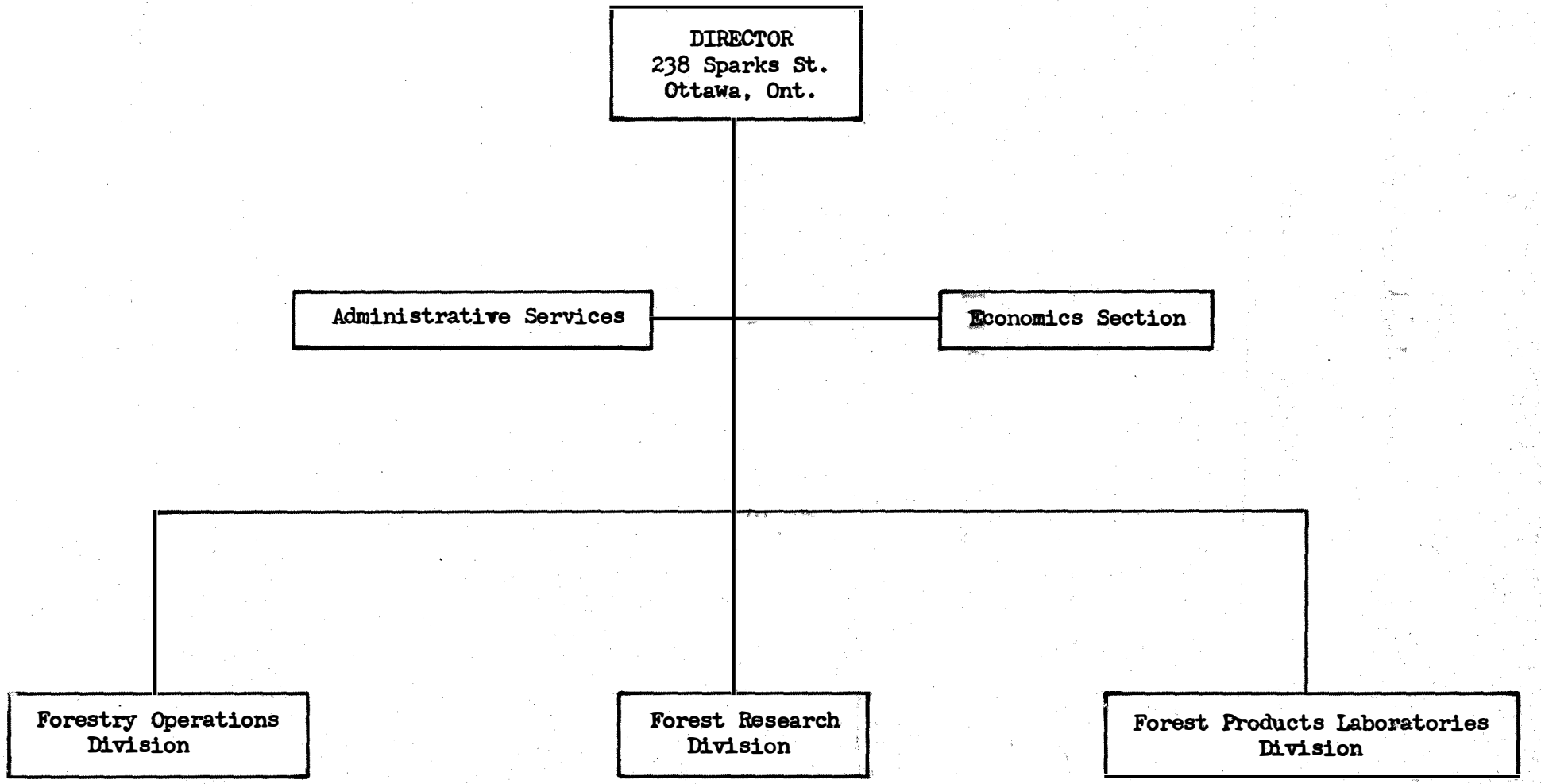
Canada
Department of Northern Affairs and National Resources
FORESTRY BRANCH

SIXTH
ANNUAL REPORT
on
Active Forest Research Projects
YEAR ENDED MARCH 31, 1955

Ottawa
JULY, 1955

ORGANIZATION CHART

FORESTRY BRANCH



Canada

Department of Northern Affairs and National Resources

Forestry Branch

FOREST RESEARCH DIVISION

Sixth

ANNUAL REPORT

on

Active Forest Research Projects

Year Ended March 31, 1955

Issued under the authority of

The Honourable Jean Lesage

Minister of Northern Affairs and National Resources

Ottawa, July, 1955

PREFACE

This is the sixth Annual Report on Active Research Projects to be published by the Forest Research Division of the Forestry Branch. It presents brief outlines of forest research projects on which work was done during the fiscal year which ended on March 31st, 1955. These projects include some which were initiated during the period under review and others, established in earlier years, which became due for re-examination. Numerous projects which must be examined from time to time, but on which no work was necessary during the fiscal year 1954-1955, are not described in this report.

The work of the Division is governed by a statement of Forest Research Policy, adopted in 1953 and published in last year's report. Research related to forest inventory methods and to forest fire protection is conducted by two Sections of the Division, located at Ottawa. A third Section is responsible for guiding the programs of research in silviculture and forest management which are carried on at the Petawawa Forest Experiment Station, by the Ontario Research Unit, and by District Offices located at St. John's, Newfoundland; Fredericton, New Brunswick; Valcartier, Quebec; Winnipeg, Manitoba; and Calgary, Alberta.

Each section and district office has formulated a limited number of problems upon which the major portion of its activity will be concentrated during the next few years. For convenience, a single series of numbers has been assigned to these problems. In this report, descriptions of projects (or individual studies) are grouped under the appropriate problems by sections and districts. To facilitate reference an "Index of Active Projects" has been included, in which projects are listed on a "principal task" or subject-matter basis.

Further information regarding projects can be obtained from publications issued by the Division, or by reference to manuscript reports known as "Binders". Research workers in Canada who may be interested in further details may apply for the loan of any binder mentioned herein, for a period not exceeding two weeks.

J. D. B. Harrison
Chief, Forest Research Division

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SILVICULTURE AND MANAGEMENT RESEARCH

Letters prefixed to project numbers indicate the forest district or experiment station where the work was conducted, except that Head Office (H) projects may involve work in various parts of the country.

H - Head Office
P - Petawawa Forest Experiment Station
NF - Newfoundland District Office
M - Maritimes District Office
Q - Quebec District Office
MS - Manitoba-Saskatchewan District Office
A - Alberta District Office
K - Kananaskis Forest Experiment Station

Miscellaneous

Forest Inventories Section

Forest Research Division — Forestry Branch

238 Sparks Street

Ottawa

Section Head: H. E. Seely

Research Foresters	Assigned Problems
F. D. MacAndrews	4
A. J. Nash	1
L. J. Nozzolillo	4
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FOREST INVENTORIES SECTION

Summary

Some 273 sample plots were measured by field parties during the year in order to supply data for stand volume tables, which are being prepared primarily for use by the air photo interpreter. Manual sorting cards have been adopted in the analysis of the data. Wide variations in the ratio of canopy density to basal area per acre became evident. A suitable knowledge of stand history is most desirable. Studies of site classification were made.

A comparison of random, selected line, and subjective methods of inventory sampling was conducted near Lanark, Ontario. No significant differences in mean values were apparent, except in the case of the subjective method in which plots were selected according to the personal judgment of the photo interpreter. Experiments conducted with air photographs of a selected area in the Yukon Territory indicated that very little advantage was obtainable from photographs of a medium scale as compared to those of a small scale.

A technical note entitled "Average Height Weighted by Volume in Air Photo Interpretation" was prepared for publication.

Improvements were made to the dot-reading planimeter or "moosehorn" employed in the field for the measurement of canopy density.

Forest inventories of northern areas were conducted by the Section in co-operation with the Northern Administration and Lands Branch and the Operations Division of the Forestry Branch. Forest maps prepared during the year covered a total area of 11,150 square miles and 502 sample plots were measured in the field. Computation and tabulation of the sample plot data were effected in a most economical manner by the Dominion Bureau of Statistics.

Provisional forest maps were prepared of 50 square miles in the Kananaskis Forest Experiment Station and 150 square miles in the Eastern Rockies Forest Conservation Area. A mosaic of Camp Gagetown, New Brunswick, was prepared.

Problem 1

PREPARATION OF STAND VOLUME TABLES

Volumetric data for use by the air photo interpreter in making estimates of timber quantities are being collected in the field in accordance with four determinants, all of which may be estimated from, or identified in, air photographs. These determinants are canopy density, average height weighted by volume, cover type, and site type. Stand volume tables based on these values, and subdivided in accordance with the ratio of canopy density to basal area per acre, are being prepared. This subdivision has been found necessary because of variations encountered in the degree of expansion of the crowns of various species growing under different forest conditions.

While it is not recommended that the more exacting kinds of forest inventory work be done from air photographs without recourse to field sampling, there is nevertheless a demand for stand volume tables suitable for the preparation of estimates directly from the air photographs, particularly when tentative estimates are required in advance of field work.

Information regarding site, age, and various forest conditions is recorded during the collection of data for stand volume tables and this makes it possible to prepare tables showing the ratio of canopy density to basal area per acre. These ratio tables will enable the air photo interpreter to express canopy density in terms of basal area, as required in the use of yield tables. Furthermore, an analysis of the data collected for stand volume tables, supplemented by form class measurements, may provide information on the relation between the development of the crown and the form of the bole.

About 250 plots per year, usually in two or three regions, are being measured for these tables. Plots are selected to represent the main forest conditions encountered and the canopy density is measured by means of an instrument known as the dot-reading planimeter or "moosehorn".

Project 1/1: Stand volume tables

Some 273 sample plots were measured during the year and the data were recorded on suitable cards, which are punched with holes and slots for use with a sorting needle. Data from 800 previously measured plots were also recorded on the cards.

It was learned that the ratio of canopy density (C) to basal area per acre (B) ranges from 0.2 in certain black spruce stands to 1.6 in some of the tolerant hardwood stands. Local variations in C/B occur within a single stand and depend on differences in (B) rather than in (C).

Studies were made to determine the factors underlying the variations which occur in average C/B as between stands of various heights and canopy density. These studies included the relating of (C) to individual crown measurements. It was decided that certain variations might be explained if stand history, especially in regard to density, could be ascertained.

Comparisons were made of the measurement of canopy density in the upward view required in the field, with similar measurement made on large-scale air photographs. Similar specifications must be employed if these two approaches are to be properly correlated.

Foresters engaged in this project received special instruction in the field in regard to the site classification methods employed by the Silviculture and Management Section.

A. J. Nash
G. B. Sully
J. C. Wright

Problem 2

DETERMINATION OF MOST SUITABLE METHODS OF AIR PHOTOGRAPHY

Research in the effect of seasonal foliage variation, the use of various films and filters, including colour films, and the use of transparencies and paper prints, is being conducted to improve the identification of tree species and to increase the accuracy of fine tree measurements in air photographs.

Project 2/3: Corrections for lack of resolution

Measurements of small objects under various conditions of contrast were made on air photographs of differing scales covering a single area. This investigation is to be supplemented by an examination of the objects in the field.

J. M. Robinson

Problem 3

DEVELOPMENT OF INSTRUMENTS

Advances in the technique of using air photographs for forest inventory purposes are accompanied by demands for new or improved instruments. These include stereoscopes and equipment for the proper illumination of the photographs; projectors and other devices to facilitate the transfer of forest type lines from the air photograph to maps of various scales; instruments for the measurement of canopy density and crown width in the field; overlays for use in the measurement of the fine tree images and shadows in the air photographs; and planimeters for the measurement of the forest stands shown on the map.

Continuation of work already in progress is desirable, together with studies of current photogrammetric and other literature describing new instruments of special interest to the forester engaged in the use of air photographs. A number of useful instruments have already been constructed by the Section, and others are under way.

Project 3/6: The "moosehorn"

The dots on the screen of the dot-reading planimeter or "moosehorn", Hilborn model, were moved very slightly to compensate for a small error caused by obliquity of view. Also, a peep-sight of smaller diameter was introduced to "stop down" the view and this proved very satisfactory in minimizing the disparity of focus between the dots and the tree crowns.

G. B. Sully

Problem 4

INVESTIGATION OF FOREST SURVEY TECHNIQUES

Various forest survey techniques are being investigated. Comparisons of field sampling procedures, and of the forest inventory value

of information obtainable from air photographs of various scales, have been commenced. Diagrams are being prepared to aid the photo interpreter's determination of the height of the trees, which is specified as the average height weighted by volume. Sample air photographs are being collected to aid the identification of tree species. Systematic procedures for determining and recording the scale of the air photographs will be established. Other work to be conducted in aid of the development of the technique of air photo interpretation includes the measurement of canopy density on large-scale sampling photographs for the setting up of standard stereograms for comparison with the general coverage photographs. Also, various methods of determining tree heights from air photographs are to be tested under different conditions. A forest inventories method recently developed by the Section is based on a classification or stratification of the forest stands by photo interpretation followed by appropriate field sampling. This method has proved satisfactory in forest inventories of areas near Forestville, Quebec, in the Province of Newfoundland, and in the Yukon Territory. A special adaptation of the method is being employed by the Province of Nova Scotia.

Project 4/1: Relation between average heights

An article entitled "Average Height Weighted by Volume in Air Photo Interpretation" was prepared for distribution as a Technical Note.

F. D. MacAndrews

Project 4/7: Comparison of sampling methods, Lanark area

A comparison of inventory sampling methods was conducted on an area near Lanark, Ontario, and the random method of sampling was employed as the criterion. The data of some 527 sample plots showed no definite difference of trend between random and "selected line" methods of sampling. On the other hand, the trend of the data of the subjectively chosen plots was quite divergent. The measurement of at least 100 more plots appears to be necessary for reasonably conclusive results. It may be explained that selected line methods are based on samples measured on lines drawn between prominent map features in such a way as to cross the stand or stands to be sampled. The plots are not selected by personal judgment but are located at points predetermined from map measurements. In the subjective method the plots are selected by the photo interpreter as representative of the stand.

L. J. Nozzolillo

Project 4/8: Air photo scale and stratification, Stewart River, Yukon Territory

It was indicated that very little advantage was obtainable from air photographs of the scale of 1,320 feet to 1 inch as compared to those at 2,900 feet to 1 inch. It appears desirable to conduct a similar experiment in more complex forest stands and to measure plots specifically for the purposes of the new project. The plots employed were long plots, measured during the Yukon Inventory work, and many of them could not be used because they were intersected by the type lines which were introduced in the photo interpretation called for by the project.

W. U. Hardy

Problem 5

FULFILMENT OF DEPARTMENTAL SURVEY REQUIREMENTS

Although these surveys are not strictly research activities, they are included here because of their importance in the whole program of the Section.

Forest inventories are being made for areas in the Yukon Territory, the Northwest Territories, national parks, Indian reserves, and other federally administered lands, or for provincial lands where required. These inventories have provided practical experience, called attention to urgent research problems, and facilitated the trial and demonstration of new methods. A forest inventory method described under Problem 4 has been developed by the Section and is usually applied in the work of Problem 5. Forest surveys have already been carried out by the Section, with or without assistance, on areas totalling about 180,000 square miles. Nearly half of the time of the Section is spent on this type of work. The inventories are usually given forest map designations instead of regular project numbers, and individual project plans are seldom prepared.

Yukon Territory

Provisional forest maps prepared during the year covered a total area of 5,760 square miles. The field party sampled the areas covered by these maps to the extent of some 2,500 square miles, together with 1,540 square miles similarly mapped during the previous fiscal year. A total of 502 sample plots were measured, comprised of 401 plots in the southeastern Yukon and 101 plots in the Big Salmon River area, where estimates are required of timber to be flooded by a proposed power development.

Work proceeded on the revising and planimetering of forest maps and the completion of detailed timber estimates for areas visited during 1953.

Data from sample plots were transferred to punched cards and computation and tabulation were done in a most economical manner by the Dominion Bureau of Statistics. Provisional forest maps were revised by means of the computed data and by the aid of recently taken air photographs.

Mosaics and base maps covering areas totalling 2,150 square miles were completed during the latter part of the year as the first step towards the preparation of provisional forest maps.

Northwest Territories and Wood Buffalo National Park

The forest resources of areas in the Northwest Territories and the Wood Buffalo National Park, which extends north and south of the Alberta--Northwest Territories boundary, are being investigated. Both the Territories and the Park are administered by the Northern Administration and Lands Branch of the Department of Northern Affairs and National Resources.

Provisional forest maps prepared during the year for use by the 1955 field party covered a total area of 5,390 square miles, of which 4,460

square miles are on the Liard River and 930 square miles are in the Alberta portion of the Wood Buffalo National Park. These maps were in part based on mosaics constructed for an area of 1,600 square miles on the Liard River.

Other Inventories

Provisional forest maps were prepared of 50 square miles in the Kananaskis Forest Experiment Station and 150 square miles of the Eastern Rockies Forest Conservation Area.

A mosaic of Camp Gagetown, New Brunswick, and contiguous areas was prepared, covering 650 square miles in all.

J. M. Robinson

Fire Protection Section

Forest Research Division Forestry Branch

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Section Head: J.C. Macleod

Research Officers	Assigned Problems
L.B. MacHattie (Meteorologist seconded from Dep't. of Transport)	7
J.S. Mactavish	6, 7, 10
E.J. Ward	6, 7, 9, 10
D.E. Williams	6, 7, 8, 10

FIRE PROTECTION SECTION

Summary

The Summary of the Section's Active Research Projects for 1953 briefly noted the progress made in developing new, simplified forest fire danger tables. The provisional tables produced at that time were given thorough field trials in 1954 in four widely separated regions, and they proved to be eminently satisfactory to the agencies testing them.

During the year all hazard tables, except that for the heath fuel type, were revised for use with the new simplified rating system. Preparations were made to reproduce all tables, in a provisional edition, in sufficient quantity to be used by all interested fire protection agencies east of Saskatchewan.

Field parties which operated in 1953 attempted to continue similar work programs, but the record-breaking wet weather experienced in the Whitecourt area of Alberta and the Bittern Creek area of Saskatchewan made it impossible to fulfil the primary portion of the program. Thus the stations may have to be operated for four seasons rather than for three as originally proposed.

Unsuitable weather in the Kananaskis Forest Experiment area in Alberta retarded progress with both phases of the fire research programs undertaken there. The major work was a continuation of the studies relating to the effect of mountains on local weather, especially fire weather. The other program was designed to determine the drying rate of windfalls and other heavy fuels under prolonged drought conditions.

The results of field work carried on at the Petawawa Forest Experiment Station near Chalk River, Ontario, were much better, largely because weather did not play such an important part in the program and the season was not so wet as that which prevailed at the stations farther west. One phase of the study of herbicides was completed -- sufficient field observations were obtained to determine the effect of a wide variety of herbicides on the inflammability of materials to which they are applied. Good progress was made in the investigation of the effectiveness and characteristics of several forestry hose mildew-proofing treatments.

At Head Office a variety of projects, other than those relating to fire danger and fire hazard measurement, were undertaken. These included the preparation of a technical note dealing with the characteristics and maintenance of back-pack tanks and pumps; completion of the analysis of field data relating to the effect of various types of slash treatments on hazard ratings, with preparation of a technical note on the subject; and the writing of a script for a 20-minute motion picture training film relating to forest fire suppression.

Problem 6

PREPARATION AND SIMPLIFICATION OF FOREST FIRE DANGER TABLES

A major portion of pre-suppression and suppression activities in forest fire control is related to the current forest fire danger rating. As a result there have been continuing demands for accurate, simple methods of making these necessary measurements.

The problem has been under investigation since 1926, and in the 1930's the basic principles still used in today's tables were evolved. The problem now is to prepare fire danger tables for specific regions, such as individual provinces or large portions of a province; to simplify methods of making the required calculations without adversely affecting the accuracy of the results; and to study the applicability of different parameters for measuring forest fire danger.

Project 4-7: Moisture content determinations in flash fuels

This is a continuing study required for several purposes but chiefly for the preparation of fire danger tables. During the fire season, daily measurements were made in a wide variety of fuels at selected sites near Bittern Creek, Saskatchewan, and Whitecourt, Alberta.

Owing to the wet weather experienced this year, field work at these Stations may not be completed until 1956, when a detailed analysis of the data will be undertaken.

D.E. Williams
J.S. Mactavish

Project 4 - 8: Moisture content determination in heavy fuels

These studies are undertaken for the same purposes as those noted in Project 4 - 7. Daily observations were made at Bittern Creek, Whitecourt, and the Petawawa and Kananaskis Forest Experiment Stations.

Detailed analysis of the data obtained will not be made until after completion of the field work in 1956.

D.E. Williams
E.J. Ward
J.S. Mactavish

Project 4 - 9: Water table level drought studies

One of the most promising indicators of drought conditions, as they affect forest fires, has been the use of fluctuations in water table levels. Observations were made at three field stations during the year.

An article on the use of water table levels as an indicator of drought conditions was published in the December, 1954, issue of The Forestry Chronicle. This study will be continued.

D.E. Williams

Project 4 - 10: Experimental fires

Small test fire data were obtained daily during the fire season at nine forest sites in Alberta and from seven in Saskatchewan.

If the field work has been completed, this information will be analysed in 1956 and will form a basic portion of the material required for the preparation of fire danger tables applicable to the specific areas under study. D.E. Williams
J.S. Mactavish

Project 4 - 13: Physical fire danger indicators

Hazard sticks, of the type currently being used by the Alberta Forest Service, were observed under a variety of exposures at Whitecourt, Alberta. The season was so wet that the sticks seldom reached equilibrium. These observations will be continued until the field program has been completed. J.S. Mactavish

Project 4 - 14 - 1: Preparation of fire danger tables

Sufficient copies of the new simplified Forest Fire Danger Tables were produced to have them given thorough trials in four areas ranging from central to eastern Canada. They were well received by all agencies concerned.

Simplified hazard tables, for all fuel types previously covered, except heath, were prepared and prototypes of a provisional publication to include all tables, by provinces, were completed. These will be reproduced for full field use in 1955. J.C. Macleod

Project 4 - 14 - 2: Preparation of fire danger table instructions

The ease and accuracy with which danger tables can be used are at least partially dependent upon their accompanying instructions. Various types of instructions were devised and given trial tests.

Brief instructions were prepared for the new simplified tables, but detailed instructions and ancillary data will not be ready for publication until next year. J.C. Macleod

Project 4 - 15: Verification and analysis of danger records

During the fire season, fire danger charts received from forest experiment stations and national parks -- about 25 stations in all -- were checked and filed. Data required for analysis were tabulated.

This is a continuing project, the results of which are used in several problems. J.C. Macleod

Project 9 - 1: Phenological studies

The development and curing of ground vegetation in the forest have a great effect on fuel inflammability. Allowance is made for these and other seasonal effects in preparing fire danger tables. Phenological observations are made weekly at all fire research stations.

Summaries of observations made appear in the year-end and file reports of fire research parties. This is a continuing project.

D.E. Williams

Problem 7

WEATHER IN RELATION TO FOREST FIRE DANGER AND FIRE BEHAVIOUR

The ways in which various weather factors affect fire danger and fire behaviour have been investigated and methods for correlating their effects have been developed and applied. Climate close to the ground has received particular attention, and methods and techniques for obtaining many of the required measurements have been developed.

Much remains to be learned about weather as it affects many phases of fire control. Some of the features at present receiving attention include: the effect of mountains on fire weather and fire danger ratings; the relation of weather patterns to fire danger occurrence; and the effect of prevailing weather on fire behaviour.

Project 4 - 1: Weather observations

Detailed weather observations were made throughout the fire season at Petawawa, Bittern Creek, Whitecourt, and Kananaskis. In addition, fire weather records were obtained from all weather stations in the national parks and from a few other stations.

