participants from year to year, with a minimum of turnover. This then will show what progress can and should be made on each individual farm, and if this results in an increase in income.

Study Spreads

It is important to have the project cover a period of years. For instance, it was found that in 1956, the first year of operation, the labor earnings of the farmers was $1,048. The labor earnings for these same 28 farms in 1957 was $3,183, or an increase over 200%. It must be pointed out again that this is for a relatively small number of farms and that the figures cover one year only. A comparison with the figures for 1958 will be more valuable because a greater number of farms will be covered and the study period will be one year longer.

The study reveals some apparent problems in the area. Labor earnings for the farmer are low. This is the amount of money

he has left for himself and family after all expenses are paid. In 1957 this was $1,094, average for all area farms. It must be pointed out, however, that he has other expendable income, such as unpaid family labor and interest on investment which are listed as expenses.

The reasons for this low labor income are many. Here are a few of them:

Total number of animal units is low.

Work units of crops and livestock are low and should be expanded.

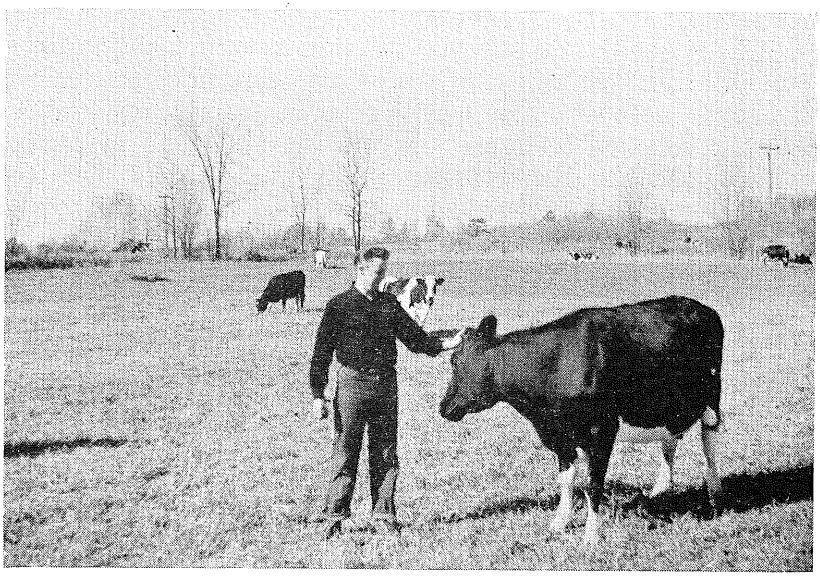
Work units per worker are low, or in other words his time on the farm is not fully occupied.

Crop acres, per farm, are low as well as the yields of grain and hay.

Tame pastures are almost absent in this study.

Percent of tillable land is low.

The above points out very succinctly where farm progress can be made and what items should be worked on. Improvement on the farm comes slowly. Immediate results can be obtained,



FARM NEEDS — Leonard Schmidt, young farmer in Carlton county, knows that his pastures must be improved and plans pasture improvement for the coming year.

however, by increased grain yields, yield and quality of hay and pasture improvement work. This can be done by better soil management, better harvesting methods, use of fertilizers—both natural and commercial. The farmer himself knows what steps he can take each year. The analysis merely points out where the weaknesses are in the farming operations.

Better feeding methods, together with improved quality of hay and grain, will increase livestock production. The total value of products per animal unit in 1957 was $211.51 on the average. With the 24 highest farms this figure was $272.20 and for the 24 lowest farms this was $159.91. This shows that the farms in the lowest bracket have a long way to go to come up to the highest or even up to the average. There is one important factor in these figures, among others, over which the producer has very little control and that is the market price of the product. Some dairymen on Grade A milk production may be getting about $1 per pound of butterfat, while those still on a butterfat basis may get only about 70 cents per pound. However, if an improvement can be made in all production items, the returns per cow will be notably increased.

Dairying Profitable

The study also reveals that farming in northeastern Minnesota, principally dairying, is a profitable enterprise and can be made even more so. In spite of the handicaps mentioned in this report, production costs are lower in the area than in Austin, Mankato and Morris, for instance. Our study shows that feed costs per pound of butterfat in northeastern Minnesota were 40 cents, while at Austin it was 45 and at Mankato it was 51 cents. The costs for this area will become even lower as various farm management practices are improved.

A portion of the farm income in northeastern Minnesota is obtained from the sale of forestry products. Fifteen farms out of the 82 represented in the 1957 Summary Report indicated some form of forestry income ranging from a low of $69 to a high of $4,043 per farm. The average forestry income per farm (average of all 82 farms) amounted to $161.34, or 2% of total farm income received. Forestry income is included as farm income in this report.

This points to the fact that there is a need for a better forest products market in northeastern Minnesota. Participants

in the farm management program have indicated their interest in developing their farm woodlots if there is some assurance of a market. Increased forest products sales could greatly increase the farm income for the northeastern area.

Water Resources

The IRRRC has been cooperating with the U. S. Geological Survey to inventory surface waters and investigate occurrences and availability of ground waters. Samples are taken to determine the chemical quality of water.

Emphasis on this program in the last two years has been placed on the Iron Range areas to promote the development of low-grade ores and aid the needs of other industrial and municipal facilities.

Last summer the IRRRC provided the U. S. Geological Survey crew with a truck and drill equipment which has been very helpful for ground water investigations.

In the last year assistance has been given the communities of Hibbing, Mountain Iron, Chisholm and Virginia to locate adequate water supplies. This assistance will be extended to other Range communities where shortages of water supply appear.

PROGRAM RESUME

Surface Water. — The collection of continuous records of stage and discharge was continued at 17 gaging stations. (See attached List 1.) Special discharge measurements to determine ground-water inflow were made in connection with ground-water studies.

Ground Water.—Continuous records of water-level fluctuations were obtained from the following observation wells which are equipped with recording gages:

SE¼ NE¼ SE¼ sec. 5, T. 57 N., R. 20 W., Hibbing
NE¼ NE¼ SE¼ sec. 7, T. 58 N., R. 17 W., Virginia
SW¼ SW¼ SW¼ sec. 12, T. 58 N., R. 18 W., Virginia
NE¼ NW¼ NE¼ sec. 13, T. 58 N., R. 18 W., Virginia
SW¼ NW¼ SE¼ sec. 16, T. 58 N., R. 20 W., Chisholm

The program of locating and mapping the ground-water basins was continued by compiling bedrock topographic maps. Data for the eastern half of the Range are being transferred to quadrangle map bases for publication as a Hydrologic Atlas of the U. S. Geological Survey. The compilation of bedrock data from drill records in the western part of the Range was continued.

A contract for test drilling, which was awarded last fiscal year, was extended to continue drilling in the following areas where the bedrock maps indicated the presence of glacial river channels:

1. Southeast of Chisholm
2. Between the Village of Kelly Lake and the area south of Hibbing
3. Ely Lake-Esquagama Lake area
4. Aurora area
5. Chisholm area

A report on ground-water conditions in the Chisholm area and Balkan Township is being prepared.

Using the data obtained as a result of our exploratory drilling program in the Mountain Iron area, the village developed a new well to augment their supply. Additional basic hydrologic data were collected in connection with a pumping test at the new well site.