File reports have been prepared on this continuing project.

E.J. Ward
J.S. Mactavish

Project 4 - 2: Evaporimetry

Use of evaporation data as a parameter for fire danger computations was discontinued in the Forestry Branch fire danger rating system published in 1946, but evaporation is still a useful element in danger rating studies. Observations of evaporation provide a valuable means of checking conclusions regarding weather and fuel moisture phenomena. D.E. Williams

Project 4 - 3: Effect of dew on forest inflammability

Data were obtained on dew deposition at Petawawa, Bittern Creek, and Whitecourt. Detailed studies were undertaken at the latter fire research station to determine the height above ground at which the greatest amount of dew may be expected to form.

Morning test fires in grass at Whitecourt, and in caribou moss at Bittern Creek, were observed to determine the wetting and duration effect of dew on flash fuels. These studies will be continued.

D.E. Williams
J.S. Mactavish

Project 4 - 5 - 1: Climatic variations in mountainous country

Studies under this project were first undertaken in the 1930's, but it was not until 1952 that the services of a qualified meteorologist were obtained. Hypotheses developed during the field season at the Kananaskis Experiment Station are expected to answer some of the outstanding questions concerning "inversions" in fire weather in mountainous country.

A bulletin relating to these hypotheses is in course of preparation for publication during 1955.

H. Cameron
L.B. MacHattie

Project 4 - 11: Meteorological instruments adapted to fire research

A special support for dew gauges was devised to simplify the procedure of obtaining dew deposition measurements through a vertical plane. This instrument will be described in a publication when testing has been completed.

A captive, hydrogen-filled balloon, controlled with a common fishing rod and reel, was found to be a first-class instrument for observing low-level winds, up to about 300 feet.

J.S. Mactavish
L.B. MacHattie

Problem 8

DETERMINATION OF FIRE SEASON SEVERITY AND RELATIVE EFFECTIVENESS OF FIRE CONTROL METHODS

A knowledge of past fire season severity has been required by fire protection administrators for many years, but fire frequency and loss figures do not provide a complete picture of the desired factors. A method of rating fire season severity, based on actual fire weather, must be developed to enable protection services to determine the efficiency of their fire control organizations.

When the relative severity of various fire seasons can be measured, it will be possible to determine the effectiveness of given changes made in certain phases of the fire control program.

Project 2 - 3: Fire prevention efficiency

Project 2 - 4: Rating severity of fire seasons

Several of the preliminary analyses required for these projects are so inter-related that they are handled jointly. Weather data and newly computed danger indices from five additional New Brunswick weather stations were recorded on punched cards and added to totals already obtained. Several techniques for rating severity have been tried with the data available on the cards, and some success has been achieved in calculating the "expected" number of fires as compared with actual fire occurrence. However, results to date indicate the necessity of making some major changes in the techniques used.

A file report has been prepared on the work to date, and it is expected that some useful results of the study will be available in 1956.

D.E. Williams

Problem 9

FUEL TYPE CLASSIFICATION

It is generally recognized that fuel type maps form an important part of most efficient fire control plans. At present comparatively few people are capable of preparing such maps, and even these must be done by time-consuming methods. The problem, then, becomes one of devising methods whereby non-specialist forest protection personnel may prepare such maps without prohibitive expenditures of time and labour.

Three methods of approaching the problem are under consideration, viz: (a) relating existing cover type and site type maps to fuel type maps, (b) using landform maps as a rough guide, and (c) using aerial photographs, either alone or in conjunction with one or both of the methods noted in (a) and (b).

Project 2 - 2: Variations of fuel type characteristics within and between cover and site types

Project 5 - 5: Rate of spread

Project 5 - 6: Resistance to control

The predominant cover types in the Montgomery Block at the Petawawa Forest Experiment Station were examined. Some of the factors noted were tree, shrub and herbaceous growth, grass and moss, standing dead fuels, duff, and soil. Probable rate of fire spread and difficulty of control were noted. Cover type maps would appear to be the most useful for the purpose at this time.

A file report on the Project has been prepared. Work will be continued on a limited basis in New Brunswick next year. E.J. Ward

Problem 10

INCREASING THE EFFECTIVENESS OF FOREST FIRE CONTROL

This problem covers many projects, a large number of which are related to forest fire pre-suppression and suppression activities. Other than for weather instruments, research projects concerning fire control equipment are considered as a part of this problem. Several of the projects were undertaken, often on comparatively short notice, at the request of protection agencies and associations.

Project 5 - 2: Effect of slash disposal on subsequent hazard

The analysis of field observations made in Manitoba was completed and a technical note was prepared for publication in 1955.

Observations in other areas of the effect of slash on hazard will be made as opportunity permits. D.E. Williams

Project 6 - 1: Development and testing of pumps and accessories

One new power pump was tested in the field by the Forestry Branch and by the National Research Council in its laboratories. When additional power pump data are available, another appendix to Forest Fire Research Note No. 13 will be prepared.

Several makes and types of back-pack tanks and hand pumps were given intensive field trials. Detailed examinations were made to determine their characteristics and details useful in routine maintenance.

A file report was prepared and it is expected that the study will be completed next year, when a technical note will be prepared for publication. J.C. Macleod
J.S. Mactavish

Project 6 - 4: Detection tower location device

In co-operation with the Associate Committee and the National Research Council, a prototype of a light-weight, portable, sectional mast having a maximum height of 81 feet was constructed and tested.

Field trials were made by this Section and necessary adjustments to the camera mount and winch should be completed by the National Research Council in time to make field tests next summer. J.C. Macleod

Project 6 - 6: Chemical vegetation inhibitors

Various chemical preparations used for sterilizing the soil or retarding vegetative growth on roadsides and fire guards are being studied. All plots established since 1946 were re-examined during the year. Twenty-four new plots were established in a grass-heath type. Effects of the treatments on fire hazard were noted, and certain of the chemicals were tested to determine their effects on ignition.

A manuscript was prepared describing the effects of several herbicides on the inflammability of a variety of materials which had been treated with chemicals. The technical note should be published in 1955.

New plots will be established on roadsides to determine the effects of selected new herbicides on large shrubs and bushes. E.J. Ward

Project 6 - 8: Survey of causes of forestry hose failure

At the request of the Associate Committee, a revised hose failure questionnaire was prepared and submitted through members of the Committee to several hundred forest fire rangers and wardens across the country. Replies were tabulated and a summary of the results was presented to the Committee meeting. Many of the returns were accompanied by samples of failed hose, and these were analysed by the National Research Council.

The Council prepared a report, published in The Forestry Chronicle, which indicated the part which mildew or rot plays in hose failure. It was shown that mildew was the direct cause of a high percentage of hose failures -- a condition which had not been known previously. The study is being continued on a co-operative basis. J.C. Macleod

Project 6 - 9: The effect of field use on forestry hose mildew-proofers

Project 6 - 10: The effect of successive wettings and dryings on the strength of unlined linen forestry hose

Laboratory tests have been made at the National Research Council to determine which of the mildew-proofing agents available were most effective, and which had the best resistance to leaching. Leaching conditions in the laboratory did not approximate those which were obtained when the hose was used under pressure. At the request of the Associate Committee on Forest Fire Protection, a field test procedure was developed, and tests were commenced on hose length which had received different treatments. It will take at least one further season, and possibly two, to complete the major portion of the program.

It has been considered for several years that successive wetting and drying of unlined linen forestry hose occasioned a considerable loss of fibre strength, but the hypothesis had not been tested. A field check could be made very readily by slightly modifying the procedures required for Project 6 - 9, above. Preliminary results should be available in 1955 or 1956.

J.C. Macleod
E.J. Ward

MISCELLANEOUS

An appreciable amount of time and effort is devoted to many tasks which cannot be properly classified as research. Nevertheless, several of these tasks are undertaken as distinct projects, and they form an integral part of the work. The more important are listed hereunder.

Project 1 - 1: Forest fire statistics -- preparation

Project 1 - 2: Forest fire statistics -- analysis

The first of these Projects covers the work of obtaining, tabulating, and collating fire loss statistics on a Canada-wide basis. The second project, unlike the first, is not done on a routine basis inasmuch as portions of the statistical data are analysed from time to time as individual requirements are noted or requested.

In co-operation with the Associate Committee on Forest Fire Protection, plans were drafted for obtaining and distributing estimates of the number of fires which occur and the area burned each month throughout the fire season, so that the press and other agencies may have topical information regarding the Canada-wide forest fire situation. The annual bulletin, "Forest Fire Losses in Canada", covering the 1953 fire season, was published.

J.C. Macleod

Project 9 - 3: Forest fire protection abstracts

Twice yearly this Section prepares abstracts of works published in trade journals and elsewhere which are pertinent to forest fire control. These abstracts are produced in loose-leaf form suitable for inclusion in binder covers provided by this Branch. Volume 5 was prepared during the year under review.

E.J. Ward

Project 9 - 4: Preparation of scripts and technical advice for forest fire protection training films

Two 20-minute fire protection training films in colour have been produced for this Branch by the National Film Board, under Branch direction. The first depicts the proper use of hand tools in fire suppression, and the second deals with the use of power pumps. The film currently in hand will show organization and strategy in fire suppression. It is expected that the camera work will be done in the summer of 1955.

J.S. Mactavish
J.C. Macleod

Silviculture and Management Section

Forest Research Division Forestry Branch

238 Sparks Street

Ottawa

Section Head: A. Bickerstaff

Head Office Unit

Research Foresters	Assigned Problems
W.G.E. Brown	15, 16, 17, 41
J.L. Farrar*	18
J.W. Fraser*	18, 19
K.T. Logan*	18, 19
L. Matte	11, 12, 13, 14

*Field work and reports described under "Petawawa Forest Experiment Station"

SILVICULTURE AND MANAGEMENT SECTION

Summary

The principal tasks covered by this Section are the following:

1. Development of a satisfactory system for classifying forests and forest sites.
2. Determination of the silvical characteristics of Canadian tree species, and the ecological relationships of the associations in which they occur.
3. Development of methods of silviculture which are applicable to the more important forest types and to Canadian economic conditions.
4. Development and testing of practical methods for determining the actual and potential growth and yield of forests.
5. Development of improved techniques of reforestation, and of improved strains of tree species suitable to Canadian conditions.
6. Improvement of methods of organizing forest data into plans of regulation and silviculture for forest areas, which will be suitable to different intensities of management.
7. Improvement of research methods, mensuration techniques, and the design of experiments.

During the past year, the consolidation of research findings on a covery-type basis has continued, and will result in a series of monographs on the more important forest types. Forest classification studies in most districts concentrated on developing practical systems of site classification based on an integration of the various factors and resultants of the site complex. Fundamental studies in ecology and plant physiology were largely centred at the Petawawa Forest Experiment Station, and concerned the differential response of tree species to changes in site factors, together with observations under natural conditions. Empirical tests of various silvicultural practices, especially harvest cuttings and seed-bed treatments involving scarification and herbicides, were undertaken from all district offices. Growth and yield research dealt mostly with studies of analysis techniques, using field data previously obtained for yield table construction. Tree breeding and reforestation research increased, with most work being done on provenance studies and propagation techniques with spruce and hard pines. Work in management and regulation was limited to studies of legislation, and the preparation and revision of plans for several small properties or woodlots. In the statistical and mensurational field several mathematical functions were developed for tree volumes and growth relationships, and a number of studies were made to check the applicability of different mensurational techniques in measuring and forecasting forest development and growth potential.

The work of the Section is conducted through the various district offices and forest experiment stations, and this report is arranged on a comparable geographic basis.

At Ottawa there is a small Head Office Unit comprised of specialists in forest and site classification, statistics and mensuration, and ecological studies pertaining to regeneration. This staff acts in an advisory capacity and conducts research at the Petawawa Forest Experiment Station, or

in co-operation with the district offices. Statements of the work done by the Head Office Unit on forest classification and statistics (Problems 11 to 17) are reported hereunder, while ecological studies are listed under the Petawawa F. E. S. (Problems 18 and 19), and the Ontario Research Unit (Problem 41).

Problem 11

DETERMINATION OF TREE VOLUME

Formulae currently being used to cube trees are known to be inaccurate, yet pertinent taper functions make possible the derivation of accurate formulae, and at least one such taper function is now available. The use of this formula for future volume determination will also reduce the tremendous amount of measurement and computation previously involved.

Project H-96: Deriving and testing formulae for individual tree volumes

Accurate formulae, derived from a pertinent taper function, require the measuring of sections at specified locations. In order to select the most efficient one, the influence of the fluctuations of sampling must be tested.

Various formulae have been derived and the testing begun, but it is not yet completed. L. Matte

Problem 12

DERIVATION OF STANDARD VOLUME TABLES THROUGH REGRESSION

In contrast to most existing volume tables, those derived by means of regression analysis are free from the errors resulting from graphical methods and inadequate appraisals of tree form. Further, these functions render possible statistical tests of significance of species and locality which may permit a reduction in the number of such tables.

Project H-101: Significance of species, locality, form, bark thickness, and age in the preparation of volume tables

During the year the main known functions have been tested, and recently a new improved function, involving only 3 terms, has been devised for a test with 1,500 trees using mechanical computation. L. Matte

Project H-95: Regression functions for the height/diameter relationship

By combining the regression functions mentioned in project H-101 with suitable functions for the height/diameter relationship, local volume tables could be derived without the use of graphical methods. A few of the main functions have been tested during 1954 and found satisfactory. However, no report is likely to be written before the completion of project H-101.

L. Matte

Problem 15

FOREST CLASSIFICATION

Work pertaining to the general forest classification of Canada is brought together under this problem.

Project H-8: Forest classification

The forest classification of Canada has been revised from Halliday's original work in Forestry Branch Bulletin 89. The classification map, region descriptions, and section names have been corrected to March 1954 for the Atlas of Canada.

Subdivisions of the sections (districts) have been set up on a cover type--land type distribution basis for the area from Newfoundland to Saskatchewan. Descriptions of these districts in the Maritimes, Manitoba-Saskatchewan, and in Ontario have been prepared.

A revised text to replace Bulletin 89 will be assembled in 1955.
W.G.E. Brown

Reports

(1) The Forest Sections and Districts of the Maritimes. Dr. I.C.M. Place. Project M-69 (Binder 1174).
(2) Forest Sections and Districts of Saskatchewan and Manitoba. J.S. Rowe. Project M.S.-173 (Binder 1118). 4 pages.
(3) The Forest Districts of the Great Lakes--St. Lawrence Region. W.G.E. Brown. Project H-8 (Binder 1005). 44 pages.

Project H-105: Physical and chemical properties of specific parent soil materials

This project is being carried out in co-operation with many others and involves collecting samples of parent materials which are stored in sample jars and analyzed as time permits. It will reveal the nature of parent materials and assist in our knowledge of the various forest districts.

Standard samples of various soil textures have been prepared for distribution to the District Offices. W.G.E. Brown

Project H-97: Site classification in Forest Section B.7, Quebec

This is a co-operative project with the Ontario Research Unit. (See also project H-72 under that Unit)

Field work was continued on the survey of sections of the Upper Lievre, Gatineau, St. Maurice, and Upper Ottawa watersheds.

A report in 1955 will describe, as an example of the application of forest classification, the land types, sites and cover types, and relate

the lesser vegetation to these and to stand history. The report will be on a practical level for company foresters, and will replace the mimeographed report numbered S. & M. 53-2. W.G.E. Brown

Problem 16

OBSERVATIONS ON ASSOCIATIONS AND TREE RESPONSES, AND FACTOR BEHAVIOUR

This problem was listed in the 1954 annual report under the title "Silviculture of Red and White Pine". It deals with the ecology of forest associations and tree species.

Project H-100: Ecology of the red and white pine cover types

See also project H-87. The study on the ecology of the pine types was continued at the Petawawa Forest Experiment Station.

W.G.E. Brown

Reports

The report on the Ecology of the Pine Types was revised to March 1954. (Binder 1123). 44 pages. W.G.E. Brown

Problem 17

APPLICATION OF SITE CLASSIFICATION IN PROJECTS OF THE FORESTRY BRANCH AND OTHER ORGANIZATIONS

Under problem 17 are included assistance to forest managers and research workers in setting up site classification, rating sites for use capability, and mapping sites. Both field and office (air-photo) work are carried out by the Forestry Branch in association with provincial and industrial personnel.

The goal is to familiarize foresters with a simple system of site classification having a minimum of classes, easily applicable in the field to their area, and capable of being mapped from air photographs with a minimum of ground work. The cover types, lesser vegetation types, physiography and soil are all considered.

Also included here are projects concerned with growth and yield, regeneration, and reforestation.

Most of the projects are co-operative and are included in the reports of other districts.

Project H-98: Site classification at the Petawawa Forest Experiment Station

A land type map was prepared for the whole area. It is planned to include this as part of a report by Atkins and Brown dealing with site and history in relation to regeneration of red and white pine.

A tentative map of detailed cover types and sites was prepared for the Headquarters Silvicultural Area (project P-242). The programme is intended to set up a series of maps showing landform, soil, cover types, history, lesser vegetation types, productivity, ease of regeneration of pine (including succession), and proposed treatment. New aerial photographs are to be taken for mapping, checking, and further interpretation. W.G.E. Brown

Project H-99: Site classification in Forest Section B.8

The Marathon Paper Mills Limited continued the mapping of site in conjunction with inventory.

Work on sites in conjunction with a growth and yield project (H-69) is proposed in 1955. W.G.E. Brown

Project H-104: Site classification in the Great Lakes--St. Lawrence Region, Section L.4c, Gatineau District

A tentative map of soil and physiographic site, and cover types, was prepared for the Eagle River Research Area of the Canadian International Paper Company. No work is planned for 1955. W.G.E. Brown

Project M-421: Site classification at Green River

Checking and mapping of sites was continued at Green River in conjunction with A.B. Vincent's study of growth and yield. This work will be carried on in 1955 by Mr. Vincent and applied in the ecological field. W.G.E. Brown

Project H-93: Growth and yield on permanent observation areas in 1923 burn, by land types, Upper Lievre

Four additional blocks of 25 plots each were established on the Upper Lievre by the James Maclaren Company, that is, on terrace, shallow till, moist till, and sand/shallow till land types. In 1955 the original blocks 9, 10, 11, and 12 will be relocated. W.G.E. Brown

Project M-83: Bathurst Company growth and yield survey

Plots established some years ago on the Upper Nipisiquit were visited. The project is to be abandoned because individual plots are on more than one site, in more than one cover type, and poorly distributed. Tentative site typing was carried out and material for a report on site was collected.

Subsequent to this a course on site was given to the students and staff of the Faculty of Forestry at the University of New Brunswick. W.G.E. Brown

Petawawa Forest Experiment Station

Forest Research Division Forestry Branch

Chalk River, Ontario

Superintendent: C.C. Thomson

Research Foresters	Assigned Problems
E.S. Atkins*	23
M.G. Bowen**	23
J.L. Farrar***	18
D.A. Fraser	18
J.W. Fraser***	18, 19
M.J. Holst	20, 21, 70, 72
K.T. Logan***	18, 19

*This officer transferred to Alberta District Office 1 April, 1955

**This officer transferred from the Maritimes District Office, 1 April, 1955

***These officers attached to Head Office Unit, Ottawa, but work chiefly at Petawawa

PETAWAWA FOREST EXPERIMENT STATION

Summary

Studies to determine the growth and vigour of mature trees and rates of movement of the translocation stream and uptake of nutrients by healthy and decadent trees, using radioactive isotopes, were continued on an 8-acre experimental area. Associated ecological observations were made.

A review of literature was made for a new project on the physiological aspects of flowering in spruce, and an experimental area was selected.

Projects dealing with the responses of tree species to varying conditions of moisture, light and temperature were continued by means of closely controlled and well instrumented experiments. Experimental sites ranged from the forest, where control of conditions is most difficult, through a nursery area, to a greenhouse, where a high degree of control was possible.

Arrangements for a detailed study of a frost pocket included measurements of micro-climate, a detailed vegetation map, and smoke tests of air drainage.

The spruce-breeding program emphasized the investigation of material established in plantations and elsewhere as a preliminary to determining the chief problems facing the geneticist. Numerous races of white spruce were sampled in northern Ontario and Quebec. Seed of various provenances of red and black spruce was obtained. Scions from elite white spruce were grafted. A red pine provenance experiment was sown in the nursery. An experiment on interspecific grafting of jack, red and Scots pine was initiated.

The woodlot management project was continued, and preliminary work was done on a new project which is to consist chiefly of the practice and demonstration of silvicultural cutting methods on an area of about 1,000 acres.

Experimental spraying of broadleaved foliage with different combinations of equipment, chemicals and concentrations, was continued to determine best practices for local requirements.

White pine reproduction, as influenced by site, was studied on various cut-over areas.

An outline of the year's work by problems and projects follows.

Problem 18

DETERMINING THE DIFFERENTIAL RESPONSES OF TREE SPECIES TO THE ENVIRONMENTAL FACTORS

Progress in silviculture will be considerably hastened if a fund of knowledge is assembled showing how the different tree species respond to the factors of the environment. Information is gained through controlled experiments, and by studies under field conditions. The factors now under study are light, heat, soil moisture, and ventilation, separately and in combination. Internal functions of the tree are being studied using radioactive isotopes.

Project P-15: Petawawa Herbarium

One-hundred and eighty specimens were collected, identified, and mounted during the field season by A.W.H. Damman. In many instances specimens were mounted both in the conventional manner and by the Gelva process. Ninety-two of the collected specimens were in flower; 46 were fruiting. The system of mounting mosses in plastic-lidded metal display boxes was initiated. A complete post-binder index was prepared. The specimen folders were re-organized into smaller units to facilitate their use. J.W. Fraser

Project P-152: Preparation of a guide for the identification of tree seedlings

The project was initiated by experimenting with techniques for photographing seedlings in the juvenile and mature stages in the same picture. The juvenile stock was nursery-grown from seed of known origin; mature stock was collected in the field. Different methods of portraying pertinent identification features were also tried.

Mock-ups of pictures obtained to date were prepared for study, and the format, photographic procedure, scope, etc., of the project were approved. Limited distribution of currently available material was proposed.

J.W. Fraser

Project P-361: The effect of light and ventilation on the growth of seedlings under controlled or artificial conditions

The purpose of this project is to demonstrate, by controlled or artificial means, the effect of light on the growth of seedlings. Several techniques are being tried, including growing seedlings beneath screens, growing seedlings between parallel walls, adding electric light to suppressed seedlings in the woods, and shading leaders of selected trees. Because of interaction problems, other factors such as ventilation, soil moisture, and temperature must also be studied. A small experiment to demonstrate the separate effects of light and wind on root growth of red pine seedlings showed that reducing light resulted in considerably shorter roots and fewer growing tips, whereas increasing wind resulted in only a slight reduction in root growth. In one experiment it was necessary to prune five to ten-year-old white pine seedlings. It was found that if two whorls were left, growth was comparable to unpruned seedlings, but heavier pruning reduced height growth and leader diameter. Where only terminal buds were left, height growth was reduced but needles were longer and leader diameter greater than usual.

A technical note is being processed for publication.

K.T. Logan

Project P-366: A study of the effect of environmental factors on the germination of native tree species

Under this project considerable exploratory work was carried out with various types of temperature measuring equipment to determine the most satisfactory techniques for measuring temperature in any of the several mediums where it constitutes an important environmental factor. The results are being

written up for limited distribution as a basis for further discussion on the subject. Binder 918 contains 4 short reports on this study.

J.W. Fraser

Project P-370: Growth of seedlings in relation to soil moisture

This is a general project devoted to the development of the techniques related to the study of soil moisture. A wax seal of paraffin-vaseline on the surface of soil in a waterproof container was found to have small effect on root growth; this vindicates the use of this technique in experiments on the water relations of plants. Experiments on the absorption of water through leaves suggested that only wilted plants absorbed water in this manner, and the quantity so absorbed was small. Four strains of red pine and four strains of white spruce were tested for drought resistance by growing them in containers and withholding water. Although the test continued until about half of the seedlings died, no differences between strains were evident.

J.L. Farrar

Project P-371: Growth of white pine seedlings under aspen stands

Several light conditions were created in an aspen stand by cutting the overstory and underbrush. Four-year-old white pine seedlings were planted in the treated areas. Results show a steady reduction in height growth and in leader diameter with an increase in cover, but there is no marked difference in seedlings on moist, somewhat moist, and very moist sites. Other ages and species were planted to study differential responses of seedlings. The effects of the cutting treatments on environmental factors, such as light, soil moisture, soil temperature, and air temperature are also being studied.

K.T. Logan

Project P-372: Frost resistance of young seedlings

Work continued on the determination of micro-climate in the Centre Lake frost pocket. Instrumentation was established to obtain data on temperature, evaporation, ventilation, etc. Recording temperature-humidity instruments were positioned to measure extreme conditions. Detailed measurements were carried out at half-hour intervals on selected occasions. Soil pits were dug and the soils described. The vegetation was studied in detail and recorded on contour maps. A report on the vegetation study is being revised for publication.

Mature pine seedlings were transplanted on north, south, and west exposures at the same elevation to study their subsequent behaviour. Juvenile stages of pine and spruce, grown in wax-sealed test tubes so that the soil moisture conditions could be reasonably controlled, were set out in various places in the pocket and subjected to natural frost conditions to determine apparent variations in resistance associated with soil moisture around the root system. The data have been summarized and will be presented in an interim report.

J.W. Fraser

Project P-373: The relative ability of tree species to absorb water from the soil

Work was continued using the dual-culture technique developed previously. The essential feature of this technique is that a part of a plant's root system is grown in an isolated mass of soil in a water-proof container where the moisture content of the soil is measured by electrical-

resistance soil-moisture apparatus. Previous results were confirmed in that a portion of a plant's root system dried the soil around it to the permanent wilting percentage but no further, as long as the plant was not wilted. However, when transpiration was prevented by immersing the leaves in water, the dried soil was made wetter than the permanent wilting percentage.

The importance of the permanent wilting percentage as a reference point on the soil moisture scale is confirmed; only those roots in soil which is moister than the permanent wilting percentage contribute growth water to the plant.

A dissertation entitled "Movement of Water between Tree Roots and Soil", which is the report on this project, was submitted to Yale University in candidacy for a doctorate. J.L. Farrar

Project P-375: Ecological studies in a hardwood stand at Chalk River with special reference to the condition of birch

The 1954-55 winter was characterized by abundant snowfall and lack of a midwinter thaw. Frost penetration of the soil was limited to the upper three inches. Winter shrinkage in radial measurements amounted to as much as thirty thousandths of an inch in some trees.

A manuscript entitled "Ecological Studies of Forest Trees at Chalk River, Ontario, Canada, II Ecological Conditions and Radial Increment" (Binder 1120, 24 pages) was completed and submitted for publication. The third part of this series, on soil moisture and soil temperature in relation to climatic fluctuations, is being prepared for publication as a Forestry Branch Technical Note. D.A. Fraser

Project P-376: Soil-moisture-temperature relations of young birch trees

Fiberglas soil units used in field studies are being calibrated using the wilting point index as indicated by sunflowers and birch seedlings. D.A. Fraser

Project P-377: Measurement of movement and distribution of radioisotopes in healthy and decadent trees

A frozen aqueous solution of rubidium 86 carbonate was inserted into a number of yellow birch and sugar maple roots and trunks on February 3, 1955. Movement of sap accompanied thawing temperatures of mid-March. Increment cores, in addition to the portable scintillation counter, are being used to determine the path of movement of the radioisotope within the tree. D.A. Fraser

Project P-381: A study of the effect of soil moisture and soil temperature on the germination of tree seed

An attempt was made to determine a satisfactory reference point for the moisture treatments. The three soils selected were silty-sand, coarse sand, and mull, all of which were steam-sterilized and air-dried prior to their use in replicated treatments for wilting point tests. Simultaneously, several techniques to maintain soil at fixed moisture levels within different temperatures were tried. Progress beyond this stage was precluded by non-delivery of essential equipment, and by unforeseen difficulties encountered in the wilting point tests. J.W. Fraser

Project P-383: The effect of light on the growth of white pine seedlings

Formerly included under Project P-361, this project is limited to a study of white pine seedlings growing in five light conditions in a nursery. Results to date indicate a definite reduction in leader length, leader diameter, and branch length with increasing shade. Maximum needle length occurs in partial shade. Environmental factors are also being studied. This project will be concluded in the fall of 1955 at which time the roots will be measured and a report prepared for publication.

K.T. Logan

Project P-385: Physiological study of factors influencing flowering in spruce

A comprehensive review of the literature on the physiological aspects of flowering was completed. A plot of white and black spruce on different moisture regimes was established for detailed study. Initial work on the effect of photoperiod and antiauxins on inducing flower formation will use young spruce trees of Petawawa origin. D.A. Fraser

Problem 19

TO DESCRIBE AND INTERPRET FOREST CONDITIONS IN TERMS OF THE ENVIRONMENTAL FACTORS

This is a companion problem to Problem 18. Both problems deal with the environmental factors: light, temperature, soil moisture, and ventilation. Problem 18 deals with the effect of these factors on the plant; Problem 19 deals with the occurrence of these factors under natural conditions and their modification by silvicultural procedures. For examples, Problem 18 deals with the effect of frost on seedlings. Problem 19 deals with the occurrence of frost in relation to topography, soil conditions, air conditions, forest cover; and the reduction of frost damage through silviculture. Thus far, work on this problem has been confined to that which is essential for progress on projects under Problem 18.

Project P-371: The effect of light on the growth of seedlings under field conditions

and

Project P-372: Frost resistance of young seedlings

These are reported under Problem 18.

K.T. Logan
J.W. Fraser

Problem 20

SELECTION, BREEDING, AND GENETICS OF SPRUCE

Current work is concentrated on the investigation of material established in plantations and elsewhere in order to obtain a better idea of the patterns of variation in spruce, particularly of growth in relation to climate.

Project P-131: Study of racial and clinal variation in red spruce

Fourteen provenances of red spruce were obtained from representative areas from North Carolina to the Province of Quebec. This material was sown in the spring of 1954 at Petawawa Forest Experiment Station. Similar experiments with seed supplied from the Petawawa seed bank are in various stages of progress in the nurseries at Acadia, N.B., and Valcartier, P.Q.

The following paper was written:

Notes from a trip to the Southern United States, January, 1953. Submitted for publication in Forestry Chronicle. C. Heimburger and M.J. Holst. 27 pages. M.J. Holst

Project P-132: Study of racial and clinal variation in the white spruces of the Great Lakes--St. Lawrence Forest Region

Phenological observations of provenances of white spruce grown at the Station were carried out. From data compiled during the summer, it is evident that typical differences exist. A temperature-latitude cline is clearly indicated, and a summer precipitation cline, mostly effective in eastern Canada, is strongly suspected.

To obtain more information on the clines in existance in the area adjacent to the tree-breeding station, 33 races of white spruce were sampled in 1953 in an area covering Southampton in the south, Cochrane in the north, Kapuskasing to the west and the St. Maurice River to the east. At the same time, 46 extremely broad and extremely slender types of white spruce were sampled to investigate wood productivity of broad and slender types respectively. The selected trees were fall-grafted to perpetuate the types. Seed from these collections was sown in the fall of 1953 and observations carried out on the seedling development during the summer of 1954.

One hundred grafts were made of a white spruce population sample from Alberta. M.J. Holst

Project P-133: Location, recording, testing and preservation for the future, of superior phenotypes of white spruce in the Great Lakes - St. Lawrence Forest Region

In 1953 the Canadian Pulp and Paper Association co-operated in provenance studies and the selection of superior phenotypes of white spruce in the Great Lakes - St. Lawrence Forest Region. Cone production was

extremely low over most of Ontario and Quebec, and only a few seed samples were obtained for the provenance experiment. Using a new technique of fall grafting, it was possible to locate and collect scions from 24 elite white spruce, and make about 1,340 grafts of this material. Data were also collected for a future pamphlet on selection of elite white spruce. The following report was written:

> Field trip for the selection of superior white spruce in Northern Ontario and Western Quebec, during August, September and November, 1954. M.J. Holst and C.W. Yeatman. File report (Binder 1169). 15 pages. M.J. Holst

Project P-134: Study of racial and clinal variation in black spruce

Seed of ten black spruce provenances, from Nova Scotia, New Brunswick, Northern Ontario, Northwest Territories and Wisconsin, were sown in the spring of 1954. The more extensive collections of black spruce provenances are being held in the seed bank until nursery and plantation sites are available for these experiments. M.J. Holst

Project P-135: Investigation of the red spruce - black spruce problem

Some observations of red spruce - black spruce introgression were made during the field trip in western Quebec in November 1954, and are reported in the record of the trip (see Project P-133). Further detailed work is to be carried out on this project; to this end a branch and cone herbarium collection box was designed, and 200 boxes were made and delivered. These boxes are also to be used for other coniferous collections.

M.J. Holst

Project P-136: Provenance experiments with Norway spruce and other exotic spruces

Through the Danish Foresters Seed Association, seed was obtained from Norway spruce stands selected for good form and growth rate. Some of this seed was sown locally and some was distributed to various co-operators in Ontario and Quebec. It is hoped that plantations established with this material eventually will be available in a great variety of climates for the benefit of tree-breeding programs.

The following material was obtained and grafted in the winter of 1953-54.

377 grafts - selected Norway spruce provenances from Humlebak, Denmark
25 grafts - Picea orientalis, Rochester, New York
145 grafts - elite (slender) Norway spruce of German origin, grown in Sweden M.J. Holst

Project P-137: Breeding of weevil-resistant and frost-hardy Norway spruce for eastern Ontario and elsewhere

Selection of Norway spruce resistant to the white pine weevil was continued. Single trees of a slender genotypical crown type are apparently

highly resistant, but by no means immune. Several such slender types have been found on the Station area and these have been propagated for future use. Plantations near Grenville and St. Jovite, Quebec, and in New York, are under observation for future selection. An attempt has also been made to hybridize the susceptible Norway spruce with the resistant white spruce, but after several years' work not one hybrid plant has been obtained. Attempts are now being made to establish a crossing bridge from Norway spruce to white spruce via Sitka spruce for transfer of the weevil resistance from white spruce to Norway spruce.

The spruce pollinating work was very limited this year owing to absence of flowers. The few flowers that could be found in white spruce and Norway spruce were saved for pollination with Sitka spruce. Most of the Sitka pollen was saved for pollinating white spruce in a northern and later flowering area (Cochrane) for production of winter-hardy white spruce × Sitka spruce hybrids. (Danish and German Sitka × white spruce hybrids have not been hardy at Petawawa.)

Two hundred and fifty Sitka × white spruce hybrid scions from the Arboretum, Horsholm, Denmark, were grafted in the winter. The slender Norway spruce listed in P-136 will be useful in this project also. Two hundred grafts were made from weevil resistant Norway spruce found near Grenville, P.Q.

The following reports were written:

Breeding for weevil resistance in Norway spruce. The New York Forester. 1954. M.J. Holst. Note, 3 pages.

Breeding for weevil resistance in Norway spruce. Submitted for publication in Zeitschrift fur Forstgenetik und Forstpflanzenzuchtung to appear in 1955. M.J. Holst. 16 pages. M.J. Holst

Project P-138: Investigation of flower inducing techniques for spruce

Forestry transplants of Norway spruce and white spruce were potted in three soil mixtures of differing pH; 5.4, 6.0 and 6.5. When established in the pots, the plants will be subjected to a series of "shock" treatments designed to induce flowering. M.J. Holst

Problem 21

SELECTION, BREEDING, AND GENETICS OF HARD PINES

Red pine has been the mainstay of most reforestation programs in Eastern Canada. So far it has been free from insects and diseases except in the mild winter regions where the European shoot moth is a serious pest. It has usually been planted in pure stands, and occasionally "off site", and often the source of seed is not known.

Scots pine has been widely planted in the northern part of the North American Continent, and with very little consideration of the provenance problems of this species. As a result, most foresters regard Scots pine as

worthless, except perhaps as Christmas trees. It is quite likely however that Scots pine has a place on poor lands in any cool climate.

Jack pine is of increasing importance in the Canadian forest economy. From a breeding standpoint very little is known about this excellent species. As its output from provincial nurseries has been increased considerably over the last few years, further investigation of its variability is desirable.

Sections were written for inclusion in a white pine--red pine monograph (Problem 41) as follows: (a) Strains and other genetic features, (b) Pertinent features of morphology, (c) Flowering and cone development, (d) Seed crop and seed dispersal, (e) Vegetative propagation. M.J. Holst, 9 pages.

Project P-139: Study of racial and clinal variation in red pine

Since 1950 an effort has been made to get together seed of suitable red pine races for provenance experiments. Seed was sown during 1951-52-53, and the main experiment including 18 provenances selected from the more important red pine regions was sown in the spring of 1954.

Red pine nursery experiments were measured, and although not very satisfactory, owing to site variations, the measurements showed variation in vigour that was correlated with a summer temperature index.

Two provenance experiments were planted, one in the field and one in the nursery.

In order to establish a collection of red pine grafts with scions taken from the flowering part of the crown, and therefore capable of flowering within a few years, 1,889 grafts were made in June 1954, with 17 provenances. Although the collection is not yet complete, it is intended to use the material for provenance hybridization. To have flowering trees of different provenances assembled in one place is much easier than trying to make hybrids with pollen shipped in for that purpose, because pollen often spoils in shipping (too wet when collected). Climatic data for the various provenance experiments were assembled.

Fifty grafts of red pine were made in the fall of 1953, and this trial was followed in the fall of 1954 with a grafting experiment using 106 grafts.

The following report was written:

Spring grafting of population samples of red pine. (Binder 1101). File report, 15 pages. M.J. Holst

Project P-140: Study of racial and clinal variation in jack pine

Jack pine provenance experiments in the nursery were measured, and the measurements were tested against a summer temperature index.

Three plantations were established with jack pine provenance material, one locally, one on KVP Company limits at Espanola, and one at Valcartier Forest Experiment Station. M.J. Holst

Project P-141: Provenance experiments with exotic hard pines

Observation plots of various strains of Pinus nigra, and also Pinus mugo and Pinus densiflora, were planted in P.A. 106, P.F.E.S.

Experiment 43, Comparison of Austrian, Corsican, and Japanese red pine, was planted at Claremont, Ontario. M.J. Holst

Project P-142: Finding, recording, testing and preserving for the future of superior phenotypes of red pine

Experiment 38, a single tree progeny test of local red pine, was planted in P.A. 106; 1,960 plants were used in the experiment, 632 in the shelter rows; 0.94 acres were involved. M.J. Holst

Project P-144: Breeding of hard pine types resistant to European pine shoot moth

No cones were obtained from the rather extensive hard pine crosses done in 1953. The Scots pine and Mugo pine flowers were killed by a late spring frost, and the red pine cones were heavily attacked by the red pine cone beetle (Conophtorus resinosae). Although trees were sprayed in the spring and the cones bagged with cotton dipped in DDT, it was obvious that beetle damage had ruined the cones in their first growing season. It is therefore necessary to drench the trees, or to protect the conelets or cones both in the first and second growing seasons.

Six hard pine crosses were made in the spring of 1954 on rootstocks and grafts in the greenhouse.

In the winter of 1953-54, 264 grafts of Pinus nigra from Italy, Spain, Algeria, Hungary and the Crimea were prepared. In addition, 74 grafts of the group Lariciones from Rochester and the Arnold arboretum were made.

The following paper was written:

The breeding of hard pine types resistant to the European shoot moth (Rhyacionia buoliana Schiff.). Submitted for publication in Forestry Chronicle. M.J. Holst and C. Heimburger, 17 pages. M.J. Holst

Project P-145: Investigation of flower-inducing techniques for hard pines

Lots of 40 transplants of red pine and Scots pine were potted in three soil mixtures of differing pH; 5.4, 6.0, and 6.5. When established in the pots, the plants will be subjected to a series of shock treatments designed to induce flowering. M.J. Holst

Project P-146: Interspecific hybridization in the group Insignes

The following crosses (14 crosses and 613 bags) were made out-of-doors in the spring of 1954:

Pinus banksiana × (*virginiana* / *palustris* / (*contorta* *latifolia*)

Pinus contorta latifolia × (*virginiana* / *palustris* / *banksiana*)

Pinus sylvestris (Riga) × (*Thunbergii* (Rochester, N.Y.) / (*densiflora* (Midhurst) / (*Thunbergii* × *densiflora* (Morris Arb.) / (*densiflora* × *sylvestris* (Morris Arb.)

Four hundred and forty-six grafts were made of lodgepole pine × jack pine hybrids scions from natural hybrid scions in Alberta and controlled hybrids from Placerville. M.J. Holst

Project P-147: Selection of the perfect Scots pine Christmas tree

Three hundred grafts were made with lots of 30 scions from each of 10 selected trees obtained from Mr. W.E. Nodwell, Courtland, Ontario.
M.J. Holst

Problem 70

SELECTION, BREEDING, AND GENETICS OF MISCELLANEOUS CONIFERS

This problem is concerned mainly with exploratory investigations into the hardiness of rare conifers of potential value. Important Canadian conifers on which a small amount of tree-breeding work is done are included.

Project P-148: Provenance experiments in white pine and testing of the pines belonging to the section Cembra and Paracembra

Experiment No. 32 with 10 provenances of white pine was planted in station Planting Area 104. M.J. Holst

Project P-149: Breeding of larch suitable for uplands in eastern Ontario and elsewhere

This work was confined to sowing the following seed lots in the nursery: four lots of European larch from Europe, two from Austria and two from Poland; the seed from three European larch growing at the Station; tamarack seed from the Station, Angus and Bancroft; and 6 controlled European larch × tamarack crosses. M.J. Holst

Problem 72

DEVELOPMENT OF TECHNIQUES AND THE MAINTENANCE OF FACILITIES FOR TREE BREEDING

The service projects essential for administering the tree breeding program, and the projects dealing with exploratory investigations of new techniques, are pooled under this problem.

Project P-4: Aquisition and distribution of plant material

Pollen and scions of Populus tremuloides were sent to Sweden, Denmark and France. White spruce and Sitka × white spruce hybrid seed was sent to Oregon and British Columbia to be used to investigate whether or not this material is resistant to the Sitka spruce weevil.

Collections of seed from northern and rather inaccessible areas were organized for the benefit of Finland and Greenland.

Other small requests for plant material were filled.

M.J. Holst

Project P-51: Nursery work

Approximately 45,000 2-0 seedlings were transplanted. Fifty-eight per cent of these were pine, 38 per cent spruce and the rest a variety of cedar, hemlock, and larch. Forty-four thousand 2-2 spruce are ready for transplanting to experimental plantations.

Work in the nursery was greatly facilitated by the acquisition of a farm tractor and other implements, including two ploughs, two toothed harrows, a disc harrow and a transplant furrower.

Almost 7,000 grafts were made of spruce and pine. M.J. Holst

Project P-60: Technique in forest tree breeding

Vegetative propagation is of the utmost importance in the development of the tree-breeding program. Collections of provenance and strain material must be established and seed orchards developed. Much time was spent investigating fall grafting of spruce and pine, and June grafting of red pine.

The following reports were written:

Performance of rootstocks and grafts in a timing experiment with fall and winter grafting of Norway and white spruce. (Binder 1117). 20 pages.

Scion storage and graft protection in the spring grafting of red pine. M.J. Holst. (Binder 1101). 15 pages. Submitted for publication as a Technical Note.

Greenhouse grafting of spruce and hard pine at Petawawa Forest Experiment Station. (Binder 1144). 31 pages. Submitted for publication as a Technical Note. M.J. Holst, J.A. Santon, and C.W. Yeatman. M.J. Holst

Project P-61: Establishment and maintenance of experimental plantations related to tree breeding

Seven experimental plantings were made in 1954; all were pine, and are listed under the appropriate projects.

Plantation areas have been cleared and cultivated and are ready for planting in the spring of 1955. They are: (1) a provenance experiment with Lake States jack pine; (2) spruce experiments; and (3) a pine-graft arboretum. M.J. Holst

Problem 23

INTENSIVE MANAGEMENT ON SELECTED SUSTAINED YIELD UNITS

Relatively small forest areas, on which intensive silviculture and management can be conducted, are part of the Station research program to provide for practice, observation, and demonstration.

Project P-82: Corry Lake woodlot

This is a 60-acre woodlot managed for a sustained yield. The annual selective cutting of a compartment was completed as provided for in the woodlot management plan. E.S. Atkins
M.G. Bowen

Project P-230: Intermediate management unit

Unforeseen extension of military training areas placed the unit in an artillery range danger area and the project was abandoned.
E.S. Atkins
M.G. Bowen

Problem 24

SILVICULTURAL TREATMENTS OF STANDS

The importance in Canadian forestry of cutting and other silvicultural treatments is rapidly increasing. There is need for more practice of cutting methods to aid the development of silvicultural skills and to discover the methods best suited to various conditions. Treatments must be tested and compared.

Project P-237: Use of chemicals in applied silviculture

Preliminary tests with a light fog-making device were disappointing. It was hoped that it could be used in foliage spraying to obtain better coverage with less solution. A series of tests was made during the summer of

1954 on different species, using several concentrations. The results have not been fully evaluated but indications are that the "swing-fog" in its present form is not satisfactory for this purpose.

A small experiment on chemical treatment of stumps was done in association with the spraying. Results will be available later.

The following reports were written:

The use of chemicals to release white pine reproduction. E.S. Atkins. (Binder 1186). 9 pages.

Susceptibility of certain trees of Eastern Ontario to basal bark sprays. E.S. Atkins. (Binder 1185). 4 pages.

E.S. Atkins
M.G. Bowen

Project P-242: Headquarters silvicultural area

An area of some 1,000 acres in the vicinity of the headquarters has been set aside, a preliminary plan for the project has been written, and a site map prepared to assist in applied silviculture.

Emphasis is being placed on the silvicultural treatment of stands on specific sites. Sustained yield will not be an immediate objective.

Work proposed for the next two or three years is as follows:

1. Preparation of maps showing all data useful for silvicultural operations
2. Selection of areas to be treated
3. Establishment of a road system
4. Preparation of a comprehensive silvicultural plan and related working plans.

E.S. Atkins
M.G. Bowen

Project P-378: Reproduction on cut-over pine stands on specific sites

Thirty-five 1/5-acre plots were laid out and measured in cut-over areas. Data have been summarized and show distinct differences in development of white pine reproduction on various sites. The results will be prepared for publication.

E.S. Atkins
M.G. Bowen

Ontario Research Unit

Forest Research Division Forestry Branch

238 Sparks Street

Ottawa

Officer-in-Charge: G.H.D. Bedell

Research Foresters	Assigned Problems
J.R.T. Andrews	46, 50
A.B. Berry	41, 44, 47
G.C. Cunningham	42, 53
J.M. Jarvis	42, 53
D.W. MacLean	44, 45, 47
R.J. McCormack	41
W.M. Stiell	41, 48, 49

ONTARIO RESEARCH UNIT

Summary

The preparation of a bulletin on the white and red pine cover type in Ontario and Quebec was continued. Many physiographic, vegetative, and climatic factors were taken into consideration in the site classification system used, but for presentation these factors were synthesized into a few site groups.

Preliminary results of experimental direct seeding of white and red pine on sandy outwash areas indicate that: (1) improved results were obtained by using red lead as a repellent; (2) seeding at depth was more successful; and (3) red pine gave better results than white pine.