Quality of Water.—Studies of the chemical quality of water in the upper St. Louis River drainage basin were continued. (See attached List 2.) Available data regarding the chemical quality of water used for public supply in the Mesabi Range area were compiled. The chemical quality of water used for public supply at Babbitt, Calumet, Hibbing, Marble, and McKinley and of water from test holes near Chisholm and Mountain Iron was determined.

Recommended Program

Surface Water.—It is recommended that the 17 gaging stations in the Mesabi Range area be continued. In addition, a gaging station should be constructed on East Two Rivers near Iron Junction to determine ground-water inflows in that basin and special discharge measurements should be made in connection with ground-water studies.

Ground Water.—Continuous records of ground-water levels should be obtained from the five observation wells in the area. Several additional observation wells should be installed in connection with the study of the Mountain Iron-Virginia area. If unused wells can be located elsewhere on the Range, they should be utilized for this purpose also.

The compilation of drill-hole data should be continued to revise and continue the compilation of bedrock topographic maps.

Test drilling and pumping should be continued in the vicinity of Mountain Iron and Virginia in connection with the study of the glacial deposits filling the bedrock valley. The City of Virginia would like to develop a ground-water supply; additional test drilling will be needed to delimit the water-bearing formations in that area.

Test drilling should be started on the western half of the Range to determine the locations of ground-water basins.

Quality of Water.—Studies of the chemical quality of water in the upper St. Louis River basin should be continued. It is proposed to augment these studies with reconnaissance studies in the upper Kawishiwi, Vermilion, and Little Fork River basins. The chemical quality of water used for municipal supply should be determined for those municipalities for which no data are available, or for which only inadequate data are available. We recommend that data obtained during this and previous years be compiled.

Estimated Cost

	Federal	State
Surface Water	$10,000	$10,000
Ground Water	52,000	52,000
Quality of Water	3,700	3,700
	$65,700	$65,700

List 1.—Gaging Station in Mesabi Range area

Bear Island River near Ely
Dark River near Chisholm
Dunka River near Babbitt
Embarrass River at Embarrass
Embarrass River near McKinley
Isabella River near Isabella
Partridge River near Aurora
Pike River near Embarrass
Poplar River at Lutsen
St. Louis River near Aurora
So. Kawishiwi River near Ely
Stoney River near Isabella
Sturgeon River near Chisholm
Swan River near Toivola
East Swan River near Tiovola
Swan River near Warba
West Two River near Iron Junction

List 2.—Quality of water stations in Mesabi Range area

Embarrass River at Embarrass

Embarrass River near McKinley

Partridge River near Aurora

St. Louis River near Aurora

Second Creek near Aurora

West Two River near Iron Junction

Topographic Maps

The topographic mapping program in Northern Minnesota has progressed rapidly. In the last three years, mapping has been concentrated on the Iron Range and maps have been completed for almost the entire Range area.

Along with the importance in mining and prospecting, topographic maps provide excellent knowledge in planning industrial and recreational development, soil erosion control, flood control, water use in conservation, subdivision planning, sewage disposal, drainage, and television station location and construction.

Topographic maps accurately depict physical features of a locality or region, as well as man-made improvements such as roads, bridges and dams.

To date all of the Mesabi Range area, all of the Lake Superior lake shore area from Duluth to Grand Portage, and a substantial part of Cook and Lake Counties have now been mapped. The mapping is continuing in the westerly direction from Ely and Lake Vermilion west and north of the Mesabi Range. Approximately 25 topographic maps have been completed in the last two years. This program will be continued by the IRRRC until all of the cut-over section of the state has been mapped.

The start of a program of topographic mapping of northeastern Minnesota was approved in the fall of 1949. The work is done by the Topographic Branch of the U. S. Geological Survey with the expense up to the engraving stage shared equally by the state and federal governments. Engraving and printing is entirely at federal expense. The amount appropriated by the Office of Iron Range Resources and Rehabilitation for some time has been $50,000 per annum. Modern methods have permitted keeping the cost per unit area about constant in spite of a serious inflation in the general economy since 1949.

The topographic maps are prepared on two scales depending on the nature of the area. The scales are 1 to 62,000 or approximately 1 inch to 1 mile and 1 to 24,000 or 1 inch to 2,000 feet. Most of the mapping supported by Iron Range Resources has been on the latter scale and will be exclusively on that scale in the future.

Work during the period July, 1956, through June, 1958, has been done on 47 sheets covering a total of 2,228 square miles. A total of 18 sheets was published.

The tabulation given below shows the sheets which have had the various stages of mapping completed during the period. Each sheet must be compiled by work at the various stages shown and in the order given.

MAP TABULATION

Basic Control Completed

Basswood Lake
Brimson
Cross Lake NE
Cross Lake NW
Cross Lake SE
Cross Lake SW
Devils Track Lake NE
Devils Track Lake NW
Devils Track Lake SE
Devils Track Lake SW
Ensign Lake
Fall Lake
Grand Marais NE
Grand Marais NW
Grand Portage NE
Grand Portage NW
Hovland NE
Hovland NW
Hovland SW
Lutsen NE
Lutsen NW
Mule Lake SE
Mule Lake SW
Pine Lake SE
Pine Lake SW
Pine River NE
Pine River NW
Pine River SE
Pine River SW
Snowbank Lake
South Fowl Lake SE
South Fowl Lake SW

Supplemental Control Completed

Brimson
Grand Marais NE
Grand Marais NW
Lutsen NE
Lutsen NW
Pine River NE
Pine River NW

Combined Supplemental Control and Advance Field Completion Completed

Basswood Lake
Ensign Lake
Fall Lake
Lake Markham
Snowbank Lake

Stereocompilation Completed

Basswood Lake
Brimson
Ensign Lake
Fall Lake
Grand Marais NE
Grand Marais NW
Lake Markham
Little Marais NW
Lutsen NE
Lutsen NW
Snowbank Lake
Soudan SE
Soudan SW

Field Completion Completed

Brimson
Grand Marais NW
Hibbing (Revision)
Little Marais NE
Little Marais NW
Little Marais SW
Soudan NE
Soudan NW
Soudan SE
Soudan SW
Split Rock NE
Split Rock NW
Tower NE
Tower NW
Tower SE
Tower SW