The influence of local climate on the phenology of white and red pine is being studied at Petawawa. Preliminary results indicate that: (1) differences in phenology and growth follow a definite pattern; (2) evaporation is a good measure of exposure; and (3) the duration of temperature differences is more significant than absolute differences in extremes.

Present cutting practices do not favour the regeneration of yellow birch. The amount of skidding per unit area does not create enough suitable seed-beds, and the removal of a few trees per acre does not provide sufficient light for seedling development. A cutting experiment was established in the Haliburton district, in 1953, to study means of correcting this condition. Preliminary results show (1) that yellow birch stocking is more than 75 per cent on treated areas, and 30 per cent on untreated; and (2) that seedling height growth is much better on the treated sections.

A cutting experiment has been established on Manitoulin Island to improve the quality of maple growing on calcareous soils. Defective trees have been marked for removal so that the residual canopy will shade about 60 per cent of the ground. Logging or poisoning of defective trees will be carried out in 1955.

Preliminary empirical yield tables have been prepared for black spruce stands growing in Forest Sections B.4 (Ontario and Quebec) and B.9 (Ontario).

A reconnaissance was made of the land types in Forest Section B.7 (Quebec). One hundred and eighty-five additional yield plots were established in this forest section in 1954 by the Consolidated Paper Company and the Canadian International Paper Company, to improve the sampling of our co-operative growth and yield study.

Experiments with jack pine were carried out on the West Branch Spanish River to determine the amount of seed required for regeneration of controlled-burn areas; and cone-bearing jack pine slash was scattered on mineral soil exposed by scarification of a recent cut-over.

White spruce were planted by three methods as part of a Research Council of Ontario co-operative planting project. Thirty-four acres of red pine plantations at Petawawa were thinned in accordance with the annual thinning program. Marking was to remove 40 per cent of the basal area by clearcutting every fifth row, and by selectively thinning the intervening rows.

A digest of legislation and regulations for provincial and federal forests was begun in 1953, and has been summarized up to December 31st, 1954.

The present edition of "Native Trees of Canada" is being revised for reprinting. Forty range maps have been revised and information on rooting habits has been added.

Photography for "Forest Flora of Canada" has been completed, and 600 negatives are available. A brief description of the range in Canada, for each species to be illustrated, has been prepared.

Problem 41

SILVICAL CHARACTERISTICS AND APPLIED SILVICULTURE IN THE WHITE AND RED PINE COVER TYPES IN ONTARIO AND QUEBEC

The white and red pine cover types, once so abundant in Eastern Canada, are fast disappearing. Before effective action can be taken to halt this trend, information is required on the silvical characteristics of the species forming the cover types, and on practical silvicultural methods for regenerating them.

Experiments are being established on those land types where regeneration is more easily obtained, in order to establish techniques. It is expected that these techniques can then be modified and adapted to the more difficult land types. The long-term objective will be to develop better methods of regenerating the white and red pines, and of improving their growth on the sites on which they normally occur.

Current work is directed toward the preparation of a bulletin which will contain information on the distribution, ecology, growth, and applied silviculture of the species. The results from early experimental work have been summarized.

Project H-87: Preparation of a bulletin on the red and white pine cover types in Ontario and Quebec

The data from two summers' fieldwork in Ontario and western Quebec and from permanent sample plots at the Petawawa Forest Experiment Station, some of which have been remeasured periodically since 1918, have been compiled and analysed. Physiographic, vegetative, and climatic factors were taken into consideration in the site classification system used, but for presentation the sites have been grouped into a relatively small number.

A close relationship was found between the distribution of pine and the climate, soil texture, soil depth, and topographic position. There was an inverse relationship between potential yield of a site and the ease of regeneration. On a similar site red pine was found to have faster height-growth than white pine for the first 50 years; thereafter white pine grows faster. The differential growth rates were correlated with the site groups.

The bulletin will include sections on ecology, silvics, tree breeding, growth, yield, natural regeneration after disturbances, artificial reproduction, management, and protection from insects and diseases.

Publication was scheduled for 1955, but has been postponed until 1956. This was necessary because the difficulty of assembling the information was greatly under-estimated.

1954-55 Reports

(1) A Tentative Division of the Forest Sections Within the Great Lakes - St. Lawrence Region on a Physiographic Basis. W.G.E. Brown. (Binder 1005). 44 pages.
(2) Ecology of the Type: A. Site Requirements; B. The Pine Sites; C. Succession in the Pine Types. W.G.E. Brown. (Binder 1123) 34 pages.
(3) Root Systems of White and Red Pine. W.G.E. Brown. 5 pages.
(4) The Red and White Pine Associations. W.G.E. Brown. 34 pages.
(5) Seedling Requirements. J.W. Fraser. 6 pages.
(6) Germination and Seed-bed Conditions. J.W. Fraser. 8 pages.
(7) Genetics, Morphology, Seed Development, and Dispersal. M.J. Holst.
(8) Red and White Pine Reproduction in the Physiographic Divisions of the Great Lakes--St. Lawrence Region. K.T. Logan. (Binder 1065). 19 pages.
(9) Growth and Yield (Chapter 3). R.J. McCormack. (Binder 1126). 38 pages.
(10) Intermediate Cuttings. Part 1: Planted Stands. W.M. Stiell. (Binder 1103). 24 pages.
(11) Intermediate Cuttings. Part 2: Natural Stands. R.J. McCormack. (Binder 1104). 14 pages.
(12) Review of Applied Silvicultural Research in the Red and White Pine Types. R.J. McCormack. (Binder 1121). 8 pages.
(13) Forest Products Specifications. R.J. McCormack. 5 pages.
(14) History of Utilization. G.C. Wilkes. (Binder 1165). 22 pages.

Project P-379: Direct seeding of red and white pine under aspen stands on sandy, outwash areas

Many fluvial outwash areas present a particular problem in regeneration because of the absence of pine seed sources and the presence of unmerchantable aspen. To find a cheap and successful method of regenerating this landtype to red or white pine, several methods of seeding, and the planting of different ages of nursery stock, are being experimented with. Several methods of seeding, with and without rodent repellents, were also tested.

Preliminary results indicate that a red lead repellent gave improved results. Seeding at depth was more successful. Red pine appeared to be better suited to this landtype than white pine. The survival of seed-bed stock, and particularly that of red pine, was high, but further survival data are required before final conclusions can be drawn. R.J. McCormack

Reports

(1) Establishment Report. R.J. McCormack. (Binder 1142). 15 pages.
(2) Progress Report--1954 Results. R.J. McCormack. (Binder 1143). 23 pages.

Project P-380: The influence of local climate on the phenology of red and white pine

It is a well-established fact that the regeneration of pines is much more difficult on some aspect-positions than on others. This is partly due to the nature and abundance of competing species, but all species are influenced by the local climate. A study of phenology and growth, assisted by limited measurement of climatic factors through instrumentation, is being carried out on a series of aspect-positions.

Differences in phenological and growth characteristics have been relatively small to date, but follow a rather definite pattern. Evaporation has been found to be a good measure of exposure. The duration of temperature differences was found to be more significant than absolute differences in extremes. R.J. McCormack

Reports

Establishment Report and Preliminary Results, 1954. R.J. McCormack. (Binder 1166). 31 pages.

Problem 42

DEVELOPMENT OF PRACTICAL SILVICULTURAL METHODS FOR THE MANAGEMENT OF TOLERANT HARDWOOD STANDS

Most tolerant hardwood stands are all-aged associations in which yellow birch and sugar maple are the predominant species. The maple is mostly defective, or contains mineral stain, and the cut consists mostly of yellow birch. This leaves a residual stand of defective maple which is at present only useful for such products as dissolving pulp, firewood, and charcoal. The development of chemigroundwood pulp will alter the situation, but it seems unlikely that much defective material will be utilized for some time. These overmature and defective trees suppress the advance growth and saplings so that they, in turn, become defective before reaching maturity. To meet the problem, silvicultural treatments should be developed to ensure a greater representation of sound trees.

Research to date has consisted mostly of observations and studies to determine the reasons for the poor quality of sugar maple and the failure of yellow birch regeneration on cut-over areas. The poor quality of maple results from interacting factors, of which suppression during early life and soil fertility are among the most important. The scarcity of yellow birch regeneration is mainly due to seed-bed conditions and to the inability of birch to compete with sugar maple advance growth, particularly under the dense residual canopies.

Ecological observations will be continued, and an attempt will be made to develop treatments suitable for regenerating the various sites to species capable of producing merchantable timber. A long-term project will be to develop methods of improving the growing conditions for young trees and for saplings already established.

Project H-77: Forest development in the Goulais River watershed

The Goulais River Observation Area was established in 1920 by the Commission of Conservation, to obtain information on stand development and regeneration following cutting. On the abolition of the Commission the area was taken over by the Dominion Forest Service, now the Forestry Branch. Sample plots have been remeasured periodically, and in 1949 a report was published which summarized stand development changes from 1910 to 1946.

Cutting rights were recently granted on part of the area, and 52 plots were in danger of being destroyed. These plots were remeasured in October, 1954. The remaining plots are to be relocated in 1955 and remeasured in 1956.

G.C. Cunningham
J.M. Jarvis

Project H-84: The quality and quantity of tolerant hardwood reproduction in the northern part of the maple/birch/beech region of Forest Section L.4, with special reference to the occurrence and abundance of yellow birch

In 1951 and 1952, surveys were conducted in the northern part of the Great Lakes--St. Lawrence Forest Region of Ontario and Quebec, to obtain information on the condition of cut-over tolerant hardwoods and their proper silvicultural management. The results indicate that sugar maple is dominant in the reproduction, and also in the main stand, on all sites suited to the tolerant hardwood associations. Although maple was abundant, it was found that it was nearly all defective. Most of this defect is caused by fungi entering young trees through breaks in the bark. Good quality maple was found only on deep argillaceous till soils, and on moderately shallow soils that had weathered to good loams.

Yellow birch is not as aggressive as sugar maple, and is mostly confined to areas where maple competition is least. Yellow birch reproduction was scarce on all of the areas studied. Most of it was found on logs, stumps, skid trails, and areas where leaf litter was either lacking or had been disturbed. In general, more yellow birch reproduction was found on the moister sites.

It was evident that present cutting practices do not favour the regeneration of yellow birch. The amount of skidding per unit area does not create enough suitable seed-beds, and the removal of only a few trees per acre does not provide sufficient light for seedling development. Other species were relatively scarce, and reproduced most abundantly on sites where sugar maple competition was weak.

G.C. Cunningham
J.M. Jarvis

Reports

An Ecological Approach to Tolerant Hardwood Silviculture. J.M. Jarvis. (Binder 1150). 56 pages.

This report, which will be published, gives the results of the survey. It describes the ecological characteristics of the hardwood species, and makes recommendations for the silvicultural management of hardwood associations.

Project H-92: Cutting and seed-bed preparation to improve the stocking to yellow birch in tolerant hardwood stands near Dorset, Ontario

This is the first of three such experiments to be undertaken in co-operation with industry. It is a practical follow-up to observational studies.

The area was selected in July, 1953, on freehold land belonging to Hay and Company, Limited, in Eyre and Havelock Townships near Haliburton. Four 10-acre sections were established in September, two being for treatment and two for control. The stands for treatment were marked to ensure the removal of all timber of merchantable sizes and to leave a uniform residual canopy shading 30 to 40 per cent of the ground. Logging and scarification was carried out by the Company. Scarification was done with a D-6 caterpillar tractor, equipped with a bulldozer blade. The marked trees, left by the loggers, were girdled.

An establishment report summarizing results to date and making recommendations for further work has been submitted. Results are: (1) yellow birch stocking is more than 75 per cent on treated areas, and 30 per cent on untreated; (2) seedling height growth is much better on the treated sections.

In the fall of 1954, Hay and Company scarified another area of about 10 acres, located 4 miles from the main project.

G.C. Cunningham
J.M. Jarvis

Reports

Progress Report--Cutting and Seed-bed Preparation to Improve the Stocking to Yellow Birch in Tolerant Hardwood Stands, Haliburton County, Ontario, 1953. J.M. Jarvis. (Binder 1176). 57 pages.

Project H-94: Removal of defective trees to improve the yield of maple growing on calcareous soils--Manitoulin Island, Ontario

Sugar maple and beech are numerous in nearly all the tolerant hardwood stands in Ontario and Quebec. On siliceous soils most maple, and nearly all beech, are so defective that they cannot be profitably utilized in the manufacture of high grade products. The yield of valuable timber is usually greater per unit of area on argillaceous and calcareous soils, but cull and other non-merchantable trees still comprise an appreciable part of the stocking. The basic reason for the superiority of these soils is not known, but is probably due to the superior nutrient regime.

Most of the defect in maple and beech is caused by fungi which enter through broken branches, scars, and bark injuries caused by whipping or by falling branches. The production of good quality maple requires the removal of the defective stems so that good ones have sufficient room to grow without injury.

This third experiment has been undertaken to follow up the findings from the first two, and to test their applicability to stands growing on calcareous soils.

The experiment is being established in two phases. In October, 1954, four 10-acre sections were established and tallied. Two treatment sections, and two controls, were chosen at random. Defective trees on the treatment sections were marked for removal so that the residual canopy would shade only about 60 per cent of the ground.

The second phase will be undertaken in May, 1955, and will include:

(a) Girdling and poisoning the trees marked in 1954 for removal;
(b) Establishing and tallying a series of permanent one-fifth-acre plots;
(c) Mapping the main canopy coverage and preparing a site type map for the area.

This is a long-term project and conclusive results will not be available for some time.

G.C.Cunningham
J.M. Jarvis

Problem 44

SILVICULTURE AND MANAGEMENT OF THE BLACK SPRUCE COVER TYPE

Most of the work has been concerned with growth and yield studies conducted in co-operation with the Provinces and with the pulp and paper industry. Some ecological studies are being made in connection with work in the intolerant mixedwood cover types.

Cut-over areas usually reproduce satisfactorily; but where advance growth is lacking at the time of cut, reproduction is often a failure. As mature rather than overmature stands will make up a larger proportion of the future cut, it is expected that the situation will become more serious.

Project H-78: Northern Clay Belt growth and yield survey

This project was undertaken in 1951, as an additional test of the stand density method of preparing yield tables. Two hundred and twenty semi-permanent plots were established by the Forestry Branch in 1952. Together with plots established by the Spruce Falls Power and Paper Company Limited, and some additional sampling that is being done by the Abitibi Power and Paper Company Limited, these should give an adequate sample of the six forest types which represent about 80 per cent of the productive forest.

A report will be published in 1955. A copy of the report is available on short-term loan (Binder 1070). 43 pages.

Black spruce yield tables based on single measurement were prepared, and volume tables were mimeographed for limited distribution.

D.W. MacLean
G.H.D. Bedell

Reports

(1) Preliminary Empirical Yield Tables for Black Spruce, Forest Sections B.4 (Ontario and Quebec) and B.9. G.H.D. Bedell, D.W. MacLean, and W.G.E. Brown. S. and M. 55-2. 17 pages.

(2) Preliminary Volume Tables for the Northern Clay Belt, Ontario and Quebec. A.B. Berry and D.W. MacLean. (Binder 1163). 17 pages.

Problem 45

SILVICULTURE AND MANAGEMENT OF THE INTOLERANT MIXEDWOOD COVER TYPES

In the Boreal Forest Region of Ontario, the intolerant mixedwood cover types occur mostly on the most productive sites, and they are a major source of wood for forest industries in that area.

The cover type consists of various mixtures of trembling aspen, white birch, black and white spruce, and balsam fir. Each species has different silvical characteristics, and management practices tend to discourage spruce and to favour one or more of its associates. This situation is causing concern to pulp and paper companies and to governmental agencies. As a result, considerable interest exists in the development of silvicultural systems more favourable to spruce.

A few cutting experiments have been initiated, but more are needed--especially in stands of rotation age.

Ecological observations have been continued, and should eventually provide information which will be useful in planning additional silvicultural experiments. Growth and yield studies have also been continued in co-operation with industry and with the Ontario Department of Lands and Forests.

Project H-69: Nipigon growth and yield survey

Work in 1954-55 was limited to instructing company foresters in site classification and the site typing of 130 yield plots. D.W. MacLean
G.H.D. Bedell

Project H-89: Harvest cutting methods and seed-bed preparation for the regeneration of softwoods, Heron Bay, Ontario. (PPRIC Project RC-17)

This cutting experiment, in an overmature stand near Heron Bay, is to increase softwood regeneration, and particularly spruce, on the mixedwood slopes of Northwestern Ontario. The project began in 1953, and eight organizations (the Ontario Paper Company Limited, the Abitibi Power and Paper Company Limited, the Ontario Department of Lands and Forests, the Research Council of Ontario, the Pulp and Paper Research Institute of Canada, the University of Toronto, the Forest Biology Division of the Federal Department of Agriculture, and the Federal Forestry Branch) have co-operated in planning and carrying out the work.

Ecological studies were mostly concerned with the 1954 seed crop, and with changes in the environment brought about by the logging operation of the preceding year. The studies are continuing. D.W. MacLean

Reports

The Black River Experimental Area Second Ecological Report. D.W. MacLean. S. and M. 55-1. 7 pages.

Project H-103: Ecology of the aspen--birch--spruce--fir type in the Boreal Forest Region of Ontario

Information is being obtained that will be useful as a background for more intensive silviculture. An observational assessment is being made of the effects of environmental factors on the development of the various species. Particular emphasis has been given to the influence of these factors on the establishment and survival of reproduction.

Work was started in 1953, in Forest Section B.8 (Central Transition), and in 1954 it was extended to Forest Section B.4 (Northern Clay Belt). A progress report is being prepared. D.W. MacLean

Problem 46

SILVICULTURE AND MANAGEMENT OF THE JACK PINE COVER TYPE

Jack pine, because it commonly retains its cones unopened, is difficult to reproduce naturally without the use of fire. The principal requirements to ensure satisfactory regeneration are: (1) an adequate seed supply; (2) a mineral soil seed-bed; and (3) favourable moisture conditions. A regeneration technique that will provide these requirements is urgently needed.

Growth and yield studies are being carried out in order to provide data for the preparation of yield tables that will show the productivity of the more important jack pine sites.

J.R.T. Andrews (in company with N.F. Lyon of the Ontario Department of Lands and Forests) visited the Longlac, Marathon, and Abitibi Limits, to study the work on jack pine regeneration.

Messrs. Andrews and Cunningham visited the Lake States to study the work on jack pine regeneration and tolerant hardwood silviculture. They also attended the Forestry Field Meeting of the Woodlands Section, C.P.P.A., and Mr. Andrews gave a paper on jack pine regeneration.

Project H-65: Experimental cuttings to obtain jack pine regeneration (co-operative with KVP Co.)

This project involves various methods of cutting and of seed-bed preparation. J.L. Farrar

Reports

Jack Pine Reproduction. J.L. Farrar, D.W. Gray, and D. Avery. Pulp and Paper Magazine of Canada. 55(12): 136, November, 1954.

Project H-72: Growth and yield studies in Forest Section B.7 (Quebec) (co-operative with James Maclaren Company, Consolidated Paper Corporation, Canadian International Paper Company, and E.B. Eddy Company)

Messrs. Brown and Bedell made a reconnaissance of the land-types occurring in Forest Section B.7 (Quebec). Mr. Brown has completed the descriptions of these land types, made sketches of the soil profiles,

and prepared a table correlating the vegetative and physiographic site types. A report is being prepared.

The Consolidated Paper Company established 125 yield plots, and the Canadian International Paper Company established 60 yield plots during the year. In this connection, J.M. Jarvis made a trip to Clova to discuss details of plot establishment.

G.H.D. Bedell
W.G.E. Brown
D.W. MacLean

Project H-74: Silvicultural characteristics of jack pine

It has been established that: (1) partial shade is beneficial to jack pine germination; (2) conditions favouring a high moisture content in the seed result in good germination; and (3) humus is a poor seed-bed because it provides poor moisture conditions.

This work was carried out at the Petawawa Forest Experiment Station.

J.W. Fraser
J.L. Farrar

Reports

(1) Effect of Shade on Jack Pine Germination. J.W. Fraser and J.L. Farrar. Silv. Leaflet 88. 3 pages.
(2) Effect of Watering, Shading, Seed-bed Medium, and Depth of Sowing, on Jack Pine Germination. J.W. Fraser and J.L. Farrar. Silv. Leaflet 90. 4 pages.
(3) Germination of Jack Pine Seeds on Humus. J.W. Fraser and J.L. Farrar. Silv. Leaflet 91. 2 pages.

Project H-75: Management plan for the West Branch Spanish River Unit (in co-operation with KVP Co.)

Work in 1954-55 consisted of the following: (1) establishment of a test plantation for 16 provenances of jack pine; (2) broadcast seeding a controlled-burn area (1953) in four intensities, one on each of four 5-acre blocks; and (3) scarifying a recent cut-over with a bulldozer, and scattering cone-bearing slash on the exposed mineral soil.

A seeding experiment was established to test the value of treating jack pine seed with red lead to reduce damage by rodents and birds.

Equipment was developed for burning the tops of individual seed trees. This consisted of a flame thrower nozzle mounted on a 60-foot magnesium-aluminum pole. The tree is sprayed with kerosene and then ignited. Further studies will be made on the practicability of the equipment.

J.R.T. Andrews

Reports

(1) Preliminary Field Work on Jack Pine Regeneration, KVP Company, May 4-28, 1954. J.R.T. Andrews. 12 pages.
(2) Preliminary Field Work on Jack Pine Regeneration--Longlac, Marathon, and Auden--July 3-17, 1954. J.R.T. Andrews. (Binder 1084). 10 pages.

(3) Preliminary Field Work on Jack Pine Regeneration, KVP Company Limits, September 20 to October 9, 1954. J.R.T. Andrews. (Binder 1107). 12 pages.

(4) Remarks addressed to the Forestry Field Meeting, Woodlands Section, C.P.P.A., on 19 August, 1954, at Port Arthur. J.R.T. Andrews. 4 pages. Quoted in the Pulp and Paper Magazine of Canada, October, 1954, p. 146.

Project H-93: Growth and yield of permanent observation blocks, Upper Lievre (in co-operation with James Maclaren Co.)

Some of the plots on the more recent observation blocks were site typed. W.G.E. Brown

Reports

Forest Growth in the Upper Lievre River Valley, 1930-1951. R.J. McCormack. Silv. Leaflet 92. 4 pages.

Problem 47

GROWTH AND YIELD METHODS

The idea of empirical stand density yield tables has met with considerable favour, as it gives promise of dealing successfully with even-aged "wild forests". This is largely due to the basic idea of using a numerical standard of density (either SDI or basal area) that is not subjective and that allows for all degrees of stocking.

The growth and yield studies of the Ontario Research Unit are mostly concerned with improving this type of yield table, and in investigating the application of forest classification methods in preparing and applying the yield tables.

During the past six years the federal Forestry Branch and co-operating companies have established about 1,700 semi-permanent growth and yield plots in four forest sections. This sampling is probably adequate for research purposes, but a number of companies are establishing additional plots to improve the sampling for the preparation of yield tables. In order to avoid duplication of effort, the Ontario Research Unit is co-ordinating this work, and has on various occasions provided instruction in plot establishment and the identification of site features. It will also, where sampling is adequate, undertake to prepare the yield tables by forest sections.

The field techniques which have been developed seem to be satisfactory, but office techniques require further research. A large amount of effort is expended in the preparation of local volume tables, and it is desirable that this procedure, with the ultimate aim of using IBM machines for compilation work, should be simplified. With this end in view, an investigation of methods of preparing height/diameter curves has been undertaken, and should be completed in 1955-56. It is a part of a long-term plan of work which has recently been drawn up.