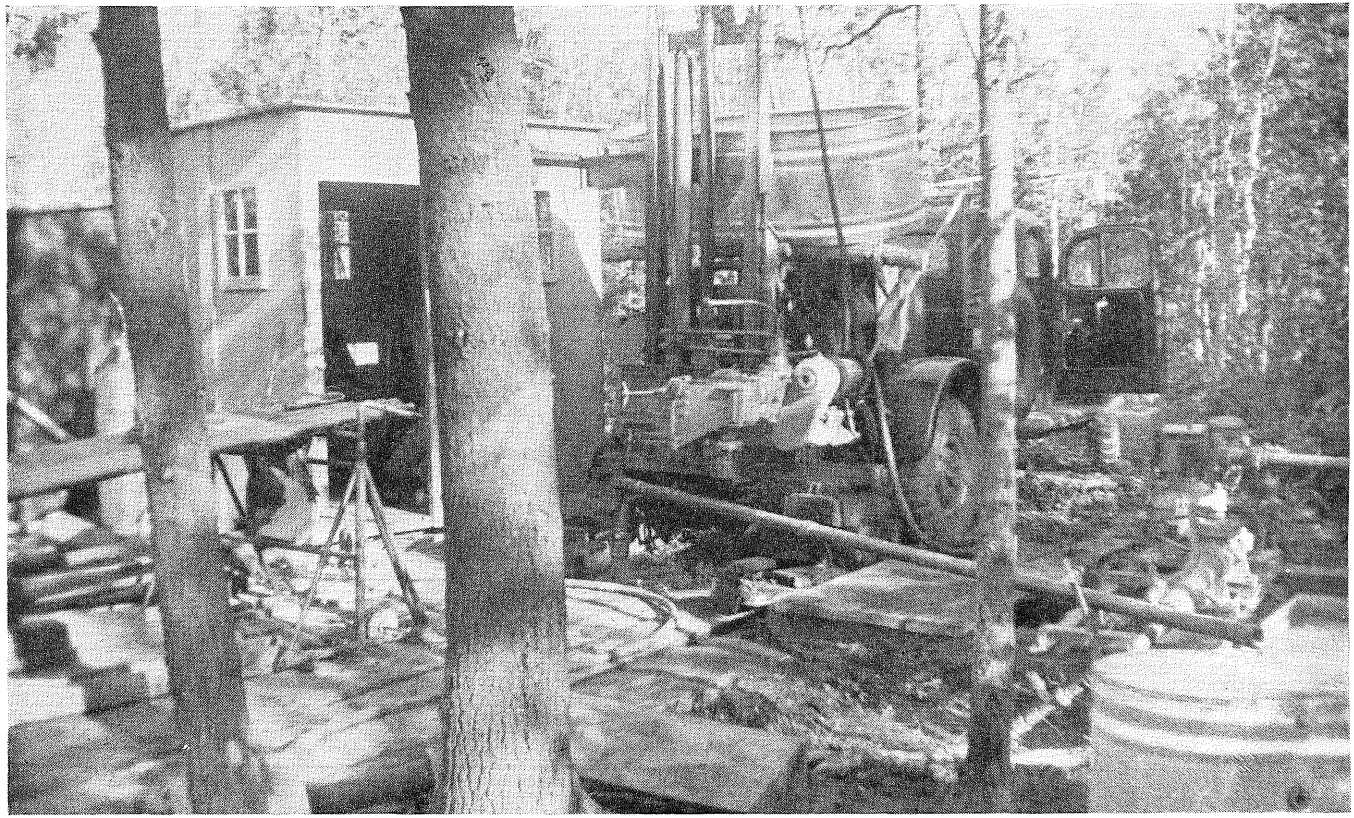
Cartography Completed

Brimson
Crooked Lake
Hibbing
Isabella River
Lake Markham
Little Marais NE
Little Marais NW
Little Marais SW
Soudan NE
Soudan NW
Soudan SW
Soudan SE
Split Rock NE
Split Rock NW
Tofte (N/2)
Tofte SE
Tofte SW
Tower NE
Tower NW
Tower SW
Tower SE

Published

Cramer (Crooked Lake)
Little Marais (Little Marais NE)
Finland (Little Marais NW)
Illgen City (Little Marais SW)
Isabella (Isabella River)
Crab Lake (Soudan NE)
Chad Lake (Soudan NW)
Soudan (Soudan SW)
Eagles Nest (Soudan SE)

Split Rock NE	(Split Rock NE)
Split Rock Point	(Split Rock NW)
Tofte (15′)	(Tofte SE)
Tofte (7½′)	(Tofte SW)
Schroeder	(Tower NE)
Sioux Pine Island	(Tower NW)
Vermilion Dam	(Tower SE)
Tower	(Tower SW)
Lost Lake	



CORE DRILLING for iron ore in Eveleth area as part of mineral investigations.

Mineral Resources

An intensive mineral survey investigation was started in the fall of 1955 in the Eveleth area in St. Louis county. This project was initiated at the request of the Eveleth city and school officials who declared the community faced the threat of eventually becoming a "ghost town" unless additional iron ore reserves are found in the area.

Mining engineers and aids employed by this department have made resistivity and magnetometer surveys in the area. Results of this survey have been plotted on charts to show where test drilling is advisable. This program will no doubt have to be expanded to other areas of the Mesabi Range because of numerous requests from Range political subdivisions.

In addition, our mineral survey crew is expanding its work to include stockpile surveys in the various Range communities at the request of these communities.

Since its organization, the mineral survey has proceeded according to the recommendations of the late Dr. Frank G. Grout and it also has assented to suggestions from local officials.

2,000 Acres Covered

Two thousand acres have been covered by intensive geophysical work. Surveys were run over the areas to locate topographic features and to locate the magnetic and resistivity lines and sections. Levels were run carrying elevations from government bench marks to survey points. Information obtained from the State Tax Department and the University of Minnesota was used in evaluating the geophysical data. Many hours were spent studying records at the University of Minnesota to gain knowledge of the iron ore deposits in areas of interest.

A complete list of lean ore stockpiles, taconite, tailings and tailing ponds was obtained from the Tax Department covering the Iron Ranges. A study of all maps and other information led to a list apparently not listed with the Tax Department.

Listed on tax records were 606 lean ore stockpiles, taconite, tailings and tailing ponds, involving 580 million tons that were listed. The study indicated 249 lean ore stockpiles, taconite, tail-

ings and tailing ponds not listed, all of which could very well constitute an enormous reserve of mined low grade iron ore ready for treatment.

Ownership of these piles and tailing ponds was determined to the extent and accuracy possible from the maps and information available.

Drilling Starts

Time was given to many individual inquiries and requests. Many reserve tonnages were checked and reported on where doubt existed in the minds of local officials.

A drill was purchased with all accessories for investigation of favorable areas as indicated by geophysical work. The drill was recruited upon its arrival for work in mineral values involved in new highway right-of-way acquisition. A drill crew was recruited locally to gain men of local experience as Mesabi Range drilling has problems experienced almost nowhere else. This drill and crew are now operating in the Eveleth area to determine the quality and quantity of minerals which may occur in that area. The information gained from this work will not only be of value to the highway department but will also furnish information to this department on the reserves of taconite or iron ore available in that area.

MARL SURVEY AND RESEARCH

Soil surveys show that over 6,000,000 acres of Minnesota's cropland needs lime. Only about 25% are now receiving lime. It would require over 17,000,000 tons of lime to bring the soils up to the desired lime content and about 2,000,000 tons would be required annually thereafter. It is particularly significant that the majority of the soils requiring lime are in the eastern and north central parts of the state. Marls are abundant in the north central area but are little utilized because of the lack of proper processing methods.

Most of the lime now used comes from the limestone in the area south of Minneapolis. In Olmsted County lime can be applied to the soil at a cost of $2.50 per ton. The same lime in Crow Wing County costs $7.50 per ton. Crow Wing County contains the most abundant deposits of marl of any county.

If a proper method is developed of excavating and preparing marl for use as agricultural lime it should be possible to cut the cost of liming soils in the northern half of Minnesota to one-half of the present cost.

The IRRRC has sponsored a cooperative marl research program with the University of Minnesota. Sampling of marl deposits and detailed chemical analysis have been made. Experiments on drying and filtering are being carried out to determine the most economical method. The work on the marl project has been encouraging and it is hoped that another Minnesota resource will be put to use.

The actual survey of marl is now completed and a complete report of the project will be published. This report will spell out the problems affecting establishment of a marl products industry.

IRRRC Surveys

NORTH SHORE SURVEY

During the biennium the IRRRC prepared a report, "A Prospectus of the North Shore Area." This report is the result of a request of the Lake County Board of Commissioners to conduct necessary studies as to the feasibility of some new wood-using industry for Lake county, with particular emphasis on the local manufacture or processing of aspen timber products.

The report was not confined to Lake county alone as it became evident from preliminary surveys that any large scale processing plant which can use the aspen of the area would be dependent on aspen supplies from a larger area than one county.

The report covers Minnesota's largest surplus wood area — Lake, Cook and the eastern part of St. Louis county. The IRRRC is confident that the facts accumulated in this report would encourage the investment of some millions of dollars in new processing plants for the area.

Minnesota's North Shore area has an abundance of wood, water, and labor capable of producing 1,849 tons of pulp, oven dry, per day.

TOURIST SURVEY

At a meeting of the IRRRC on February 15, 1958, at Duluth, a hearing was held and approval was given to appropriate funds, not to exceed $50,000, for a tourist survey of the Arrowhead area. Nineteen counties were to be covered by this survey. A contract was drawn with the Minnesota Arrowhead Association to conduct the survey and to publish a report of their findings. Qualified men were hired to conduct the survey which was started during the summer and continued through the fall season.

This report is intended to give definite proof as to the interests of our tourists, and point out what our resorts and parks should do to make the tourists' visit in Minnesota pleasant and appealing, thereby assuring us of a return trip by the tourists.

This information will show the value of the tourist industry to the rest of the economy, such as how much of the tourists'

money is spent for food, clothing, transportation, lodging, sporting goods and other supplies.

This is the first survey of its kind in the Arrowhead area and should give the basic information needed to develop the tourist industry of the area and the State as well.

TOURIST GUIDE PROGRAM

At a Commission meeting held at Duluth the IRRRC approved an appropriation of $1,500 toward an Indian Tourist Guide Training Program to be held at Bemidji State College. Approximately 25 persons were to receive guide training under the program. This is another project of the IRRRC for the benefit of our Indian friends and it is felt that it will do a great deal to further develop our tourist industry in the State as well as create employment opportunities for the Indian.

MISSISSIPPI HEADWATERS

In the spring of 1958 Itasca and Beltrami county boards requested a survey of the Chippewa National Forest area comprising the four counties of Beltrami, Cass, Itasca and Hubbard. This survey is to determine the feasibility of some new industry to develop the natural resources of the area.

On May 29, 1958, a meeting was held at Grand Rapids to go over the material gathered by our foresters for the Mississippi Headwaters area survey prospectus. Attending the meeting were the State Department of Forestry, county land commissioners, the county boards of the four counties, federal forestry representatives from the Chippewa and Superior National Forests, and the foresters for the Indian Service at Bemidji, and the IRRRC forestry staff. Material in the prospectus was reviewed and minor corrections were made.

It was also decided that in the publication of the prospectus pictures from the area would be used to show some of the advantages of the area for additional woodprocessing industry. This prospectus was scheduled for early publication.

CUYUNA INDUSTRIAL SURVEY

At the request of the Chamber of Commerce of Crosby and other groups of that area the Department has initiated a pro-

gram to make an industrial survey of the Cuyuna Range area. However, because of shortage of manpower for this work, this survey cannot proceed to completion until the Chippewa Area study has been completed.

ELY INDUSTRIAL SURVEY

At a meeting of the St. Louis Development Association in Ely, the IRRRC was requested to make an industrial survey of the Ely area.

Because of the growing number of requests for this type of study, the Commissioner has set up a new position for an industrial survey man in the department.

Upon filling of this position it is hoped that the surveys can progress more rapidly because of the fact that one man will be assigned the responsibility of compiling material already available and gathering additional information.

Peat Program

For several years the IRRRC has carried on a peat research program to develop a vast resource (7,000,000 acres) here in Minnesota. A large part of this peat resource is in Beltrami, St. Louis and Koochiching counties.

Through our cooperative research program at the University of Minnesota we have been taking bog samples and making analysis to determine their chemical value.

Main purpose of this research work is to determine new uses of peat. It has been proven that peat can be used as a binder in making taconite pellets and has proven equally as good and as economical as bentonite and starch which are presently used.

PEAT MISSION TO EUROPE

In July, 1957, the IRRRC sponsored a Technical Exchange Peat Mission to Europe and the Soviet Union. Members of the Mission were Kaarlo J. Otava, commissioner of the IRRR; Representative Peter X. Fugina, a member of the IRRR Commission; Dr. Edgar L. Piret of the University of Minnesota; Dr. Moses Passer of the University of Minnesota, Duluth Branch; and L. L. Newman of the U. S. Bureau of Mines.

Their travel took them to Germany, Austria, Soviet Union, Sweden and Finland and gave them an opportunity to view their tremendous peat operations.

A sound film was presented to our peat delegation by the Soviet Government which showed the entire process of harvesting and drying peat. Valuable information also was received on chemical and agricultural uses for peat.

Studies will have to be made from an economist's standpoint after going through cost figures furnished by the Soviet experts on using peat for fuel. This, along with other technical information gathered, will put Minnesota years ahead in developing this tremendous resource.

In the last year there has been an increased interest and activity by commercial peat producers in the State. Minnesota moss peat is used for horticultural purposes. This department

has assisted several out-of-state users in contacting Minnesota peat producers to acquire peat for their horticultural trade. Minnesota peat moss (sphagnum) is highly acceptable for their trade.

Most peat harvesters in Minnesota at the present time have small operations and inadequate equipment. There is a need for a better method of harvesting and drying of the peat to make their operations more economical and also to step up the production. It is also very important that Minnesota peat producers develop a uniform grade product to protect their future markets.

Through the IRRRC research program, such as peat bog sampling and analysis, and the information gained by our peat mission to Europe and the Soviet Union, we expect to overcome many of these problems. Research in developing new uses for peat, economical harvesting and drying processes, and developing a uniform product could make Minnesota the largest peat producing state in the union.

RESEARCH REVIEW

The IRRRC Chemical Products from Peat Project (CPPP) at the University of Minnesota is under leadership of Dr. Piret, department of chemical engineering, Minneapolis campus; Dr. W. P. Martin, soils department, St. Paul campus; and Dr. Passer, chemistry department, Duluth Branch. Active staff participants also include Drs. L. A. Snyder, A. J. Madden, and R. S. Farnham. R. G. White handles technical coordination of the over-all program.