Reports

Growth and Yield Technique - Ontario Research Unit: Work Plan - Progress Report - Probable Course of Future Research. G.H.D. Bedell. 10 pages.

Problem 48

ARTIFICIAL REGENERATION OF POTENTIALLY PRODUCTIVE LANDS

During the past year the work with this problem was limited to some experimental planting and the preparation of two reports.

Project H-91: Survival and development of plantations established by pulpwood companies in Ontario and Quebec (co-operative C.P.P.A.)

"Co-operative Plantation Survey - Interim Report" was distributed by the Canadian Pulp and Paper Association (C.P.P.A., W.S. Comp. 11-54, 9 pages).
W.M. Stiell

Project P-235: Survival and development of plantations

A report "The Petawawa Plantations" (Binder 1078) 57 pages was prepared and is being processed for publication. W.M. Stiell

Project P-239: Afforestation of old farms near Chalk River (co-operative Atomic Energy of Canada Limited)

Over-winter failures averaged 8 per cent in the plantations established near Chalk River the previous year. The dead specimens were replaced with 25,000 red pine. The survival of the replacements varied from 92 to 99 per cent at the end of August. Favourable weather at planting and during the growing season doubtless contributed to these satisfactory results.
W.M. Stiell

Project P-241: The effect of planting method on survival and development of spruce (co-operative Research Council of Ontario)

Fifteen hundred white spruce were planted by the full-saddle, half-saddle, and wedge methods. Two blocks of 30 rows each were used for the experiment, and within each block the 10 rows for each planting method were selected at random.

The site and the weather were both favourable, and at the end of the growing season differences in growth and survival were not sufficient to indicate superiority of any one planting method.

The experiment was repeated in September, to test the three methods for fall planting. W.M. Stiell

Problem 49

SILVICULTURAL TREATMENT OF PLANTATIONS

Experiments in respect to this problem involved thinning, pruning and debudding in plantations at the Petawawa Forest Experiment Station. In addition, effects of previous treatments were observed and measured.

Project P-220: Debudding of red pine, PSP's 214, 215, 222A, 222B, and 293

PSP 293 was debudded and the leaders were measured.

W.M. Stiell

Project P-240: Management of plantations, Petawawa Forest Experiment Station

The annual thinning program for red pine plantations continued and Cutting Unit 2 (34 acres) was thinned. Forty per cent of the basal area was removed by cutting every fifth row and by thinning the intervening rows selectively. The trees were felled and limbed with axes and the logs were skidded in bundles, with a Ford farm tractor, to a portable skidway where they were bucked into pulpwood with a power saw. Two hundred crop trees per acre were pruned with pole saws to a height of 17 feet. This work was carried out by a 5-man crew, directed by a forest assistant.

W.M. Stiell

Problem 50

TO ASCERTAIN THE PRESENT STATUS OF FOREST MANAGEMENT IN CANADA

It is necessary to have clear interpretation of existing forest legislation and regulations in order to understand forest management in Canada. With this background information it would be possible to study the forest management practices of representative companies and governmental agencies, in order to furnish material for an analysis of problems, and to give some idea of the intensity of management now in effect.

Project H-86: Forest management practices in the pulpwood forests of Canada

A digest of forest legislation and regulations of the provinces and of the federal government was begun in 1953. Legislation in effect up to December 31, 1954, has now been summarized in draft form. These summaries are given for each province and for federal lands. Each chapter gives a short history of the development of legislation and administration in the province concerned, a general idea of the extent of forest land (by tenure), and a summary of the principal acts and regulations. The final chapter contains a discussion of all forest legislation.

J.R.T. Andrews

Problem 53

"NATIVE TREES OF CANADA" AND "FOREST FLORA OF CANADA"

Project H-61: Native Trees of Canada

The present edition is being revised for reprinting. This involves:

(1) Replacing some 40 range maps with revised copies.
(2) Revising the Latin nomenclature.
(3) Rewriting portions of the text to incorporate information on rooting habits, cover changes made in the distribution maps, and eliminate a few inaccuracies.
(4) Replacing some of the poorer photographs.

G.C. Cunningham

Project H-88: Forest Flora of Canada

The photography for this publication has been completed. After culling, six hundred negatives were retained. The checklist of Latin, English, and French names has been reviewed, and most of the Latin nomenclature has been approved. Some work remains to be done on the English and French Sections, particularly for species known under several names. A brief description of the range in Canada, for each species to be illustrated, has been prepared. G.C. Cunningham

Reports

(1) A Checklist of Plants to be Included in Forest Flora. G.C. Cunningham. 29 pages.
(2) Wildlife and Forest Research. G.C. Cunningham. 3 pages. Paper delivered at Wildlife Conference, June 15-16, 1954.

Newfoundland District Office

Forest Research Division Forestry Branch

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St. John's, Newfoundland

District Forest Officer: D. E. Nickerson

Research Foresters	Assigned Problems
W.A. Dickson	26, 27
J.M. Gill	25, 27
W.C. Wilton	27, 28

NEWFOUNDLAND DISTRICT OFFICE

Summary

The major silvicultural research activity in this District in 1954 centred on the carrying out of two large-scale cutting experiments on pulpwood limits in co-operation with local paper companies, and the establishment of a number of experiments on a 50-acre area of representative coastal forest.

The cutting experiments are being carried out to determine the effect of clearcutting and partial cutting in 40-to 60-year-old stands of balsam fir on one area and black spruce on the other. Two five-man survey parties were required for the entire field season to lay out the experiments.

The 50-acre experimental area was established on representative coastal forest lands of the Avalon Peninsula. Small-scale cutting experiments were carried out on this area; these included clearcutting in strips, thinning and pruning. Other experiments involved different methods of site preparation for seeding and planting. One four-man field party was engaged on this work for the major part of the field season.

Re-examination of direct seeding plots on the Hampden burn revealed no appreciable loss of 1953 balsam fir seedlings. However, an examination of plots on the Avalon Peninsula, on which similar work had been carried out in 1953, revealed severe seedling mortality due to frost action. Remeasurement of a planting experiment and periodic examination of phenological stations established in various sections of the province in 1953 were continued.

Other new projects, started in 1954, included the establishment of a small-scale nursery near St. John's, a direct seeding experiment on a scarified area of heath barren, leaf analysis of chlorotic and non-chlorotic balsam fir, and initial work in connection with site classification. An examination of an area at Harpoon River, where an experimental cutting study had been carried out in 1925, was also completed.

Manuscripts which were submitted for publication during the year dealt with a three-year study of Avalon Peninsula forestry problems and with the results of a direct seeding experiment on a cut-over and burned area in western Newfoundland. Work is continuing on a proposed publication entitled "Forest Reproduction in Newfoundland".

PROBLEM 25

DEVELOPMENT OF A FOREST SITE CLASSIFICATION FOR NEWFOUNDLAND

There is at present no adequate system of forest site classification for Newfoundland. Forestry Branch work has revealed a pressing need for a site classification system, not only as a basis for yield studies but also as a basis for research in cutting methods and reforestation.

The initial attack on the problem will consist of testing the applicability to Newfoundland conditions of various systems of forest site classification developed elsewhere. This will be followed by the actual classification of limited areas for illustration purposes.

Project NF-17: Preliminary regional phenological comparisons

This work, which commenced in 1953, consists of collecting phenological data for certain tree, shrub, and herb species, at six widely distributed locations in Newfoundland. An attempt is being made to find possible correlations between these phenomena and the climatic data for each location.

A progress report, covering work in 1954 has been prepared. (Binder 1137) 36 pages.

J.M. Gill

Project NF-20: Development of a forest site classification for Newfoundland

Active work on this project began in 1954. The first year's work was mainly observational, since it was felt that no attempt should be made to develop a site classification system until a fair knowledge of the various vegetation types of Newfoundland had been acquired.

Six weeks were spent in a tour of the Northern Peninsula, and a memorandum on the ecological status of the heath barrens was prepared.

During the winter, three tentative systems of site classification, applicable to Newfoundland conditions, were prepared. These systems will be tried out and tested in the field, in various regions of the island, during the 1955 field season.

J.M. Gill

Project NF-33: Chlorosis investigation

During February and March, 1955, through the facilities extended by the Memorial University of St. John's Newfoundland, the mineral content of chlorotic and non-chlorotic balsam fir needles was investigated. The chlorotic leaves were found to contain much less phosphorus, less iron, less potassium, but more calcium, compared with the healthy leaves. A series of fertilization trials is planned for the 1955 field season.

A memorandum summarizing the results of the leaf analysis has been prepared.

J.M. Gill

PROBLEM 26

DEVELOPMENT OF CUTTING METHODS FOR PULPWOOD LIMITS

Clearcutting in Newfoundland is, and probably will remain, the most common cutting method used in the harvesting of pulpwood. One paper company has found that dense black spruce stands on the South West Gander River drainage do not adequately reproduce when clearcut. As a result these stands are being progressively cut in 100-foot-wide strips.

The first two of a series of co-operative large scale cutting experiments by the Forestry Branch and industry began in 1954. The work is being carried out in stands of fir on one area, and spruce on another, both of which are somewhat younger than those in which the companies normally operate. These experiments will be duplicated during the 1955 field season.

One object of the work is to determine whether or not immature stands can be economically logged and yet reproduced to desirable tree species. The response to treatment of the residual stand on the partially cut blocks and its removal in later years are other aspects of the study.

These areas were selected from four areas examined in 1953 in connection with Project NF-15, "Planning of a Large Scale Experimental Cutting Program for Pulpwood Limits".

Project NF-21: Large-scale cutting experiment, No. 1

Fifteen square blocks, each ten acres in size, were established in 56-year-old stands of black spruce on the Badger Division of the Anglo-Newfoundland Development Company Limited. Three blocks were clearcut in accordance with local standards, three blocks were partially cut, and three other blocks were laid out as uncut control. In the partially cut blocks, 40 per cent of the volume was marked for cutting. Although cutting concentrated on the largest trees, care was taken to see that an even and relatively uniform canopy would be present in the residual stand.

To complete the establishment of the project, three more blocks will be clearcut, and three other blocks will be partially cut, during the 1955 field season.

A memorandum has been prepared covering the 1954 field work.

W.A. Dickson

Project NF-22: Large-scale cutting experiment, No. 2

Fifteen square blocks, each ten acres in size, were established in 40-to 60-year-old stands of balsam fir on the northwest shore of Deer Lake on freehold limits of Bowater's Newfoundland Pulp and Paper Mills Limited. Three blocks were clearcut in accordance with local standards, three blocks were partially cut, and three other blocks were laid out as uncut control.

In the partially cut blocks, 40 per cent of the volume was marked for cutting. Although cutting concentrated on the largest trees, care was taken to see that an even and relatively uniform canopy would be present in the residual stand.

To complete the establishment of the project, three more blocks will be clearcut, and three other blocks will be partially cut, during the 1955 field season.

A memorandum has been prepared covering the 1954 work.

W.A. Dickson

PROBLEM 27

DETERMINATION OF SUITABLE SPECIES AND TECHNIQUES FOR REFORESTATION IN NEWFOUNDLAND

Approximately one-third of the total land area of the Island of Newfoundland is non-forested. Furthermore, about half of the forested area is classed as non-productive. Many of these areas once supported commercial tree growth, but as a result of burning and over-cutting, they are now man-made barrens. Undoubtedly many of these areas could be brought back into production. The problem is to find the most suitable species and to develop the proper reforestation techniques.

The research approach to this problem involves selection of species, selection of planting sites, and the development of proper techniques for reforestation of the different sites by direct seeding or planting. The search for suitable species will be continued, and concentrated effort will be applied to the determination of a method for classifying planting sites. Through use of small-scale test plots, reliable information will gradually be accumulated to serve as a foundation for any large-scale reforestation effort which may be undertaken later.

Project NF-10: Experimental seeding, Cormack burn

This project was started in 1950 to determine the relative values of three methods of direct seeding, using black spruce seed, on a 1949 burn in western Newfoundland. Broadcast seeding on the snow, broadcast seeding on the ground, and seedspotting were tried out in the experiment.

Broadcast seeding on the snow and seedspotting have both been successful, but when the amount of seed required for equivalent success is considered, seedspotting gave by far the most satisfactory results.

It is proposed to use the permanent sample plots for a stand development study to be set up in 1959 as a separate project.

Work in 1954 consisted of the preparation of a manuscript for publication. (Binder 1149) 10 pages.

W.A. Dickson

Project NF-11: Direct comparison of various species and classes of planting stock on non-forested areas

Twelve permanent sample plots, each 100 feet x 100 feet, were established in the spring of 1952, in groups of three, in four districts on the Avalon Peninsula. These plots are fenced, and one-half the area of each plot was planted with various species and strains of planting stock obtained from the Salmonier Nursery. In 1953, due to the lack of suitable planting stock, the remainder of the area was seedspotted in accordance with a prepared plan.

An establishment report was prepared in 1952 and progress reports in 1953 and 1954 (Binder 1055) 27 pages. Annual examinations will continue as long as warranted.

W.C. Wilton

Project NF-14: Experimental planting in peat lands

The preparation of a planting site on fairly well-drained peat soil, by cutting furrows with an agricultural land-breaking plough, was attempted in 1953. This equipment proved unsatisfactory. No further work on the project has been done this year, but another attempt, using modified equipment, will be made in 1955.

J.M. Gill

Project NF-18: Experimental seeding, balsam fir

This experiment, established on a 1952 burn, was designed to determine the relative merits of broadcast seeding and seedspotting.

Eight permanent sample plots, 45 feet x 35 feet in size, were established in 1953. The balsam fir seed used in this experiment was obtained from the Green River Management Area in New Brunswick.

Results of examinations made in 1953 and 1954 indicate that seedspotting is superior to each of the three degrees of broadcast seeding when the relative amounts of seed used is considered.

A progress report covering the 1954 work has been prepared. (Binder 1141) 13 pages.

W.A. Dickson

Project NF-24: Establishment of a small-scale nursery

This project was undertaken to fill the need for suitable planting stock within this district. Three hundred square feet of seed-bed surface was prepared and seeded to a number of exotic species in 1954. An equal amount of seed-bed surface will be seeded this year.

An establishment report has been prepared. (Binder 1125) 9 pages.

W.C. Wilton

Project NF-27: Heathland site improvement (Torbay)

This experiment is designed to test the effects of four methods of eradicating heath plants and four methods of manuring on the establishment and growth of planting stock. A total of 3.2 acres of well-drained heathland was laid out in blocks, plots, and sub-plots. The main treatment, consisting of four methods of eradicating heath plants, has been completed. The sub-treatment, consisting of replications of four manuring treatments, will be carried out in May, 1955, after the area has been planted with Scots pine.

An establishment report will be prepared.

W.C. Wilton

Project NF-28: Seeding trial of exotic species on prepared plots

Seedspotting of 18 exotic species was carried out on three one-twentieth acre plots. These plots were established on an area which had been clearcut and burned for the purpose.

An establishment report is being prepared.

W.C. Wilton

Project NF-29: Scarification of barren heath site by rock rake

Approximately two acres of barren heathland on the limits of the A.N.D. Company at Terra Nova was scarified by means of a rock rake towed by a D.7 tractor. The area was seeded with 12 lbs. of white birch seed and lesser amounts of Douglas fir, western hemlock, black spruce, and eastern larch.

An establishment report has been prepared. (Binder 1140) 8 pages.

W.C. Wilton
J.M. Gill

PROBLEM 28

NEWFOUNDLAND COASTAL FORESTRY PROBLEM

The principal conclusion of Project NF-1, "Assessment of Bonavista Peninsula Forestry Problems, 1950", was that some form of local proprietorship must be introduced if progress in forest management is to be achieved. It is proposed to attack the problem through co-operation with the Provincial Forestry Division in its efforts to devise forms of local management, and at the same time, to develop silvicultural methods for the areas involved.

Project NF-3: Assessment of Avalon Peninsula forestry problems

This project began in 1951 with a forest growth study. It continued in 1952 with a forest inventory, and in 1953 the field work was completed with a study of depletion.

The final report has been submitted for publication. (Binder 1156).

W.C. Wilton

Project NF-25: Establishment of a series of 50-acre experimental areas

The first of these areas was established near Torbay on the Avalon Peninsula in 1954. The area was surveyed and fenced.

An establishment report has been prepared.

W.C. Wilton

Project NF-26: Experimental cutting of coastal forest lands

This project consisted of a number of small-scale experiments to test cutting methods which might be used in typical low-grade balsam fir -- spruce forest. The experiments included clearcutting in strips, thinning to various degrees of spacing, and pruning.

An establishment report will be prepared.

W.C. Wilton

MISCELLANEOUS PROJECTS

Project NF-7: Regeneration of burned-over areas

Project NF-8: Regeneration in cut-over black spruce fire type stands

While active field work in connection with these projects ceased in 1952 and 1953 respectively, much of the tabular data as well as other results of the studies, are being utilized in the preparation of a proposed publication entitled "Forest Reproduction in Newfoundland".

W.A. Dickson

Maritimes District Office

Forest Research Division Forestry Branch

Federal Building

Fredericton, N.B.

District Forest Officer: H. D. Heaney

Research Foresters	Assigned Problems
M.G. Bowen*	30
M.H. Drinkwater	29, 30, 33
H.G. MacGillivray	29, 32
J.W. McLeod	29, 32
I.C.M. Place	29, 31
A.B. Vincent	29, 30, 31
B.C. Wile	29, 30

* This officer transferred to the Petawawa Forest Experiment Station, 1 April, 1955.

MARITIMES DISTRICT OFFICE

Summary

The emphasis on research in the Maritimes District is on the silviculture of spruce and fir. Much work has been done on the draft of a lengthy publication summarizing the available information relevant to Maritime conditions.

An important project was started at the Green River Management Area to assess the spruce budworm damage to spruce and fir regeneration.

A comprehensive report was completed on the origin, structure, and growth of dense immature fir thickets in northern New Brunswick. The implications of this work are important because of the widespread occurrence of young stands of this kind.

A survey was made of the conditions prevailing in old-field stands of white spruce in Nova Scotia. These stands yield large volumes of material during the first rotation, but it is difficult to keep the areas productive. The survey was aimed at gathering preliminary information for a comprehensive study of their management.

A regional classification of the forests of the Maritimes has been devised and the forest sections and districts delineated. A study of the relationship between height growth, age, and site quality was made at the Green River Management Area. Largely owing to damage from insects, squirrels, frost, and snow, height growth of dominant and codominant trees appears to be an insensitive index of site quality on all but the best and poorest sites.

Long-term research work in the genetics of spruce and fir was continued. More seedlots were obtained for provenance studies. One white spruce and several fir trees which may have some inherent resistance to budworm attack were located. An attempt was made to adapt a serological technique to show the relationships between red, white, and black spruce. Experiments with propagation of conifers by air-layering met with some success.

A comprehensive report on the condition of the tolerant hardwoods in northern Nova Scotia was completed. This contains tentative recommendations for future research.

Work was done on numerous miscellaneous projects including completion of a management plan for the Sheet Harbour Forest, maintenance of 10 managed woodlots throughout the Maritimes, cleaning and thinning of plantations, two experiments in direct seeding, and one on the control of damping-off in the Acadia nursery.

PROBLEM 29

GENERAL SILVICULTURE OF SPRUCE AND FIR IN THE MARITIMES

Because spruce and fir are the most important species in the forest economy of the Maritime Provinces, the silviculture of the types in

which they predominate constitutes the principal field for forest research in this District. Much information has been gathered, but part of it is unpublished, and the remainder is scattered through so many publications as to be virtually inaccessible to most foresters. The problem is to present a synthesis of this information.

Little fieldwork has been started specifically for attainment of this objective during the past year, though most of the work in the District relates to it. For example, some detailed work has been done on site classification at the Green River Management Area, and a regional forest classification has been devised on which to orient discussion. Much work has been done on regeneration. In addition, several members of the staff have reviewed the literature on growth and yield of spruce and fir, artificial regeneration, and the influence of logging methods on silviculture.

A first draft of the publication will be completed in 1955. A contribution on pathology has already been received from the Division of Forest Biology of the Science Service, Department of Agriculture, and one on the entomological aspects is nearly complete.

Project M-53: Selection and diameter-limit cutting in an all-aged coniferous forest, St. Margaret's Bay, Nova Scotia

The stands were destroyed by hurricane Edna on September 12, 1954, and the project was abandoned.

M.H. Drinkwater

Project M-54: Partial cutting in black spruce stands, Stanley, Hants County, Nova Scotia

Damage by hurricane Edna necessitated an unscheduled remeasurement of 33 permanent 1/10-acre sample plots. Fortunately, windfall was not great, and the fallen stems were salvaged.

M.H. Drinkwater

Project M-69: A preliminary survey for the reclassification of the forests of the Maritimes

The survey was started in 1952 to give firsthand knowledge of the vegetation, soil, and geology of the region. This has made possible the preparation of generalized soil maps and the plotting of the ranges of most of the tree species in the region.

With the aid of this and other information, Halliday's classification for the Maritimes has been revised, and new descriptions made of the districts and sections. This information will be incorporated in the monograph on the silviculture of spruce and fir.

Reports

A provisional classification of the forest vegetation of New Brunswick and Nova Scotia. Draft report. H.D. Long. (Binder 1174) 36 pages.

I.C.M. Place
H.D. Long

Project M-75: Silviculture of spruce and fir in the Maritimes - a monograph

This project is a bookkeeping device for referencing and filing correspondence on the monograph. A literature review on the topic has been done by various members of the local staff. A draft of the publication is expected by July, 1955.

I.C.M. Place

Project M-225: Nursery management, Acadia

This is a continuing project set up for cost estimates on the maintenance of the nursery. In 1954, 250,000 2-0 seedlings were given to the New Brunswick Forest Service, and 15,000 were transplanted at Acadia. A number of experiments were conducted in the nursery, and were set up as independent projects.

Reports

Nursery, Acadia. 1952-1954. File report (Binder 1153) 11 pages.
J.W. McLeod

Project M-293: Succession of lesser vegetation at the Acadia Forest Experiment Station

Ten 1/2-milacre chart quadrats were established on several sites in 1948. Some of these quadrats were denuded of humus and vegetation, and others were left as control. They are remapped every second year, and this was done in 1954.

H.G. MacGillivray

Project M-304: Selective, transition shelterwood, and economic clearcutting in a 70-year-old spruce-balsam fir stand, 1949, Acadia

An establishment report was written on this experiment, which is designed to compare different methods of cutting.

Reports

Selective, shelterwood, and economic selection cutting in a 70-year-old spruce-balsam fir stand, Acadia, 1949. File report (Binder 1086) 64 pages.
B.C. Wile

Project M-314: Seed dissemination of spruce and balsam fir

A seed trap experiment at the Acadia Forest Experiment Station was designed to yield information on the duration of seed fall and the distance seeds are dispersed in central New Brunswick. Routine collections and germination tests were made.

Reports

Seed dissemination of spruce and balsam fir. File report. 2 pages.

J.W. McLeod

Project M-317: The use of fire to control the composition of reproduction in spruce-balsam stands

A number of 1/5-acre plots were burned in spring, mid-summer, and early fall of 1951 in an attempt to increase the ratio of spruce to fir in the reproduction on a cut-over area. Work in 1954 consisted of an examination of the plots. Spruce reproduction has increased proportionally, but regeneration is generally sparse and sporadic in occurrence.

B.C. Wile

Project M-422: Balsam fir regeneration trends following moderate to heavy pulpwood cuts in softwood stands, Green River

Routine re-examinations were made of 150 milacre quadrats. The object of the project was to learn whether future stocking can be forecast from early records. Disturbances by animals, and damage incurred during examinations, precluded attainment of the objective, and the project has been closed.

Reports

Balsam fir regeneration trends. File report (Binder 1145) 15 pages.