Chemical Investigations

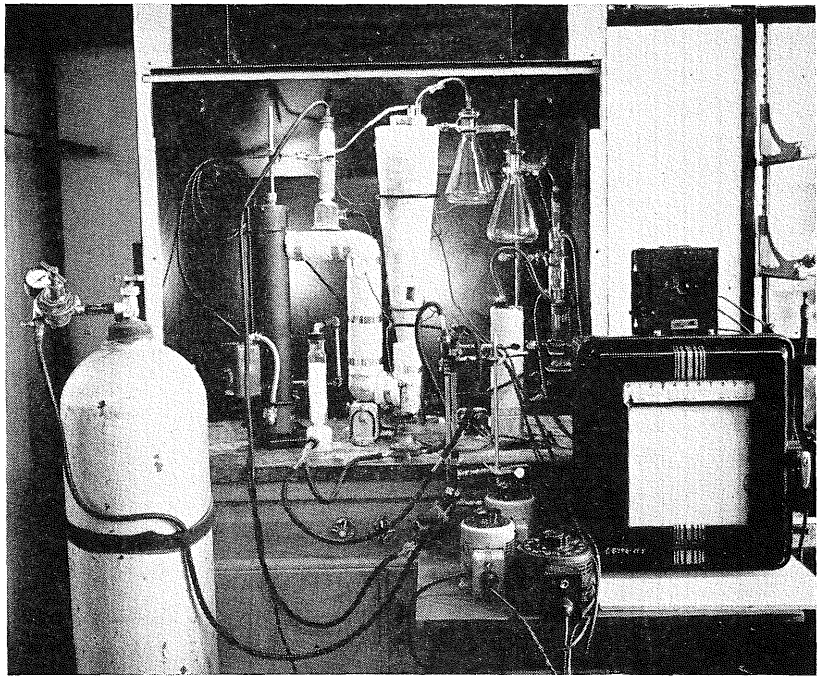
Research is now well under way on the preparation of peat-based products having a high level of organic nitrogen (above 6%). The primary objective is to obtain products suitable for horticultural crop uses, but it is felt that chemical studies may well uncover other uses. For this work a laboratory-scale reactor was designed and constructed wherein the peat is treated in a fluidized bed with gas mixtures of air and ammonia at temperatures up to 660° F. (See Figure 1.) Nitrogen levels up to 18% have thus far been attained. A first series of 15 samples was tested by the Soils group.

A new area of chemical investigation was initiated concerning the functional groups present in peat. The determination of

functional groups involves quantitative estimation, by specialized methods, of precisely defined reactive groups embedded in or attached to the molecules. Methods for methoxyl, carboxyl, phenolic hydroxyl, reducing sugars, uronic acids, and unsaturation were investigated. (See Figure 2.) Some of these procedures are now perfected, others are still in the experimental stage. The information gained will help provide guideposts for developing new chemical uses for peat.

Tests were initiated of peat and its derivatives as thinners for oil well drilling fluids. Two of the derivatives have exhibited some promise, showing thinning action comparable to that of a standard commercial material (quebracho).

The laboratory studies begun earlier of peat-based binders for pelletizing taconite were rounded off in 1957. Emphasis was placed on the confirmation of earlier results and the development of a dry mixture of peat and alkali. The mining industry is now fully informed of this development.



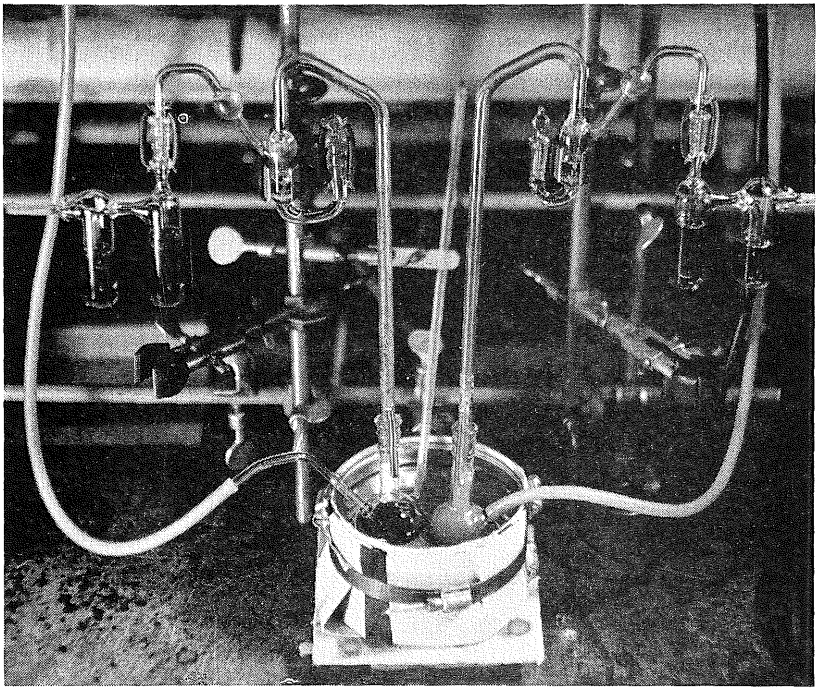
NEW FLUIDIZED-BED reactor for preparing high-nitrogen peat products. CPPP, department of chemical engineering, University of Minnesota (Figure 1).

Explorations were begun of the effects of various solvents on peat, including several of the new and powerful solvents recently available commercially. (See Figure 3.) Detailed examination of exhaustive extraction with hot and cold water was undertaken. The results will shed further light on the chemical nature of peat, as well as provide methods of selectively isolating various constituents.

Peat-Derived Humic Acids

The humic acids fraction of peat continues to attract special attention because of its reactivity, high concentration in peat, and potential low cost. It is estimated that the peats of Minnesota represent a natural reserve of the order of one billion tons of these complex acids.

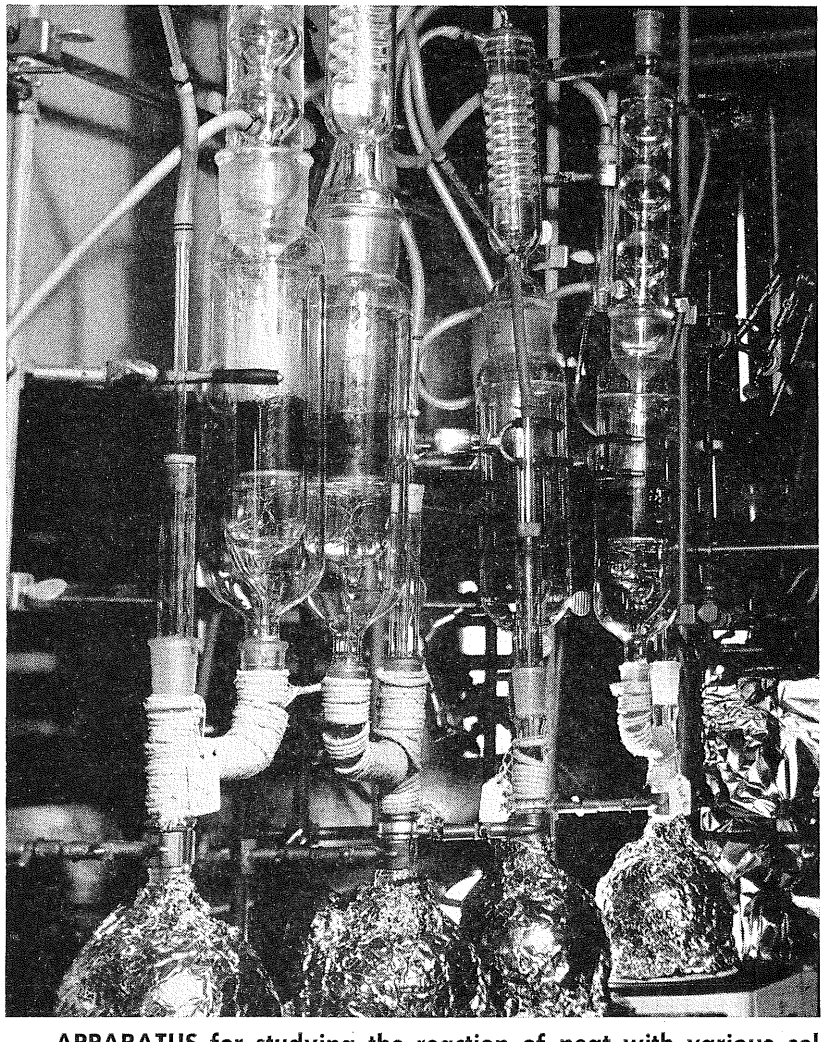
A variety of physico-chemical research techniques were applied to the problem of determining molecular weights, polyelec-