A.B. Vincent

Project M-425: Diameter-limit cutting on a commercial scale on the Green River Watershed

Reproduction and mortality were tallied three years after cutting twelve 0.4-acre plots in a diameter-limit cutting made by Fraser Companies Limited. Spruce and fir reproduction has not benefited from the treatments. Mortality in the residual stand is great enough to offset any increase in the rate of growth owing to release. Windfall has caused most mortality.

Reports

Remeasurement of mortality, windfall, and reproduction three years after diameter-limit cutting. File report (Binder 1099) 7 pages.

A.B. Vincent

Project M-430: Logging damage to spruce and fir advance growth during pulpwood cuttings, Green River

A comparison of damage incurred during stump cutting and yarding operations. No fieldwork was carried out in 1954. Damage seemed to be related chiefly to the abundance of advance growth before logging, but was not great enough to affect seriously the prospect for a new stand.

Reports

Logging damage to spruce and fir advance growth during pulpwood cutting, Green River. File report (Binder 1093) 17 pages.

A.B. Vincent

Project M-435: Examination of small man-made openings to determine incidence of spruce seedlings

The object was to find out whether microclimatic and seed-bed conditions in small openings cut in the forest favoured spruce seedlings more than fir. Openings 1/40 to 1 acre were examined, together with adjacent uncut plots, but no significant correlations were found.

Reports

Examinations of small man-made openings to determine incidence of spruce seedlings. File report (Binder 1127) 7 pages.

A.B. Vincent

Project M-436: The effects of the spruce budworm outbreak on softwood reproduction

The size and condition of softwood reproduction was examined on 4-milacre quadrats on four 20-acre plots that had been exposed to different intensities of budworm attack. Damage to reproduction so far seems to vary directly with the severity of budworm attack on the overstory; 45 per cent of advance growth more than 1-foot high was dead in a stand heavily defoliated since 1950; only 2 per cent of the smaller seedlings were killed. Yearly examinations will be made while the infestation persists.

Reports

Effects of the current spruce budworm outbreak on spruce and fir reproduction, Green River. File report, 16 pages.

A.B. Vincent

PROBLEM 30

SILVICULTURE OF IMMATURE STANDS OF SPRUCE AND FIR

Dense stands of immature spruce and fir occupy great areas in the Maritimes. Owing to clear-cutting, the current spruce budworm infestation, and the abandonment of farm land, they will occupy much more land. They will not only supply most of the wood of the future, but owing to their age they are the stands most susceptible to treatment.

How and when should they be cut? Should they be thinned, and if so, how and when? What results may be expected from thinning? Can such stands be managed on short rotations without incurring difficulty in getting regeneration? These are only a few of the questions to be answered.

During the past year, a detailed report was completed on the origin and growth of fir thickets in northern New Brunswick. On the rich soils of the north, these stands, if they escape destruction by budworm, will probably provide yields in excess of 20 cords to the acre when they are 80 to 90 years old. Investigations show that density has a great influence on the early merchantable yield of these stands, and suggest the possibility of early thinning to reduce the rotation age. It is possible that dense stands of fir may stagnate on the poorer soils that occur in much of southern New Brunswick and Nova Scotia.

Getting reproduction after cutting is difficult in stands of white spruce on abandoned fields in Nova Scotia. A study was made of conditions prevailing in such stands as a preliminary to a series of cutting experiments in the type.

A start has been made on creating an uneven-aged stand of spruce and fir, of 40 to 50 acres extent, at the Acadia Forest Experiment Station, to compare with adjacent even-aged stands which will be handled in a variety of ways. High-yield silviculture will be the aim.

Project M-77: Silvicultural measures in old-field white spruce stands in Nova Scotia

Difficulty is encountered in getting reproduction after cutting stands of white spruce on abandoned fields in Nova Scotia. In 1954, a survey of this type of stand was made to gather the necessary data for planning cutting experiments to get regeneration. A report is being prepared.

M.H. Drinkwater

Project M-206: Thinning young balsam fir

In 1939, a stand of young balsam fir was thinned to three different spacings. Transect sample plots in each condition, and in an uncut control, have been remeasured at 5-year intervals. Work in 1954 consisted of remeasurement.

B.C. Wile

Project M-321: Intermediate sustained yield unit, 1951, Acadia

Originally, an area of 320 acres was divided into 20 cutting compartments that were to be cut on a 20-year cutting cycle. In 1954, the fourth compartment was marked, cut, and remeasured. For a variety of reasons, the plan is being modified, and the area of the project reduced. The four compartments already cut will continue to be managed to produce an uneven-aged stand, but the cutting cycle is to be regulated according to the needs of the individual stand. Four adjacent compartments will be handled in contrasting even-aged cutting methods.

M.G. Bowen
B.C. Wile

Project M-426: The structure of the balsam fir understory in two-storied stands, Green River

Dense thickets of balsam fir that originated during the spruce

budworm infestation of 1915 to 1919 cover large areas in the Maritimes. This study is aimed at getting a picture of their mode of origin, and subsequent development as affected by density, in northern New Brunswick. Fieldwork was completed in 1953 and the following reports were written in 1954.

Reports

(1) The development of balsam fir stands in the Green River Watershed following the spruce budworm outbreak of 1913 to 1919. University of New Brunswick, thesis for M.Sc. degree. (Binder 1092) 88 pages.

(2) A condensation of the above thesis for publication as a Technical Note (Binder 1161).

A.B. Vincent

PROBLEM 31

DEVELOPMENT OF SUITABLE TECHNIQUES OF SITE CLASSIFICATION FOR THE MARITIMES

Site classification is necessary in the development of sound methods of silviculture and management. It is essential also to long-term planning. It should be a basis for yield studies and a guide to silvicultural practice.

The problem is to develop a technique which can be adapted to any part of the region, and used both by industrial and research foresters. Current plans call for use of vegetation, physiography, and climate. However, plans for the publication on spruce and fir have led to some diversion of effort, and the complexity of the region requires a comprehensive knowledge of the soil, geology, and climate. For these reasons, progress has not been as rapid as was hoped.

Despite this, progress was made during the year. A regional classification of the forests of the Maritimes has been completed, and preliminary descriptions prepared for the various sections and districts. The districts delineated will serve as convenient units in which to establish local site classifications, and all this information will eventually be incorporated in a major publication.

An attempt was made to determine whether the height/age relationship gives a consistent indication of site quality on the Green River Watershed in northern New Brunswick. The results suggest that any correlation between height growth and site which might be indicative of site quality is obscured on the middle range of sites by factors such as the mode of origin of the stand, and damage by insects, animals, frost, and snow. The next step will be to determine whether correlations exist between species composition, basal area, and yield and site. The basic data for this work is largely available from records of the line plots in the research blocks in the area. Remeasurement of the line plots at the Acadia Station will provide a

further opportunity to explore the relationship between site and yield.

Project M-69: A preliminary survey for the reclassification of the forests of the Maritimes

This project has already been mentioned under Problem 29. The reclassification of the forests of the Maritimes is a preliminary to more detailed work in site classification, and the delimiting of sections and districts provides units in which to devise detailed classifications.

I.C.M. Place
H.D. Long

Project M-438: Correlation of the relationship between height, age, and yield of spruce and fir, and site, Green River

A preliminary site classification has been devised for the Green River Management Area. The purpose of this project was to see whether the height/age relationship is sufficiently different on these sites to be a good index of site quality. Data from 25 sample areas suggest that the history of stand establishment, insects, disease, and damage by animals have so modified height growth as to obscure any consistent differences on the middle range of sites.

Reports

A preliminary study of the correlation of the height/age relationship of spruce and fir and site, Green River. File report (Binder 1112) 26 pages.

A.B. Vincent

PROBLEM 32

DEVELOPMENT OF IMPROVED STRAINS OF SPRUCE AND FIR

Because of the importance of the forest industries to the economy of the Maritimes and the accessibility and strong recuperative powers of the forests, great possibilities exist for the practice of intensive silviculture, especially in the spruce and fir types. Spruce and fir are widely distributed, and undoubtedly local races with various desirable characteristics exist. The problem is (a) to locate those strains most fitted to Maritime conditions, (b) to determine which characteristics are heritable, so that the knowledge can be used in cutting the stands to preserve their genetic worth, and (c) to lay a foundation for breeding better trees.

The chief means of accomplishing these ends are to establish provenance tests with diverse lots of seed from throughout the ranges of the species, to locate outstanding trees as potential sources of breeding material so as to make progeny tests of them, and to establish genetic arboreta.

During 1954 and 1955, provenance studies have been mainly concentrated on red and black spruce, although the collection of seed lots of white spruce and fir continues. Efforts to locate elite trees were concentrated on the

search for budworm resistant white spruce and fir, although subsidiary experiments were conducted in air-layering. Tentative plans have been made for testing the frost hardiness of stock of various provenance.

Project M-71: Selection of spruce and fir for resistance to spruce budworm attack during the current budworm infestation

In 1953, a search began for balsam fir and spruce trees that have shown resistance to attack by spruce budworm. So far, efforts have been concentrated in the Green River Watershed, and four fir and one white spruce have been selected for further study. Attempts are being made to propagate these trees by grafting, and the eventual objective is to develop strains resistant to the budworm.

Reports

Selection of spruce and fir for resistance to spruce budworm attack during the current budworm infestation. File report (Binder 1040) 7 pages.

H.G. MacGillivray

Project M-72: Spruce and balsam fir provenance experiments

This study aims at the evaluation of various taxonomic, physiological, and genetic characteristics of red, white, and black spruce, and balsam fir. The method consists of assembling seed lots from different sources and establishing plantations under uniform conditions within the local range of soils and climates. In 1954, cone measurements, measurements of current growth, cotyledon counts, and seed weights were obtained for several lots of spruce and fir. These data have not yet been thoroughly analysed.

Reports

Spruce and balsam fir provenance experiments, 1954. File report (Binder 1071) 21 pages.

H.G. MacGillivray

Project P-131: Red spruce provenance experiments

Thirty-two seed-beds have been reserved in the Acadia Station nursery for sowing seed collected by M.J. Holst of the Petawawa Station. The seed has been stratified and the weight per 1000 seeds obtained.

H.G. MacGillivray

Project M-76: Selecting and testing superior individual spruce and fir trees

Certain trees are outstanding in quality and vigor in comparison with their neighbours, and if possible such trees should be preserved. The object of this project is to locate such outstanding specimens, and to conduct progeny tests with scions and seed from them.

Vegetative propagation is of vital importance, and most work during 1954 centred around induction of aerial layering of branches of spruce and fir. Some success has attended these efforts, and a report will be prepared after the 1955 field examinations.

H.G. MacGillivray

Project M-224: Phenological observations, Acadia

This project was re-opened in 1954, and routine observations were made on several species of conifers, hardwoods, shrubs, and herbs. The object is to obtain a biological yardstick for comparing weather from season to season, to get accurate information on the dates and duration of various phases of plant growth, and to develop phenology as a tool in genetic studies.

H.G. MacGillivray

Project M-334: Evaluation of red and black spruce as distinct species

This study aims at determining whether or not the identity and behaviour of red and black spruce are sufficiently different to warrant their separation, or whether habitat is responsible for most of the apparent differences.

During 1954, efforts were made to develop the technique of serum diagnosis to indicate degrees of relationship. Results so far are inconclusive.

H.G. MacGillivray

Project M-335: Relation between frost hardiness of plants and certain phenological characteristics

In 1954, a study was begun in two white spruce plantations at the Acadia Station which have suffered severely from frost injury. Efforts are being made to find out whether the severity of damage is correlated with such phenological characteristics as the bursting of buds in the spring, the rate of elongation of shoots in early spring, changing of foliage colour, etc.

Reports

Relation between frost hardiness of plants and certain phenological characteristics. File report. 3 pages.

J.W. McLeod

Project M-336: Planting heavily and weakly branched 2-2 spruce seedlings, Acadia

The purpose of the study is to find out whether the tendency of spruce to be heavily or weakly branched at maturity can be recognized during the seedling stage. In 1954, efforts were directed at formulating some objective measure of branchiness in seedlings. A brief progress report has been prepared.

J.W. McLeod

PROBLEM 33

THE MANAGEMENT OF TOLERANT HARDWOODS IN THE MARITIMES

Either the climate of the Maritimes is too severe or much of the soil is too poor for growing sugar maple of high quality. Beech is nearly valueless because of a bark disease. Birch dieback has ruined most of the yellow birch. Owing to these factors, and the high-grading of merchantable stands, large areas of tolerant hardwoods are virtually unproductive. At the request of the Nova Scotia Department of Lands and Forests, the Forestry Branch has assigned a research officer to work in this forest type.

During the past year, a report on a reconnaissance survey of the tolerant hardwoods in Nova Scotia was completed. The conclusions are not reassuring. Sugar maple and beech of poor quality reproduce vigorously on hardwood sites, and tend to increase proportionally as the more valuable yellow birch and the best stems of sugar maple are harvested. One remedy would be to utilize poor hardwoods for pulp, but the immediate prospects for this are not bright. If the birch dieback has ceased, intensive management for growth of yellow birch may be practical in some places. Failing this, the alternatives are to continue growing low-quality sugar maple cordwood or to introduce conifers into the forest. Studies of the reproduction of yellow birch and conversion of stands to softwoods are planned.

A routine re-examination was made of a thinning experiment in sapling stands of sugar maple.

Project M-62: Thinning sapling stands of tolerant hardwoods, Nuttby, Colchester County, Nova Scotia

In 1951, a study was begun of the response of individual saplings of sugar maple to various degrees of release. In 1954, the first of two scheduled remeasurements was made. The results so far are inconclusive, and no detailed report will be made until after the second remeasurement in 1957.

M.H. Drinkwater

Project M-66: A reconnaissance survey of the tolerant hardwood forest types in Nova Scotia

A survey was made in 1952 and 1953 to obtain factual information about the hardwood forest types in Nova Scotia on which to base recommendations for their management. It was found that because of disease and logging, the tolerant hardwood forests of the province are in a derelict condition.

Reports

A reconnaissance survey of tolerant hardwood forests of northern Nova Scotia. Proposed Technical Note (Binder 1147) 46 pages.

M.H. Drinkwater

MISCELLANEOUS PROJECTS

Some projects do not fit into the categories of any of the main problems. The most important of these was the management plan for the Sheet Harbour Area in Nova Scotia.

Projects M-18, 20-22, 24-27, 48 and 49: Managed woodlots throughout the Maritimes

During the war and shortly after, the Forestry Branch undertook to prepare management plans for demonstration woodlots and to mark them annually for cutting. Most of these woodlots are on federal experimental farms or illustration stations. The work takes about a month each year for a party of three or four men.

Reports

Annual report on managed woodlots established in the Maritimes. File report (Binder 1085) 10 pages.

B.C. Wile

Project M-56: Induction of flowering and seeding of red pine by partial girdling, Stanley, Hants County, Nova Scotia

This project was established in 1951, and the cone crop of the treated and untreated trees has been counted each fall, at which time the girdling was renewed. Although the girdled trees have produced more cones than the ungirdled ones, the increase has been small and the treatment is regarded as unpractical with trees approaching maturity. The project will be closed and a report prepared.

M.H. Drinkwater

Projects M-270 and M-271: Planting native and exotic coniferous species, with variations of seed origin within species. P.P.P. 23/41 and 23/42, Acadia

About 10 acres of young spruce plantations were cleaned of competing vegetation in July, 1954. This is the second such treatment. Most of the work was done with brush scythe and axe, but spraying with Esteron 245 was used successfully on two subplots. A short progress report was prepared.

J.W. McLeod

Project M-303: Direct seeding of white spruce and red pine on a non-reproducing area, 1949, Acadia

The purpose of the project was to compare two seeding techniques and one method of seed protection on seed-beds prepared (a) with a grub hoe, and (b) by tractor treads. About one acre of land was involved. In 1954, the survival and growth of the seedlings was checked.

The results were disappointing. Stocking of the red pine seed spots varied from 27 to 83 per cent, depending on treatment, while that of white spruce varied between 15 and 20 per cent regardless of treatment. Growth of both species was poor and further mortality may be expected.

Reports

Direct seeding of white spruce and red pine on a non-reproducing area, 1949, Acadia. File report (Binder 1158) 8 pages.

J.W. McLeod

Project M-324: Direct seeding of white spruce on a controlled burn after clearcutting on a spruce-balsam type, Acadia

The purpose of this small experiment was to determine the effect of covering seed spots with sawdust, and screening on establishment of seedling. Work in 1954 consisted of the third annual measurement of survival and growth. Both the sawdust covering and screening led to marked increase in stocking. Growth has been fair; the average height of the tallest 4-year-old seedlings was 7½ inches.

Reports

Direct seeding of white spruce on a controlled burn after clearcutting a spruce-balsam type, Acadia. File report (Binder 1154) 6 pages.

J.W. McLeod

Project M-331: Interim assessment (1952) of all plantations at the Acadia Forest Experiment Station

Reports

Plantations of the Acadia Forest Experiment Station. Proposed Technical Note (Binder 1100) 34 pages.

J.W. McLeod

Project M-337: Nursery control of damping-off and root rot in first-year coniferous seedlings

Nine treatments were tested for control of damping-off and root rot in red pine seedbeds. With the exception of dusting seed with Crag 658, all treatments significantly reduced seedling mortality. Soil treatments were somewhat better than seed-dust treatments, and seed-beds of sphagnum moss gave the best results of all.

Reports

Nursery control of damping-off and root rot in first-year coniferous seedlings. File report (Binder 1152) 12 pages.

J.W. McLeod

Project M-338: Thinning coniferous plantations

About 20 acres in 10 pine plantations were marked and thinned. About 1½ acres of red pine were marked for pruning of crop trees.

Reports

Thinning coniferous plantations. File report (Binder 1160) 14 pages.

J.W. McLeod

Project M-433: Preliminary planting trials with white spruce on strip roads, Green River, 1953-1957.

The purpose of this project is to find out whether it is feasible to increase the density of stocking and the percentage of spruce in the stand by planting strip roads in stump cutting operations. Three one-acre plots were planted with about 800 2-2 white spruce seedlings in 1953 and 1954. Mortality in the 1953 plots varied from 4 to 33 per cent, and was chiefly owing to competition of ground vegetation and to snow crushing shrubs down onto the seedlings. More planting will be done during the next three years.

Reports

Preliminary planting trials with white spruce on strip roads, Green River, 1953-1957. File report (Binder 1095) 10 pages.

A.B. Vincent

Project M-603: Management plan for the Nova Scotia Forest Management Area

The management plan for a 44-square-mile tract of forest in Halifax County near Sheet Harbour was completed.

Reports

Sheet Harbour Forest Management Plan. File report (Binder 1077) 114 pages.

M.G. Bowen

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Research Foresters	Assigned Problems
J. C. Boynton	36, 37, 39
J. D. Gagnon	34, 35, 40
R. G. Hatcher	36, 37, 39
G. Lemieux	34, 35, 40
A. Linteau	34, 35, 40
J.D. MacArthur	37, 38, 39

QUEBEC DISTRICT OFFICE

Summary

Site classification in the Boreal Forest continued to be an important feature of the research program in Quebec. Additional data to fill out sampling in the less frequently occurring types were gathered in conjunction with the closely allied project, construction of normal yield tables. Twenty five site-types have now been identified, and these are grouped into five broad productivity classes, four of which are merchantable. Site-type studies were resumed in the Great Lakes-St. Lawrence Forest Region. Preliminary investigation at Windsor Mills revealed 15 site-types, four of which had previously been described. More detailed analysis will be made when other localities can be included.

Good progress has been made with the compilation and analysis of measurements and the construction of normal yield tables, to be used with the site-types in the Boreal Forest. More samples from certain age-classes are still required to complete the data. A report on site-types in the Boreal Forest has been completed for publication.

Two more observation areas were established to study regeneration and growth after logging and fire, particularly to find how long it will take to provide for the next cut. One area includes a recent cut and a 30-year burn adjacent to the Portneuf river, which flows into the St. Lawrence. The other area was laid out in the Gaspe peninsula, at the headwaters of the Matane and Cascapedia rivers. It includes, besides recent cutting, 10, 20 and 30-year cuts in which balsam fir was frequently found in dense thickets. A small thinning experiment was made in balsam stands of different ages. Reports were completed for the Portneuf and three other established areas on the Harricanaw, Cyriac and Watopeka rivers. A total of 15 areas has been established, thus completing the first part of the program. Remeasurement starts in 1957.

Management of forest land on the Valcartier Military Reserve has reached the stage where nearly all the mature softwood and most of the good-quality hardwoods have been cut. Consequently, the cut was much reduced last winter, and most of the logging took place on the military side of the river to salvage wood from areas intended for training purposes. A new map of the area southeast of the river has been completed.

The permanent sample plot records at Valcartier have been brought up to date, and are being grouped for analysis of the silvicultural experiments they represent.

The partial cutting at Lake Edward was temporarily suspended because of an unfavourable hardwood market, but a much larger area than in the past will be cut this coming fall to wind up the operation.

The second cutting in the Lake Kenogami experimental area was made last winter, and the plots are to be remeasured this summer. Possible mining activity poses a question as to whether the area will remain undisturbed for another 20 years as had been hoped. The spruce budworm infestation has been particularly severe, almost completely defoliating many of the otherwise thrifty trees left after the first cutting. Most of the large white spruce, 16 inches in diameter or more, had to be cut, as they were showing signs of decadence.

Line-plot sampling in the selection cutting on the Epaule river showed that many patches of younger growth were scattered throughout the sample areas. These line-plots are to be measured every year or two by the co-operating company as a check on growth and windfall. Remeasurement by the Forestry Branch is expected to be made later on. Plots will be established this summer in the clear cut area, which is also part of the experiment.

Black spruce regeneration was investigated along a newly built truck road in the Boreal Forest, Section B-3. Since most of the reproduction in that area results apparently from layering, the occurrence of large numbers of black spruce seedlings in the disturbed soil was interesting. Sampling showed that moss-covered sand was the most favourable seed-bed. A report has been written for publication.

Co-operation in genetic studies includes provenance tests on white pine, jack pine, red spruce and Norway spruce. Some of these are being duplicated by a private company.

Problem 34

SITE CLASSIFICATION

A method of classifying forest sites by their potential productivity is a fundamental requirement for research, silviculture, and management. Site-type investigations have been conducted in the Province, but have been largely confined to the Great Lakes-St. Lawrence Forest Region, whereas forest operations now take place most extensively in the Boreal Region.

Accordingly, in 1949, a study of site was commenced in Forest Section B.1; after six seasons' field work a practical system of site classification has been developed. Twenty-one site types have been identified, and grouped into 5 broad productivity classes, four of which are merchantable. The principal factors making up site have been investigated, including physiography, and physical and chemical properties of the soil, and these have been correlated with vegetation, volume production, and height index.

Project Q-2: Site type classification, Great Lakes - St. Lawrence Forest Region

A preliminary investigation of the site-types of this forest region was made at Windsor Mills, where one block in the Observation Area (about 1,000 acres) was site-typed; and at Cabano, in the course of field work on Project Q-55. Fifteen site-types were identified, four of which had previously been described by Heimburger at Lake Edward, and in addition four others have also been identified in the Boreal Forest Region.

Analysis of these types is being made, but no report will be written at this time since individual sections are only partly sampled.

A. Linteau

Project Q-35: Site-type classification, Boreal Forest Region

The report on this project was again revised and is now being processed for publication.

A. Linteau

Problem 35

SILVICS AND ECOLOGY OF TREE SPECIES

The poor growth in many of the plantations at Valcartier and Proulx has emphasized the fact that too little is known of the site requirements of our principal tree species. Knowledge of these requirements is highly desirable for the planning of silvicultural measures, particularly reforestation.

This offers a broad field of research, and obviously only a few of the many aspects can be selected for study at this time. The popularity of white spruce and red pine for reforestation in the province led to the decision to concentrate upon these two species.