DETERMINATION of methoxyl groups in peat helps in understanding nature of reactivity. CPPP, Duluth Branch, University of Minnesota (Figure 2).

troltye character, and acidity. (See Figure 4.) Humic acids have also been pyrolyzed ("cracked") with strong alkali and heat, or reduced with agents such as lithium.

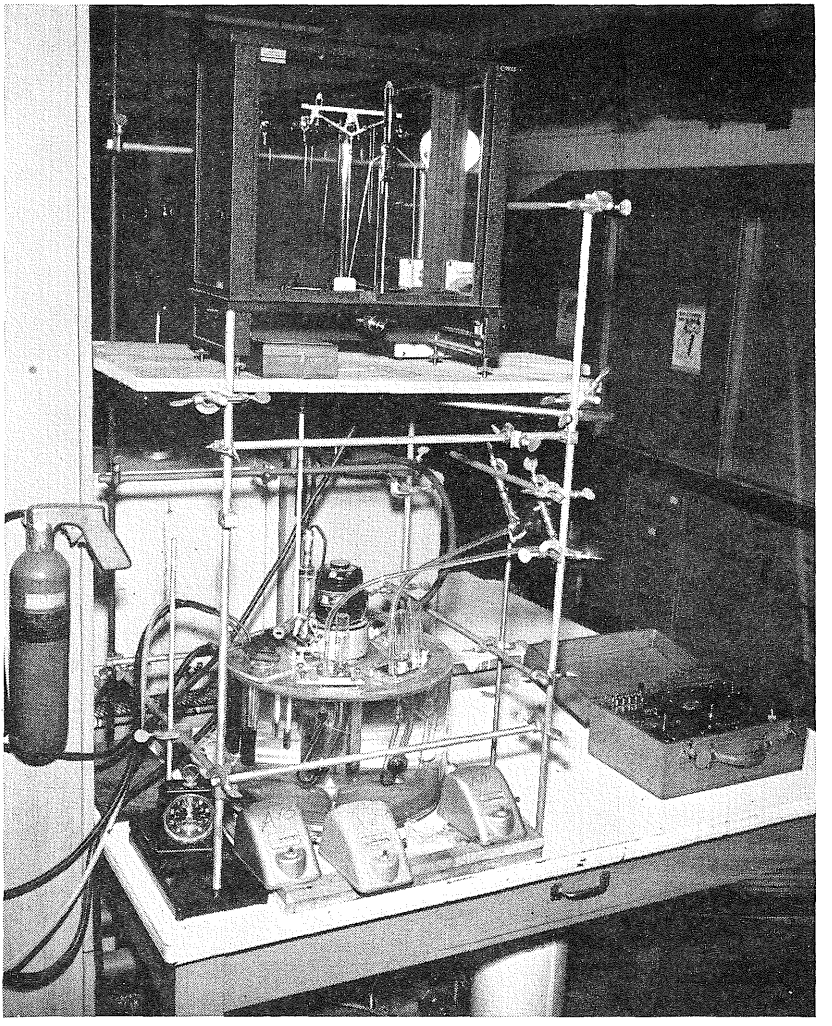
The effect of alkali concentration and filtration conditions on the extraction of the humic acids from peat were investigated. The resulting improved preparative methods are helpful in obtaining laboratory raw material and potentially important to any future commercial processes.



APPARATUS for studying the reaction of peat with various solvents. CPPP, Duluth Branch, University of Minnesota (Figure 3).

Survey of Peat Bogs

Underlying the chemical and geo-botanical characterization of Minnesota peats is the bog-sampling program, which has been actively pursued during the biennium. Some 600 new samples were taken from 19 bogs in six counties. Particular attention was paid to northern areas not previously covered—Koochiching, Beltrami, Lake of the Woods, and northern St. Louis counties.



VISCOSITY measurements give clues to basic structure of humic acids. CPPP, department of chemical engineering, University of Minnesota (Figure 4).

The development of improved analytical procedures for determining the major organic groups of peat is now essentially completed. Rapid and accurate methods are now available for the analysis of bitumens, humic acids, humins, holocellulose, alpha-cellulose, and ash. These standardized CPPP methods were applied in full to 75 botanically-classified composite samples representing over 400 of the individual peat samples.

There has been active interest in recent years in applications of peat for high-value specialty products such as metallurgical and activated carbons. The ash content of the peat is one of the most important criteria of its suitability to such usages. During the past two years CPPP has determined the ash content of a large number of samples from a wide variety of peats from principal Minnesota bog areas. These data were just made available in a recent report.

There is also interest in the constitution of peat ash, particularly the content of such elements as germanium, rare earths, and elements important to plant life (e.g., manganese, iron, zinc, boron). Through the cooperation of the U. S. Geological Survey and Bituminous Coal Research, Inc., the frequency distribution was determined of more than 30 elements in a Minnesota peat and the humic acids fraction therefrom. A study covering the geochemistry of germanium as related to Minnesota peat deposits was released during the biennium.

The CPPPP peat classification scheme has been refined, extended, and checked in the field with representatives of the National Soil Survey, U. S. Department of Agriculture. This work is particularly important in that the practical utilization of the various Minnesota peats for agricultural and industrial uses is dependent on recognition and identification of the nature and extent of the deposit.

A popular misconception that "all peats are alike" has in the past often prevented proper utilization of peat. The peat classification and associated analytical data which have been and are being obtained represent a very solid contribution to the knowledge of the peats of Minnesota.

Soils Products Evaluation

The program of preparing and evaluating peat-based fertilizer and soil amendment products continues. During the past

two years, the program was widened to include evaluations by specialists in the fields of horticulture and forestry. The following tests were carried out during the biennium on CPPP experimental peat products and on related foreign materials of potential interest:

A greenhouse regressional rate study of peat products conducted for the first time under conditions of accelerated growth. Through the use of statistical methods, involving treatment of the data on the Univac computer, this new and powerful technique offers rapid eval-

TURF TESTS of experimental peat products. Weight of clippings is key to product effectiveness. CPPP, soils and horticulture departments, St. Paul Campus, University of Minnesota (Figure 5).

uation of a much larger number of samples than previously feasible.

Turf experimentation involving plots of established grass at the University Fruit Breeding Farm, the Northrup King Seed Research Farm, and the Toro Turf Research Farm. (See Figure 5.)

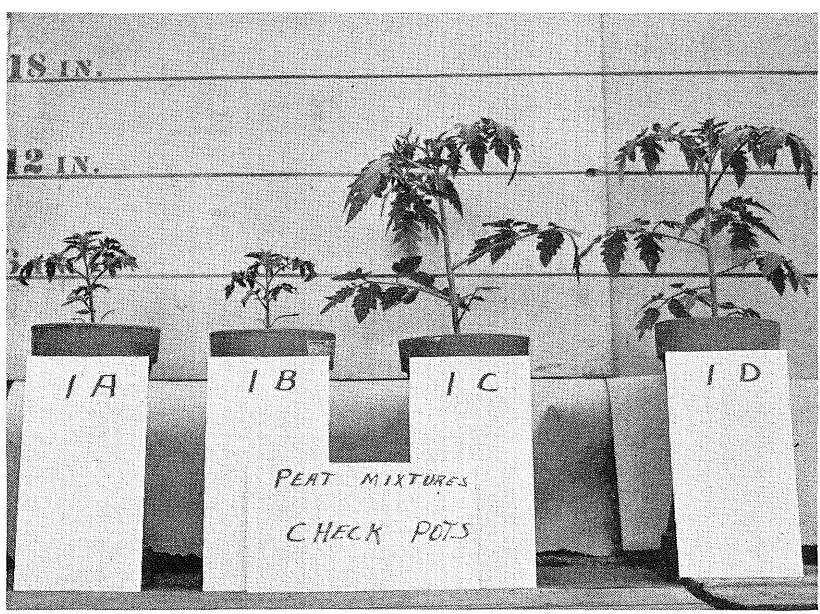
Controlled evaluation studies to determine the value of peat-based materials in starting and maintaining tree seedlings.

Horticultural flower growth tests with cyclamens as assay plant.

Basic laboratory research aimed at determining the fertilizing and stimulatory effects of peat products on root and stem growth.

Field experiments with small grains at the Northeast Experiment Station, Duluth.

Closely related to these evaluations is a study of greenhouse potting peat mixtures which was undertaken during the past biennium. At present, imported peats are widely used by greenhouse men for horticultural potting mixes. It was therefore de-



EXPERIMENTAL CPPP horticultural potting soil mixture being tested with tomato plants. Soils department, St. Paul Campus, University of Minnesota (Figure 6).

sirable to determine the suitability of Minnesota peats for this important market. Four varieties of Minnesota peats were tested on a variety of plants, including tomatoes, roses, and junipers. (See Figure 6.)

Information Program

Concurrently with widening the scope of its researches, CPPP has broadened its relationship with academic and industrial researchers in similar fields both locally and throughout the world. The publication of six papers by CPPP personnel within the past two years has both stimulated inquiries and served to make the work of the Project more widely known.

Establishment of the punched-card peat library covering the world's literature on the chemistry and technology of peat was completed. This file is now routinely maintained up to date as new literature appears.

Distinguished peat specialists from England, Ireland, Australia, and Germany, visited CPPP, especially during the last biennium, and brought first-hand knowledge of their work. In turn, CPPP personnel participated in the IRRRC Technical Peat Exchange Mission.

Industrial Review

Considerable work has been done in the past year in trying to find woodprocessing plants which can be located in the Iron Range area. There are various places in that area that would provide suitable locations, among them Virginia, Ely and Cook, Two Harbors and Mississippi Headwaters area. However, due to an economic slump in the pulp and paper industry at the present time, the Department has been unable to get any of the concerns who are interested in this field to start new plants. Nevertheless, we are still working on a projected plant for Virginia and if economic conditions improve this should become a reality shortly.

MAPLE SYRUP PLANT

The Grand Portage Indian Reservation located in the very northeastern tip of Minnesota has, it is estimated, one of the finest stands of maple trees in North America.

The IRRRC appropriated $15,000 to provide facilities such as buildings and equipment to the Grand Portage Chippewa Cooperative for the harvesting and processing of maple sap.

Cooperation from the State Department of Agriculture was obtained to aid the cooperative in management and technical assistance in the proper handling and manufacturing of the products.

The maple syrup plant operated during the 1958 spring season and provided part-time employment for 23 Indians from the Grand Portage Indian Reservation.

We did learn from this year's operation that the plant is capable of producing a first quality product in great quantities. Also, that there is a market for this product at a reasonable price. However, due to the fast warm-up of the weather in the 1958 spring the sap season was unusually short and therefore it cut down on the amount of the sap available for maple syrup production.

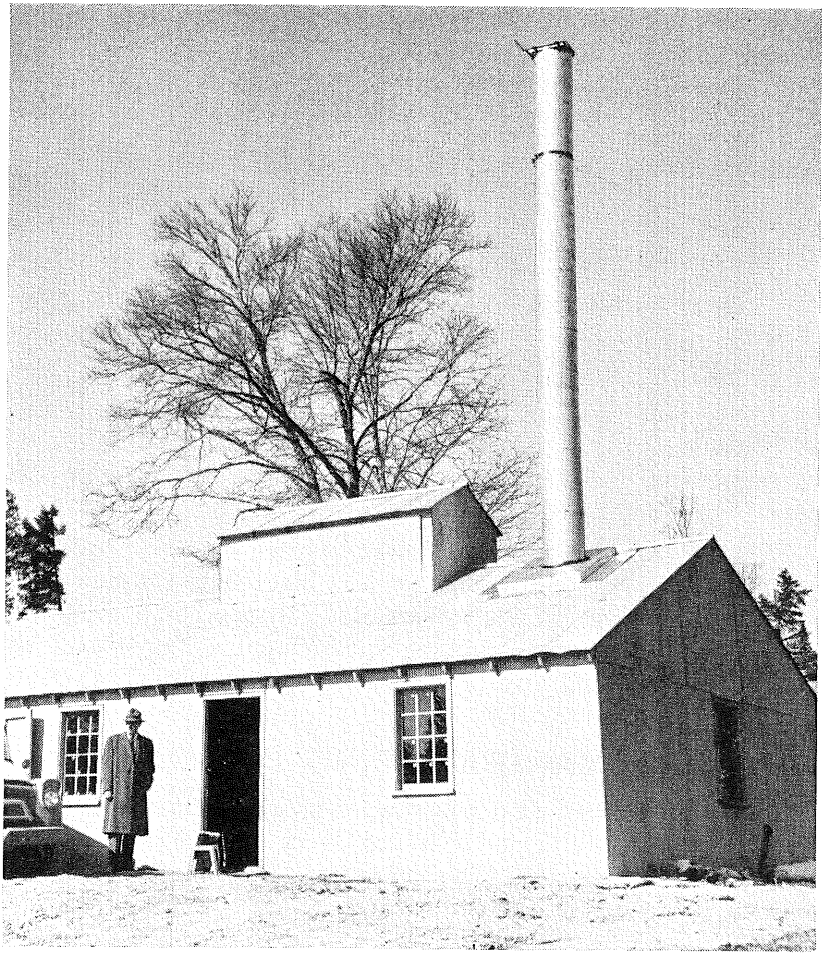
This plant, with proper management and operation, can become a big economic factor for the Indians of the Grand Portage Reservation.