Project Q-52: Soil fertilization in red pine and white spruce plantations at Valcartier

This experiment was begun in October 1952 when white spruce was planted on three series of plots located in the Plains Block, in a frost pocket. In May, 1953, fertilizers were applied and failures were replaced. In October red pine was planted on the same plots.

In May, 1954, red pine failures were replaced, and in October sugar maple slash was scattered on some of the unfertilized plots.

Results to date point to a lower mortality and less chlorosis where potassium and magnesium have been applied. Final conclusions will be drawn later.

A. Linteau

Project Q-55: Soil and site requirements of white spruce in Quebec.

Preliminary investigation in 1953 showed that natural stands of white spruce in the Great Lakes - St. Lawrence Region can be grouped into three site index classes, and that good and poor stands grow indifferently on several soil types, slopes and aspects; but no stands were found on soils with a water table lying less than 15 inches from the surface. Available nutrients are not clearly related to stand quality, but a definite trend was observed for pH, organic matter percentage, and carbon/nitrogen ratio.

A preliminary report was written, and further sampling was carried out in 1954. (Binder 1110) 14 pages.

A. Linteau

Project Q-57: Soil treatment of white spruce in the Proulx plantations

Most of the white spruce plantations established on the sandy plains at Proulx are in poor condition, apparently due to nutrient deficiency. In the fall of 1952, 12 1/40-acre plots were laid out and fertilized by Brown, Holst, Cunningham and Linteau with superphosphate, ammonium nitrate, and potassium chloride, to determine whether the condition of the trees could be improved.

One year later no response could be observed except where potassium chloride had been applied. Experience elsewhere has shown spring fertilizing to be more effective, and accordingly another series of 12 ¼-acre plots was fertilized to potassium and magnesium, potassium, potassium and trace elements, potassium and magnesium and trace elements. In the fall it was observed that some of the treatments had apparently been successful in eliminating the chlorosis which had previously been evident, but that needle and twig growth had not changed.

An article on the Proulx plantations is being prepared for publication in the "Forestry Chronicle".

A. Linteau

Project Q-63: Amino acid content of plants and soils in relation to site quality

The laboratory work on this project has been completed, but a report has not yet been prepared. It is apparent that mosses synthesize in their tissues a greater amount of free amino acids than any of the herbs and shrubs studied and that, for a given species, the quantity of amino acids in the tissues is related to site quality.

J. D. Gagnon

Project Q-64: Factors in the establishment and development of black spruce reproduction

An investigation into one of the aspects of this problem was made during the summer of 1954 when 2,855 milacre quadrats were examined on mineral soil exposed during the construction of a road on the limits of the Canadian International Paper Company near Cooper Lake in Forest Section B-3. The conditions were analogous to strip clearcutting combined with soil scarification. Results of this investigation indicate that excellent reproduction of black spruce can be obtained under these conditions. Stocking and growth appeared to be best where the exposed mineral soil contained a high proportion of organic matter, which conserved the moisture.

A report was written which may serve as the basis for a technical note. (Binder 1155) 21 pages.

A. Linteau

Problem 36

HARVEST CUTTINGS AND THINNINGS

Many commercial logging operations in the Province remove the entire merchantable stand down to 4 inches d.b.h. This practice sometimes delays the establishment of adequate reproduction, or it may result in very dense reproduction with subsequent overstocking and heavy mortality.

It is probable that yields can be increased by cutting systems which will leave the smaller trees to grow. They may also prevent the formation of overly-dense stands. Different systems of partial cutting have been tried in order to discover which are the best for different local conditions.

The problem of increasing the growth rate of selected stems in younger overstocked stands, which have followed clearcutting and blow-down, might be solved by means of regular thinnings which would increase the yield.

Several partial cutting and thinning experiments have been started by the Forestry Branch, the earliest dating back to 1923. Other experimental cuttings started by companies are being studied.

Project Q-5: Cutting tolerant hardwoods to favour conifers

Five permanent sample plots (2,3,4,5, and 10) established in 1934 in mixedwood and hardwood stands at Valcartier were remeasured. Detailed analysis of the results of these experimental cuttings has not yet been made, but it appears that the sapling stand of both conifers and hardwoods has been greatly increased by the treatment. The results have been somewhat obscured by subsequent cutting on some of the plots.

J.C. Boynton

Project Q-6: Thinning spruce and balsam fir (Great Lakes – St. Lawrence Forest Region)

In 1934 and 1936, two 50 to 60-year-old balsam fir stands at Valcartier were thinned. A reproduction felling was made in these stands in 1953-54, but upon inspection in the summer of 1954 a light salvage cut was found to be necessary. The salvage cut was made in the winter of 1954-55, and the plots will be remeasured in the summer of 1955.

R. J. Hatcher

Project Q-8: Selection cutting in yellow birch, spruce and balsam fir, Lake Kenogami

The stands in the Lake Kenogami Experimental Area which had been partially cut in 1923-24 were marked for a second cut in 1953, but the co-operating company, Price Bros and Company Limited, was forced to postpone the operation for one year. At their request, in the fall of 1954 the trees marked with blazes in 1953 were re-marked with paint to ensure that no trees would be missed by the cutters. At the same time more trees, especially the large spruce, were marked. The operation was carried out during the fall and winter, a total of 784 cords being cut on the area of 149 acres. Supervision was provided by the company.

R. G. Ray
J. C. Boynton

Project Q-15: Selection cutting in spruce and balsam fir at Valcartier

The stand near Long Lake which was cut for the second time in 1953-54 was found to require a light salvage cut. This was made in the winter of 1954-55. The transect plot will be remeasured in 1955.

R.J. Hatcher

Project Q-38: Thinning balsam fir in the Boreal Forest

In 1949, part of a very dense 25-year-old stand of balsam fir on the Cyriac river was thinned to prevent stagnation and to develop windfirm trees.

One permanent sample plot was laid out in the thinned area, and another in an adjacent unthinned area in the same stand. From the 1954 remeasurement, it appears that severe defoliation by the spruce budworm has prevented the thinning from having any beneficial effect. In fact there has been no appreciable growth on either plot in the 5-year period.

J. C. Boynton

Project Q-43: Empirical thinning in an 18-year-old stand of tolerant hardwoods, Valcartier

Three transect plots were laid out and tallied in a young hardwood stand which followed clearcutting about 20 years ago. The stand will be thinned in 1955.

J. C. Boynton

Project Q-62: Partial cutting in spruce-fir by the Donnacona Paper Company, Epaule River

In 1953 the Donnacona Paper Company started large-scale partial cutting operations in the Boreal Forest Region north of Quebec City. Arrangements were made with the company for the Forestry Branch to carry out a long-term study of the cutting methods employed, and in the summer of 1954 some of the cutover stands were sampled by 112 tenth-acre line plots. A draft report was written after compiling the field notes. Line-plots will be laid out in a clearcut area next season to compare with the partial cutting.

J. C. Boynton

Problem 37

RATE OF GROWTH AFTER LOGGING AND FIRE

Forest industry will have to rely for most of its future wood supply upon the second-growth stands which have followed logging operations or fire. Little is known of the growth rate in such stands, although this information is essential for forest management.

The success of the growth study in the cut-over pulpwood forest at Lake Edward led to the adoption of the line-plot survey method for a series of growth studies throughout the province beginning in 1947. Since that time a total of fifteen observation areas has been established in representative localities; each area covers about five square miles and is sampled by a grid of tenth-acre line plots, which will be remeasured at ten-year intervals. Valuable information on the condition of cut-over and burned stands has already been obtained from these areas.

Project Q-1: Forest growth survey, Lake Edward

A report covering the 40-year period after a pulpwood operation in the mixedwood forest at Lake Edward has been approved for publication. (Binder 1164) 58 pages.

R. G. Ray

Project Q-37: Forest growth survey, observation area No. 6, Lake Metis.

A file report on this observation area, which was established in 1950, was completed. (Binder 1105) 58 pages.

J. C. Boynton

Project Q-53: Forest growth survey, observation area No. 11, Harricanaw River

A file report on this area, which was established in Forest Section B-7 in 1953, was completed. (Binder 1157) 59 pages.

R. G. Ray

Project Q-60: Forest growth survey, observation area No. 14, Portneuf River

This observation area, located on the limits of the Consolidated Paper Corporation on the Portneuf river in Forest Section B-1, includes 272 tenth-acre line-plots in stands which had recently been clearcut for pulpwood, 14 plots in a 20-year old burn and 10 plots in uncut virgin stands.

The establishment report has been completed. (Binder 1133) 52 pages.

R. J. Hatcher

Project Q-61: Forest growth survey, observation area No. 15, Matane River

This area, established in 1954 on the freehold timber lands of the Hammermill Paper Company on the Matane and Cap Chat rivers, in Forest Section B-2, includes 256 plots in stands cut-over for pulpwood one, ten, twenty and thirty years ago. Compilation has been completed but the report has not yet been written.

J. D. MacArthur

Problem 38

REFORESTATION

The objectives under this problem are two-fold: first, to plant up suitable areas on the Valcartier Military Reserve and while so doing obtain information on planting techniques and the suitability of various species for planting on different soils; second, to study the survival and rate of growth of plantations established in the province by the Forestry Branch, the Provincial Government and other agencies.

Starting in 1933, large areas of abandoned farm land on the sandy plains at Valcartier were planted with red and white pine and white spruce. Because of adverse soil and climatic conditions, the red pine plantations have failed and white pine plantations have been partially successful. It is believed that jack pine and lodgepole pine will succeed in the same locations, and fail areas are being replanted with these species. At the same time, the more exacting spruce and white and red pine are being planted on the better sites, with every indication of success.

Growth and developments are also being followed in other plantations, among them the Consolidated Paper Corporation plantations near Grand'Mere, the

plantations of the Southern Canada Power Company at Drummondville, and plantations near Lachute.

Project Q-4: Seed-bed treatment, natural and artificial reproduction

In 1934 a small patch of a 50-year-old balsam fir stand was clearcut, and the following seed-bed treatments applied: a) mineral soil exposed; b) slash piled and burned; c) litter burned; and d) control. One sub-plot of the 0.11-acre plot in each condition was sown with spruce seed, one left for natural reproduction. Reproduction was tallied in 1939, 1948 and 1954, and the data are ready for analysis.

J.C. Boynton

Project Q-20: Growth and development of white pine plantations on old farm land at Valcartier

Some 1,150 white pine transplants (2-1 and 2-2) were planted in Todd's Brook Woodlot.

J. D. MacArthur

Project Q-21: Planting white pine under white and wire birch at Valcartier.

In 1939 white pine was planted under a white and wire birch stand which had previously been thinned. Two permanent sample plots were established to follow the growth and development of the planted trees. These plots were remeasured in 1949 and it was found that most of the planted trees had been killed or badly damaged by rabbits and by snow falling from the crowns of the birches. In 1952 the birch on PSP 24 was again thinned. Both plots were remeasured in 1954.

J.C. Boynton

Project Q-22: Planting exotic species

Six thousand Norway spruce (1-2 and 2-2) and 1,850 Scots pine (2-1) were planted in the spring of 1954.

A plantation plot was laid out to study the lodgepole pine planted in 1952.

J. D. MacArthur

Project Q-23: Growth and development of spruce plantations on old farm land at Valcartier

Some 800 transplants were planted in Todd's Brook Woodlot.

J. D. MacArthur

Project Q-26: Tree nursery, Valcartier

In addition to the normal nursery work required to provide planting stock for existing and future reforestation projects, 14 special seed-lots of red spruce collected throughout the range of the species were sown as part of a provenance experiment organized by the Petawawa Forest Experiment Station

J. D. MacArthur

Project Q-50: Growth and development of jack pine plantations on old farm land at Valcartier

A special plantation of 5,900 jack pine transplants raised at Petawawa F.E.S. from seed-lots of different provenances was established in the Plains Block. Mortality at the end of the growing season varied from zero to 4.3 per cent with an average of 3.1 per cent.

Approximately 5,000 transplants were spot planted to replace failures in the red pine plantations originally established in 1934.

A plantation plot was established in the area planted with jack pine in 1951.

J. D. MacArthur

Problem 39

FOREST MANAGEMENT

One of the responsibilities of the Quebec District is the management of the forested part of the Valcartier Military Reserve. Most of the forest has been surveyed with line-plots which are remeasured periodically. All cutting, whether by permit or by military personnel, is controlled by the Forestry Branch, and depletion records have been maintained since 1933.

Intensive management of two small woodlots at Valcartier has been undertaken to develop and demonstrate forestry practice, particularly "compartment" management.

Project Q-17: Valcartier working plan

All areas cut-over in 1953-54 were mapped, and the line plots in the Swamp Block were remeasured. Cutting under permit was continued in all blocks, the total volume removed during the fiscal year amounting to approximately 28,000 cubic feet of softwood and 14,000 cubic feet of hardwood sawlogs, 1,450 cords of pulpwood (123,000 cubic feet) and 280 cords of fuelwood (24,000 cubic feet).

About 3 miles of access roads were built to permit more intensive management.

A map of the Long Lake Area in the Plains Blocks was prepared, and depletion records for the area were compiled as preliminary steps in bringing the area under intensive "compartment management".

R.G. Ray
J.C. Boynton
R.J. Hatcher
J.D. MacArthur

Project Q-41: Todd's Brook woodlot

A light improvement and salvage cut was made in part of this demonstration woodlot. Eight hundred and fifty white spruce and 1,150 white pine transplants were set out in an old field from which the shrub growth had

previously been cleared. The road system was extended, and existing roads were graded and gravelled. A transit survey was made of the boundaries of the woodlot and wooden posts were placed at all turning points.

R.G. Ray
J.D. MacArthur
J.C. Boynton

Problem 40

PREPARATION OF NORMAL YIELD TABLES

Normal yield tables are a valuable tool in the preparation of management plans, greatly facilitating the calculation of the allowable cut. No such tables exist for pulpwood species in the Boreal Forest Region, although the need for them has frequently been expressed.

Normal yield tables are considered a practical and accurate means of predicting the growth of even-aged stands. They can be used for more than one rotation period and they provide a standard with which actual yield can be compared, or the effect of partial cutting gauged. Furthermore, the full stocking yield is a good index of absolute site productivity.

Project Q-56: Normal yield tables for spruce and fir (pulpwood species) in the Boreal Forest Region

Twenty-five new plots were measured on the Cascapedia and Madeleine Rivers and their tributaries in Forest Section B-2. White spruce stands were found with the highest side index yet encountered, but it is doubtful if enough samples will ever be obtained to include this site-class in the yield tables.

Compilation of the yield tables continued, but a perfect cross-checking of the curves of total basal area, average basal area, and number of trees for all site classes, has not yet been found, and it appears that additional sampling in the 21-40 and 101-140 age classes will be required next season.

A. Linteau

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Research Foresters	Assigned Problems
J. H. Cayford	54, 55, 56
R. A. Haig*	54, 57
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*Liaison Officer,
Forestry Operations Division

MANITOBA-SASKATCHEWAN DISTRICT OFFICE

Summary

In 1954, five field parties completed 23 projects, while office work was done on an additional eight projects. In addition, the Fire Protection Section continued its work begun in 1953 at Bittern Creek, Saskatchewan.

Fourteen projects were concerned with the regeneration and growth of white spruce. On the Riding Mountain Experimental Area, a number of small plantations were established, a study of seed production and dispersal was started, and seedling counts were made on several thousand scarified plots. Five 10-acre areas of mature mixedwoods were logged in different ways to investigate effects on regeneration and on growth of residuals. The influence of aspen on growth of young spruce was evaluated, and methods of release were tested. Release of young spruce from competition of hazel brush by means of herbicides was also studied. Growth data collected since 1921 in a mature spruce-fir stand on the Duck Mountain Area were analyzed. Work continues on the preparation of a monograph concerning the white spruce-aspen type.

Eight projects were devoted to jack pine, five being concerned with problems of regeneration. Experimental seeding was carried out throughout the summer in the Sandilands Forest Reserve. Studies of the influence of slash disposal, harvest cuttings, and soil scarification on germination and growth of seedlings were continued. A regeneration survey of cut-over and burned-over pine stands in central Saskatchewan was completed. There were three projects concerned with growth and yield on undisturbed and thinned plots.

Numerous stands of black spruce on upland sites were examined throughout Manitoba to determine what factors contribute most to the generally inadequate amount of regeneration. In a second project devoted to growth of black spruce, 100 permanent sample plots in the Sandilands Forest Reserve were reexamined to assess the mortality following a severe wind-storm.

A limited amount of work was started on red pine in southeastern Manitoba. Seedlings were planted on four different sites; a mixed jack pine-red pine stand from which most of the former species had been removed was scarified in an effort to increase the stocking of red pine seedlings; a similar mixed stand was logged in different ways to improve regeneration of red pine.

Progress was made on ecological studies to be used in a site classification. Data collected on old plantations in the Spruce Woods were re-analyzed for a revised report. New collections of forest plants were added to the office herbarium.

Problem 54

DETERMINATION OF CORRECT SILVICULTURAL PRACTICES FOR MERCHANTABLE CONIFEROUS SPECIES

Of the limited number of tree species suitable for saw-timber in Manitoba-Saskatchewan, white spruce is by far the most important. Current

cutting practices for spruce frequently result in a conversion of the type to inferior hardwoods. Hence the number of understocked stands lacking young coniferous growth is increasing. Jack pine is assuming greater importance due to changing economic conditions. During the past few years extensive cuttings of pine have been made for specific products—ties, poles, etc.—and the resulting residual stands are very often understocked and of poor quality. There is need for studies of harvest cutting methods in relation to all the above species in order to determine what systems are most favourable for both natural regeneration and residual growth. A minor problem in southeastern Manitoba concerns the harvesting of mixed jack pine-red pine stands to secure increased regeneration of the latter species.

Studies are being made of the effects of ground scarification on the establishment and survival of coniferous seedlings in both disturbed and undisturbed stands. Further investigations have been initiated, and previous ones continued, to determine the best techniques for successful planting of spruce and pine. Experiments to test the comparative efficiency of herbicides for the eradication of shrubby forest undergrowth are being continued.

Project MS-166: Cutting methods for management of white spruce in mixed stands

The cutting experiment begun in 1953 was replicated; six 10-acre compartments of mature white spruce and aspen were cut according to various methods, in order to study the effects on regeneration, as well as on residual growth and mortality. Partial scarification of three compartments was carried out to encourage the natural regeneration of spruce.

A third replication of the experiment will be made in 1955. Additional scarification is planned, provided there are indications that spruce will produce a seed crop in the fall. Permanent sample plots will be established within each compartment. A report will be submitted in 1955.

R. T. Pike

Project MS-163: Silvicultural techniques for securing jack pine regeneration, Sandilands Forest Reserve

In 1952, three 10-acre blocks of 60-year-old jack pine were clearcut by different methods to study the effects on regeneration. The experiment was replicated in 1953 at which time the first blocks were partially scarified. In 1954, the replicates were also scarified and permanent sample plots for the study of regeneration were laid out.

Preliminary results show best regeneration on strip cuttings. A progress report has been prepared and submitted.

J. H. Cayford

Project MS-179: Releasing red pine

One-chain-wide strips were clearcut in a mixed, intermediate-aged stand of red pine-jack pine. Between the strips, all jack pine and malformed red pine were removed. A tally was made of advance growth on both clearcut and

partially cut areas. It is proposed to establish transect plots in 1955 for a study of regeneration. A progress report was prepared. (Binder 1168) 27 pages.

J. H. Cayford

Project MS-157: Establishment and survival of jack pine seedlings, cut-over stands

To relate survival of seedlings with seed-bed, method of slash disposal, and number of years since establishment, 800 regeneration plots were remeasured in cut-over jack pine stands. The experiment shows that prompt scarification after cutting, followed by slash scattering, is the most effective method for securing pine regeneration on moist clay-loam soils. Seedlings established during the first year show less ability to survive than those established later. A final report was prepared.

R. T. Pike
R. A. Haig

Project MS-156: Influence of scarification on white spruce regeneration in cut-over stands

Three hundred and fifteen plots established in 1951-52 on bulldozed and ploughed strips under a cut-over spruce-aspen stand were re-examined to assess regeneration success. Due to poor cone crops since 1948, there has been little regeneration on the strips. A final report will be prepared after the 1955 re-examination.

R. T. Pike

Project MS-124: Influence of scarification on white spruce regeneration, undisturbed stands

Two thousand regeneration plots, on ploughed strips and on undisturbed control areas under mature spruce--aspen stands, were remeasured. In general, the superiority of mineral soil over forest litter as a seed-bed has been established, although heavy mortality has been experienced by seedlings on the mineral soil. There has been only one good seed year (1948) since the beginning of the experiment, hence recent results of the scarification are negligible. A final report will be prepared in 1955.

R. T. Pike

Project MS-178: Silvicultural techniques for securing red pine regeneration

Three blocks were marked out in an open red pine stand from which all merchantable jack pine had been removed in the period 1952-54. Strips were scarified using the tractor-drawn Athens plough. Residual trees and advance growth were tallied. Regeneration plots will be established on scarified and unscarified areas in 1955. An establishment report was prepared. (Binder 1135) 5 pages.

J. H. Cayford

Project MS-180: Planting red pine

One thousand 2-1 red pine seedlings were planted on each of four sites to study comparative survival. Only one plantation, located on

droughty soil in a burned-over jack pine stand, was a failure. The plantations will be replicated in 1955. An establishment report has been prepared. (Binder 1138) 9 pages. J. H. Cayford

Project MS-160: Planting white spruce

Weekly plantings of 3-2 white spruce were made throughout the summer on three small blocks of cut-over spruce—aspen. A comparison of planting success with four kinds of spruce stock (2-3, 3-1, 3-2, 2-4) was begun, using a replicated block design. Mixed plantations of pine (2-1 stock) and spruce (3-2 stock) were established in two blocks on a cut-over spruce-pine site.

Further small plantations are planned for logged areas in 1955. Survival of plantations put in since 1952 has been good on the Riding Mountain Area. An establishment report was prepared and submitted. (Binder 1102) 26 pages. J. S. Rowe

Project MS-113: Reforestation by planting, Spruce Woods Forest Reserve

Thirty-three plantations, all that remain of 63 established between 1904 and 1928, were examined. Of all species planted, jack pine shows the best survival, growth, and form. Though survival of Scots pine and lodgepole pine has been fair, their growth rates are poor. Spruce plantations failed completely. A final report has been prepared.

J. S. Jameson

Project MS-147: Control of underbrush and vegetation by herbicides, Riding Mountain

Forty-five small plots, densely stocked to Corylus, were sprayed with various herbicides in 1950 and 1952. Results to date indicate that ammate, herbate ester 2, 4-D, and isopropyl ester 2, 4, 5-T all kill hazel leaves and stems but considerable resprouting occurs within two years. Coniferous seedlings were not affected by any herbicide. A progress report is being prepared.

In 1955, a study of basal spraying will be started using herbicides in an oil base. Methods of poisoning over-mature aspen will be investigated.

R. T. Pike

Problem 55

DETERMINATION OF THE FACTORS INFLUENCING THE ESTABLISHMENT AND SURVIVAL OF CONIFEROUS SEEDLINGS ON CUT-OVER, BURNED-OVER, AND UNDISTURBED STANDS

In Manitoba and Saskatchewan, the natural regeneration of the coniferous species on both disturbed and undisturbed stands is generally unsatisfactory, and in many cases is a complete failure. This condition is most serious with white spruce; jack pine does regenerate after a fire, but not always adequately, and on cut-over and undisturbed stands it is often a failure. Black spruce reproduces on certain sites but not on others. The problem is to determine

the factors influencing the establishment and survival of coniferous seedlings on cut-over, burned-over, and undisturbed stands.