TREES TAPPED FOR SAP on Grand Portage Indian reservation in northeastern tip of Minnesota. This is part of what is regarded as one of the finest stands of maple trees in North America.

CHUN KING PLANT

Chun King Sales, Inc., Duluth, which received asstance from IRRRC in 1950, has developed a sizeable industry for Minnesota. It now ranks as the largest packer of Oriental foods in the world.

Considerable plant expansion has taken place in the last three years, including plant construction and installation of equipment necessary for processing of frozen foods.



MAPLE SYRUP PLANT, front view, which is part of maple syrup operation on Grand Portage Indian reservation.

Chun King and its related firms employ upwards to 1,000 persons a good share of the year. Complete recovery of the IRRRC funds became a reality on May 29, 1957.

At that time Chun King Sales, Inc., according to the provisions of the contract with the State of Minnesota, asked that the plant be put up for sale. Chun King was awarded the bid for the plant and all IRRRC expenditures for this project were returned to the General Revenue Fund.

FLOODWOOD PLANT

During the last session of the Legislature a bill was passed providing for the sale of the Floodwood peat plant. This plant was originally built by the State in 1946 and 1947, and put into use on or about May 1, 1948.

Purpose of the plant was to produce agricultural and horticultural peat, using the hydraulic method for mining, and using mechanical means and heat for the drying process.

The plant proved uneconomical to operate and was finally closed in 1950 and since that time has been idle. Recently this plant was put up for sale and sold to the highest bidder.

It is expected that the new owners will provide this plant with the know-how and equipment to make a successful undertaking so that the plant becomes a favorable factor in the economy of the Floodwood area.

The Floodwood plant will now be used as a pilot plant to perfect manufacturing techniques and methods for a new product largely made from wood fibers along with other fiberous raw material. The plant will provide employment for people of the Floodwood area and also provide a market for forest products.

McGREGOR MANUFACTURING CORPORATION

During the biennium a new wood-using industry was established in the State. The McGregor Manufacturing Corporation came into existence with the cooperation of the McGregor Development Company (a local group of McGregor business men) and the IRRRC.

The McGregor Development Company provided the site and the building and some operating capital. Private interests pro-

vided additional operating capital and the State of Minnesota provided machinery for the plant.

The McGregor Manufacturing Corporation is now in production in the manufacture of laminated folding skis, regular skis, lawn furniture and water skis. The firm hopes to expand production to other lines.

Present employment is about twenty persons. In addition, it is providing a market for surplus ash lumber which is abundant in the McGregor area. Until the beginning of this operation the market for ash lumber in Minnesota was almost non-existent.

As a result of the additional payroll in the McGregor area other retail businesses have been expanded and new ones established in that community.

RESOURCES CONFERENCE

A second Governor's State-Wide Resources Conference, held in Virginia, Minnesota, from April 23 to 25, 1958, drew some 600 persons. Distinguished speakers, experts in their fields, appeared on the program and covered a wide range of topics, such as Forestry Resources; Mineral Resources; Human Resources; Industrial, Recreational and Tourist; Agriculture; Power and Energy; Water Resources. A complete report on the conference, with all the information presented, was published. This again will become another handbook for the development of our resources in northeastern Minnesota.

Receipts and Outlays

RECEIPTS

	1956-1957	1957-1958
Taxes:		
5% of Occupational Tax on Iron Ore	$1,106,298.85	$1,314,442.06
Transfers In:		
Recovery of unobligated balances of transfers out in prior years;		
Dept. of Agriculture	1.75	19.97
Bd. of Health	.....	3,899.21
Dept. of Conservation:		
Div. of Forestry	20,225.28	9,703.06
Div. of Lands & Minerals	6,938.49	12,913.90
Forestry Study Commission	2,307.53	.....
Misc. Refunds	30.99	262.87
Sale of Surplus Machinery, Equipment, Tools at Floodwood, Minnesota, peat plant	.....	4,705.00
TOTAL RECEIPTS	$1,135,802.89	$1,345,946.07

Receipts from IRRR Projects Credited to General Revenue Fund

Property rentals	$ 1.00	$ 1.00
Quit Claim Deed in re: Laws 1957, Chapter 461	50.00	.....
Sale of Floodwood, Minnesota, peat plant (monthly payments)	.....	2,566.68
Stores for Resale:		
Arrowhead Canning Co., Grand Rapids, Minn.	1,250.00	1,875.00
Arrowhead Seed Growers Coop., Cook, Minn.	1,000.00	1,000.00
Cedar Products, Inc., Deer River, Minn.	3,600.00	3,600.00
Chun King Sales, Inc., Duluth, Minn.	85,828.39	.....
McGregor Manufacturing Corp., McGregor, Minn.	.....	724.66
McLeod, Inc., Grand Rapids, Minn.	1,800.00	1,800.00
Nu-Ply Corporation, Bemidji, Minn.	20,416.69	5,833.34
Superwood Corporation, Duluth, Minn.	36,750.00	33,687.50
TOTALS	$150,696.08	$51,088.18

EXPENDITURES

PROJECT	1956-1957	1957-1958
Administration	$ 36,982.43	$ 56,321.65
Agriculture (Farm development and farm management)	5,684.36	6,947.23
Chemical Products from Peat (Research)	56,613.53	56,715.00
Forestry Development	155,030.87	226,092.20
Forestry Rehabilitation Camp, Thistledew Lake	2,000.00	.....
Governor's Second Statewide Resources Conference	.....	1,651.73
Indian Survey	2,500.00	.....
Legume Seed Investigations (Research)	29,907.72	.....
Maple Syrup Plant, Grand Portage, Minn.	.....	12,486.72
Marl Survey	6,196.97	2,363.32
McGregor Manufacturing Corp., McGregor, Minn.	43,479.60	.....
Mineral Survey	18,514.92	36,392.74
Minnesota Arrowhead Assn. Tourist & Resort Survey	.....	50,000.00
Peat Processing Plant, Floodwood, Minn.	3,009.98	2,042.29
Port Authority of Duluth (Survey)	15,000.00	.....
Topographic Mapping (U. S. Geological Survey)	50,000.00	50,000.00
Tourist Guide Training Program	.....	400.00
Water Survey (U. S. Geological Survey)	68,061.90	62,500.00
TOTAL EXPENDITURES	$492,982.28	$563,912.88

TRANSFERS OUT

Dept. of Administration (Supplementary Salary Adj.)	.....	$ 1,470.00
Dept. of Agriculture (White Pine Blister Rust Control)	$ 5,000.00	7,500.00
Board of Health (Water Pollution Control)	15,000.00	20,000.00
Dept. of Conservation:		
Forestry Div.	441,108.38	421,723.33
Lands & Minerals Div.	109,486.00	127,469.85
Interim Commission on Taxation of Iron Ore	.....	30,000.00
Mapping Advisory Board	.....	14,000.00
University of Minnesota:		
Beneficiation of Low-grade Ores	87,500.00	100,000.00
Legume Seed Research	.....	30,000.00
TOTAL TRANSFERS OUT	$658,094.38	$752,163.18
TOTAL EXPENDITURES AND TRANSFERS	$1,151,076.66	$1,316,076.06