The problem is complex, and a thorough study of its many aspects will require years of work. Regeneration, like other biological processes, involves a developing organism and its environment, both in close interaction.

Observational studies are being made, and single examination plots established, on disturbed and undisturbed areas on the major sites. Until recently the only species studied was white spruce, but in 1954, investigations of jack pine and black spruce were initiated. It is intended to continue work on regeneration problems of these three conifers.

Project MS-158: Seed supply periodicity, dissemination of white spruce seed

Two one-tenth-acre plots in mature spruce—poplar stands were marked out. All spruce were measured as to age, height, diameter, length of cone-bearing crown, and total crown. Different methods of estimating quantities of cones on standing trees were tested. Twenty seed traps per plot were used to sample seed fall in September and October.

The project is to be continued indefinitely. An establishment-progress report will be prepared in 1955.

J. H. Cayford
J. S. Rowe

Project MS-176: Factors influencing jack pine reproduction on cut-over, burned-over, and undisturbed stands

Fifty-four plots in 12 areas were examined, these including cut-over and burned-over areas in both mixed and pure pine stands. Studies were made to relate the presence and abundance of regeneration to the various habitat factors such as crown cover, soil moisture, and minor vegetation. The data are being compiled, and a report will be submitted in 1955.

J. S. Jameson

Project MS-143: Influence of jack pine slash disposal on coniferous reproduction

The data collected in 1950-51 on 30 cut-over jack pine stands were analyzed to compare the effects of various methods of slash disposal on regeneration. Results indicate that regeneration is poor regardless of the method of slash disposal. Areas where it was merely piled were found to have most regeneration.

A revised report has been submitted for publication. (Binder 1057) 12 pages.

H. J. Johnson

Project MS-177: Seeding jack pine

Sixteen strips, 11 feet wide and five chains long, were seeded in each of three 4-acre blocks which had previously been scarified by the Manitoba Forest Service. One randomly selected strip in each block was broadcast seeded each week throughout the summer months. The experiment will be replicated in 1955. A preliminary report (Binder 1132, 5 pages) has been prepared.

J. H. Cayford

Project MS-175: Factors affecting the reproduction of black spruce on upland sites

A survey of black spruce stands was conducted during 1953 and 1954 to determine the status of regeneration. It was found that the swamp sites were adequately restocked to black spruce, but upland sites in general were not. Closer studies of the latter showed that unfavourable seed-bed is the main cause of failure.

A report will be prepared in 1955. H. J. Johnson

Problem 56

DETERMINATION OF THE EFFECT OF ASPEN COMPETITION ON THE GROWTH OF WHITE SPRUCE IN MIXEDWOOD STANDS

In the Mixedwood Section of Manitoba and Saskatchewan, white spruce is normally associated with poplar species, but the silvicultural significance of the association is not fully understood. Possibly the poplar overstory is beneficial, particularly when the stand is young, but there is evidence that it retards the growth of the spruce at a later stage of development.

It would be valuable to determine at what age or stage of development the poplar exerts its greatest suppressing effect on the spruce understory, and also to determine practical means of releasing the spruce at the most beneficial time. Investigations in Saskatchewan have indicated that approximately 60 per cent of the spruce in the 50 to 60-year-old mixedwood stands suffer from top whipping by poplar, and that an ultimate loss in volume increment of about 50 per cent is not unlikely.

From mixed stands of various ages and stages of development, much can be learned concerning the above problems. One approach is stem analysis of trees which, though initially suppressed, have become dominant by penetration of the poplar canopy. Another approach is the comparison in the same stand of both suppressed and free trees. Finally, ideas concerning time and method of efficient release can be tested by local thinnings in the vicinity of selected trees, or by more extensive thinnings of selected plots. Investigations along these lines were initiated in 1951 and continued in 1953 and 1954. Further work will be required on this important problem.

Project MS-167: The effect of aspen on white spruce in a mixedwood stand

Stem analyses of suppressed and free spruce trees in mixedwood stands have shown that height, diameter, and volume growth of single stems may be decreased by at least 15 to 25 per cent due to aspen competition. In addition, suppressed trees are frequently of poor form.

A technical note is being prepared for publication.

J. H. Cayford

Project MS-153: Release of white spruce by the removal of the poplar overstory

In a 40-year-old mixedwood stand, six tenth-acre plots were established to study the influence of aspen on the growth of white spruce. Two treatments were tested—removal of all aspen, and removal of aspen only in the vicinity of selected spruce. This brings the number of plots established in connection with this project to 33. An interim report has been prepared (Binder 1032, 19 pages), but no results will be available until remeasurement.

J. H. Cayford

Problem 57

TO STUDY THE EFFECT OF GROWTH AND YIELD OF PARTIAL CUTTING IN IMMATURE STANDS

Immature stands of all tree species are far more prevalent than mature and overmature stands throughout the district. The importance of exploring the possibilities of obtaining a greater volume of usable wood products, or a better quality of final crop trees, by varying the silvicultural treatments has long been recognized.

With some few variations, the silvicultural practice with respect to merchantable aspen and black spruce has been to clearcut. The justifications for these practices are excellent reproductive capacity of the hardwoods, the prevalence of coniferous advance growth on swamp sites, and the lack of windfirmness of residuals left when a pure dense stand is merely thinned out. Jack pine stands have been clearcut or selectively cut for specific products, while the usual practice in white spruce stands has been to cut to a prescribed diameter limit, thus removing all but the small stems. Limited knowledge concerning growth and mortality of residuals has given little incentive to a change-over from the "one-cut" to a "multiple cut" system.

Various silvicultural treatments are being tested on permanent plots in immature stands of the major forest types. Some experiments have been designed to correlate growth of final crop trees with the degree of thinning practised when the stands were younger; others compare the volume resulting from a single harvest cutting at maturity with the total volume obtained from a series of cuts extended throughout the rotation period. It will be necessary to initiate new studies of this problem to determine for all species and species mixtures the types of treatment, and the times of treatment, which will result in the greatest economic return from the forests. Experiments are of a long-term nature, and much remeasurement work will be required in the future before reliable results are obtained.

Project MS-133: Thinning aspen, Turtle Mountain Forest Reserve

Five sample plots, established during 1948 in a dense 11-year-old stand of aspen, were remeasured in 1953 to find the effects of different degrees of thinning on residual growth. Analysis of the data in 1954 indicated that the seven-foot by seven-foot thinning had produced a better response than either the five-foot by five-foot thinning or the control. A report has been prepared.

R. A. Haig
R. T. Pike

Project MS-134: Strip thinning with a tractor winch, Saskatchewan

A comparison of winch-thinning in strips with the orthodox mechanical hand-thinning was made in both jack pine and black spruce stands during 1949 and 1950. On the strips, trees were winched to the road in groups, thus leaving exposed a favourable seed-bed of disturbed soil without slash cover.

The 12 one-acre plots, nine in pine and three in spruce, were remeasured in 1954. Preliminary results indicate little regeneration in residual strips, but regeneration on the cleared strips is encouraging. A report will be prepared in 1955. J. S. Jameson

Project MS-132: Thinning jack pine, Duck Mountain

Five plots, established during 1948 in a dense 10-year-old stand of jack pine, were remeasured in 1953 to find what effects two intensities of thinning had produced in the five-year period. Little can be said yet concerning the effects of thinning on growth, but it is evident that mortality has been extensive in the controls, chiefly as a result of rabbit damage. An interim report has been prepared. R. T. Pike
H. J. Johnson

Project MS-136: White spruce release cutting, Strathclair Road, Riding Mountain

Three plots, each one-quarter acre in size, established during 1920 in a 60-year-old white spruce and aspen stand to study the effects of thinning, were remeasured in 1953. Residuals on the plot thinned from above (all dead trees, all aspen, and 33 dominant or codominant spruce removed) have shown excellent growth. A report has been prepared. R. A. Haig
R. T. Pike

Problem 58

TO STUDY GROWTH AND YIELD OF CONIFEROUS STANDS AND TO PREPARE YIELD TABLES OF EVEN-AGED JACK PINE AND BLACK SPRUCE STANDS

Forest management plans require basic information on growth and yield. Without such information it is not possible to predict either the length of rotation or the quantity of wood which will be produced. Though precise answers concerning future rates of growth can never be expected, fairly reliable figures can be obtained if yield tables have been drawn up. The necessary data for such yield tables are being collected. When available they will indicate the probable course of development of stands, and also serve as a standard for checking the success or failure of current silvicultural methods.

Normal yield tables state the yields of pure, fully stocked, even-aged stands, at various age intervals. A fully stocked stand is defined as one in which the growing space is well utilized, with a density favouring

optimum basal area growth for a given period. Most stands depart from the normal condition due to a variety of factors—accidental, physiographical, or physiological. Hence it is necessary to establish the relationship between actual stocking and full stocking. Further, it must be determined what the ranges of understocking and overstocking are, how these can be recognized, and what caused them.

Previous to the rate of growth survey initiated on the Riding Mountain Area in 1946, only a few growth plots were in existence in the district. From 1946 to 1948, 1,200 permanent sample plots were established to study the growth of white spruce and associated species. The first remeasurement will be in 1956. In 1950-51, projects concerned with the growth and yield of jack pine and black spruce were begun. Further plans have been made to expand these two projects, starting in 1956.

Project MS-151: Growth and yield of jack pine, Sandilands Forest Reserve

In 1950, a total of 142 permanent sample plots were established in jack pine stands of different densities and age classes to study growth and yield. During the summer of 1954, a wind-storm destroyed a number of plots, necessitating a re-examination in order to find what replacements were necessary. Additional plots will be established in 1955. An establishment report was prepared in 1953. (Binder 959) 17 pages.

H. J. Johnson

Project MS-152: Growth and yield of black spruce, Sandilands Forest Reserve

In 1950-51, a total of 88 permanent sample plots were established in pure black spruce stands of different ages and densities to obtain information concerning the growth and development of this species. An assessment of wind damage and accidental cutting on the plots was made in 1954. Replacements for damaged plots will be established in 1956. An establishment report has been prepared.

H. J. Johnson

Project MS-11: Yield of white spruce and balsam fir in an undisturbed stand, Duck Mountain

One large plot in an undisturbed overmature stand of spruce and fir has been under observation since 1921. The stand is now disintegrating, and there is little sign of regeneration to replace the decadent trees. Total volume in 1946 was less than in 1921, chiefly due to mortality of balsam fir. A technical note was prepared for publication.

R. T. Pike

Problem 59

TO CLASSIFY AND INTERPRET INTO GROWTH POTENTIALITIES THE FOREST SITES IN THE ACCESSIBLE BOREAL FOREST OF MANITOBA AND SASKATCHEWAN

The need for basic knowledge concerning forests and forest sites yearly becomes more apparent as decreasing forest supplies bring the problems

of regeneration and productivity into sharper focus. Clearly, a classification of sites which shows what areas have high, medium or low potentialities with regard to the various phases of silviculture would be valuable. Such a classification requires ecological study in the field, for if it is to be valid it must be based on exact knowledge of the relationships which exist between forest and their environments (climate, soil, topography, etc.).

Several studies directed to the evaluation and reclassification of forest sites have been attempted in the past. Some have been directed primarily towards use of minor vegetation as indicators; others have been broader, aiming at an integrated approach through the study of all environmental and vegetational factors.

Since 1953, work has been done on a broad scale in Saskatchewan and Manitoba in order to get a general picture of forest sites in the eastern districts of the B.18 Section. More detailed work is planned for the future.

Project MS-168: A site classification for the Riding Mountain Forest Experimental Area

A survey of soil sites was made on 13 sections of the Riding Mountain E perimental Area in 1953. Soil associations and moisture regimes were mapped on a broad scale, and notes were taken on minor vegetation, regeneration, etc. Analysis of the data has shown little variability in the age/height relationship of dominant spruce, though on poor sites--the dry and the wet--growth slows abruptly at a relatively early age. A progress report has been prepared and submitted. (Binder 1106) 61 pages.

J. S. Rowe

Project MS-173: Forest site classification for Manitoba and Saskatchewan

Work was confined to three areas in western Manitoba and in eastern Saskatchewan--Duck Mountain Forest Reserve, Porcupine Hills Reserve, and Torch River Reserve. Studies of sites and forest growth were made on sample plots located in such a way as to sample soil moisture regimes within defined land types. A map showing physiographic subdivisions for Saskatchewan and western Manitoba was prepared as a basis for future work. Data will be analyzed, and a report prepared in 1955.

J. S. Rowe

Problem 60

MISCELLANEOUS PROJECTS — 1954

Project MS-128: Collection of white spruce seed

Collections of seed were made in various parts of the district during the fall of 1954. Germination was tested, and counts were made of numbers of cotyledons on germinates. Approximately five pounds of seed is on hand for experimental purposes.

Project MS-142: Collection of forest plants

Collections were made in the Sandilands Forest Reserve, Riding and Duck Mountains, Prince Albert, and Bittern Creek areas, by members of the staff. Specimens were identified and mounted on herbarium sheets for future reference.

Project MS-174: Monograph: "The white spruce-aspen type"

Considerable research has been done in the important spruce-aspen forest type in western Canada, but the results have never been collected and made available to the public. Work on a comprehensive report has been progressing over the past few years, and publication is expected in 1956.

J. S. Rowe

Alberta District Office

Forest Research Division Forestry Branch

707 Public Building

Calgary, Alberta

District Forest Officer: J. L. McLenahan

Research Foresters	Assigned Problems
R. F. Ackerman	61, 62, 63, 66
E. S. Atkins*	
D. I. Crossley	61, 62, 64, 66, 68, 69
K. W. Horton	64, 69
J. Quaite	62, 65, 68
L. A. Smithers	65, 68

*This officer transferred from the Petawawa Forest Experiment Station, 1 April, 1955

ALBERTA DISTRICT OFFICE

Summary

Forest research in the Alberta district was carried out in both the Boreal and Subalpine Regions during the year. Investigations designed to provide information which will lead to the development of suitable silvicultural and ma agement techniques, in the main cover types of Alberta, have been undertaken. Particular attention has been given to the lodgepole pine, spruce-aspen, and pine-aspen types.

The problems of harvest cutting in mature stands, combined with seed-bed preparation and slash disposal, in both the lodgepole pine and spruce cover types, have received considerable attention. Earlier studies have been analyzed and valuable results have been established. New studies have been undertaken to fill in gaps in our present knowledge and to substantiate preliminary results from earlier work. Of particular interest and significance are the results of cone opening studies on slash and germination on scarified seed-beds, with lodgepole pine.

Broad observational studies of succession and development in the lodgepole pine type have provided a valuable picture of the forest cover conditions in the province. Fire has emerged as the most important agent in determining the cover type distribution.

Substantial advances have been made in our knowledge of the silvical characteristics of lodgepole pine and the application of such information will greatly simplify the task of determining appropriate silvicultural techniques.

The investigation of site conditions in Alberta and the classification of site quality on a physiographic basis has been continued, with special attention bei g given to the mixedwood cover type of northern Alberta.

Reforestation research has been confined to the Kananaskis Forest Experiment Station where seasonal planting studies have indicated that low mortality spruce plantings can be carried out throughout the summer months without causing any permanent reduction in vigour. Stand conversion studies from aspen to Douglas fir have shown planting to be far superior to direct seeding for such purposes.

The control of high density conditions in lodgepole pine stands resulting from fire, a major problem in Alberta, has received attention. A new thinning experiment has been established in a young stand; older experiments in stagnating reproduction stands and dense semi-mature stands have been analyzed, and thinning practices have been proposed.

Studies of growth and yield in the various cover types have not been active during the current year.

A monograph dealing with lodgepole pine is being prepared which will summarize the results of past research and co-ordinate this information into concrete silvicultural and management procedures.

Problem 61

THE DETERMINATION OF SUITABLE SILVICULTURAL TECHNIQUES FOR REGENERATING LODGEPOLE PINE

Lodgepole pine is a fire type that regenerates prolifically on the burned forest floor after the seed is released from the cones by heat. It is a primary invader that gives way to spruce and fir, unless re-established by fire. If we wish to perpetuate this species, and do not want to use fire, then ways must be sought to effect the same results in a less dangerous and destructive fashion. In order to learn how to regenerate it without this natural aid, a great deal of investigative work is necessary to ascertain the nature and amount of seed crop, safe methods of releasing it from natural storage, distance of effective dissemination, favourable seed-bed conditions, effective slash distribution or disposal, and so on. The forester working with this species has a great advantage in that he has at his hand a tremendous supply of stored seed. It is our objective to learn the husbandry necessary to utilize it effectively.

Project K-65: The effect of unincorporated organic material, competition of lesser vegetation, root competition of a residual stand, and fire on the germination and survival of seedlings of lodgepole pine and western white spruce in a thinned stand of lodgepole pine

Annual tally of germination and survival of seedlings was carried out. A final report for publication will be prepared.

D. I. Crossley

Project K-68: Lodgepole pine seed production and dispersal

This study was designed in 1952 to provide information on the cone-bearing habits of trees of different ages, the periodicity of seed crops and various factors surrounding the dispersal of the seed crop. Both seed traps and cone crop observation techniques have been applied to the solution of these problems. A statistically designed seed trap study has indicated some periodicity of yearly seed fall and the generally low volume of seed release. However, the most noteworthy result was the significant difference between seed fall immediately beneath the seed source and the much lighter catches of airborne seed to the leeward. Cone crop observation studies showed consistent yearly behaviour of individual trees for a number of years with respect to number of cones borne and percentages of open and closed cones. Although young stands showed high percentage of opened cones, semi-mature and mature stands bore a preponderance of closed cones. The detailed results of both of these studies (Binder 1171) will be made available in published form.

D. I. Crossley

Project A-14: Management studies in a maturing lodgepole pine stand in the foothills region of Alberta

This project was initiated in 1951 on a 160-acre block of typical dense 85-year-old lodgepole pine. Individual 10-acre compartments were treated

by a series of twelve cutting methods ranging in intensity from clearcutting to thinning. Information on the stand before and after cutting has been obtained from permanent sample plots. A five-year remeasurement of these plots in 1956 will provide information of stand behaviour after various cutting methods, as well as indicating regeneration trends. To date remarkably little windthrow has occurred on the area and isolated cases have usually been associated with shallow soils overlying extremely coarse materials which inhibit rooting. During the current year a publication describing this experiment and a series of associated studies has been prepared (Binder 1088) 15 pages. D. I. Crossley

Project A-23: Mechanical scarification and strip clearcutting to induce lodgepole pine regeneration

This study was carried out at Strachan, Alberta, in an 85-year-old lodgepole pine stand, to determine the effects of mechanical prescarification on regeneration in a strip clearcutting area. Two years after stripcutting, it has been found that regardless of whether the seed supply originated from slash-borne cones or marginal seed sources, lodgepole pine reproduction was significantly better on the prescarified areas, and only on these strips could the regeneration be considered to have adequately restocked the clearcut area.

A report on this project has been prepared for publication. (Binder 1159) 17 pages. D. I. Crossley

Project A-27: The effect of crown cover and slash density on the release of seed from lodgepole pine cones in residual slash

This study was begun in 1953 and continued in 1954 to determine the conditions under which the rosin bond of lodgepole pine cones fractured and the release of seed was accomplished. Both detailed studies of individual cone opening and temperatures, and obse vational studies on slash-borne cones were employed. Rosin bond rupturing took place in most cases at temperatures of 44° to 49°C. Such temperatures occurred in cones which were within 6.5 inches of the ground when standard air temperatures of 80°F+ were reached. The proportion of slash-borne cones which opened increased as the degree of overstory decreased; the distance above ground level was found to be critical. Maximum opening occurred from 0 to 6.5 inches above ground level. The results of this study have been prepared for publication. (Binder 1162) 64 pages.
D. I. Crossley

Project A-35: Regeneration of lodgepole pine following strip clearcutting, mechanical scarification and slash disposal

This study was started in 1954 to investigate the value of strip clearcutting, followed by seed-bed preparation and slash disposal, as a reproduction method for lodgepole pine in the B.19 section of Alberta. The experimental area was clearcut in alternate strips, 5 chains wide. After cutting, replications of the following three treatments were established on 12 one-acre treatment blocks.

1. Seed-bed undisturbed; slash lopped and scattered.
2. Seed-bed undisturbed; slash removed.
3. Seed-bed scarified; slash removed.

Seed traps have been set out to measure the seedfall from the adjacent uncut stands.

An establishment report has been submitted. (Binder 1182) 14 pages.

R. F. Ackerman

Problem 62

THE DETERMINATION OF SUITABLE SILVICULTURAL TECHNIQUES FOR REGENERATING WHITE SPRUCE

Spruce regeneration following present cutting practices in Alberta is unsatisfactory in white spruce stands, and in mixed spruce--aspen stands. These stands occur over a wide range of sites in both the Boreal and Subalpine Forest Regions, and the accessible and therefore most valuable areas have been cut over. Their present unproductive condition constitutes a serious problem that is engaging much of our research effort. Past work strongly suggests that a mineral seed-bed is a prerequisite to successful establishment of a new crop, but the questions of duration of its receptiveness, and of the inter-related seed-crop periodicity remain.

Project K-47: Seed-bed treatment for spruce

The main results of this project have been submitted for publication (Binder 1007, 12 pages) under the title "White spruce reproduction resulting from various methods of scarification". The future development of this regeneration stand will be observed.

D. I. Crossley

Project K-48: Seed-bed treatment under a mixedwood stand

The most recent results of this study have been published in Silvicultural Leaflet No. 63. The future development of this reproduction stand will be observed.

D. I. Crossley

Project K-59: The effects of unincorporated organic material, competition of lesser vegetation, and root competition of a residual stand on the germination of western white spruce in a residual stand of spruce

Annual tally of germination and survival of seedlings was carried out on this project; no new results have been obtained. A final report for publication on this project will be prepared.

D. I. Crossley

Project A-5: Mechanical scarification to induce white spruce regeneration in old cut-over spruce stands

This project commenced in 1950 when light mechanical equipment was used to scarify the forest floor under a residual spruce-aspen stand which was regenerating inadequately. Tallies of the resulting regeneration were taken annually. Baring of the mineral soil has resulted in an increase in spruce regeneration although the subsequent growth has been poor. Although no serious invasion of aspen suckers has occurred, the re-invasion of competing vegetation, especially on the best sites, has been rapid. The increased [illegible] of the seed-bed to spruce appears to have endured for at least three years. The results of this study will be made available in published form. (Binder 1108) 17 pages.

D. I. Crossley

Project A-12: Experimental cutting of white spruce in a mixedwood stand in northern Alberta

An annual tally of reproduction was carried out but no new results have been obtained. A file report will be submitted.

J. Quaite

Project A-38: Broadcast burning and windrowing and burning to eliminate logging slash and induce spruce regeneration

This project was established in 1954 to assess the value of two reproduction methods for spruce in the Subalpine region of Alberta.

1. Clearcutting followed by broadcast burning.
2. Clearcutting followed by mechanical scarification and windrowing of the slash.

Under the direction of the Burmis Lumber Company, Burmis, Alberta, an area of approximately 5 acres has been burned and 4 acres scarified. The Forestry Branch has undertaken to rate the success of these treatments and investigate the germination and survival capacity of the resultant types of seed-bed. Seed traps have been set out on the area to measure seedfall from the adjacent stands.

Investigation in the fall of 1954, one year after treatment, revealed that because of the absence of a spruce seed crop in 1953, no regeneration has occurred. However, the seed-beds are still in a highly [illegible] condition and good results are expected to follow the medium seed crop of 1954.

An establishment report has been prepared. (Binder 1184) 17 pages.

R. F. Ackerman

Project A-39: The effect of seed crop periodicity on the reproduction of subalpine spruce after clear-cutting and scarifying

In an effort to develop a satisfactory reproduction method for spruce in the subalpine region of Alberta, clearcutting by strips and

patches, followed by slash disposal and scarification of the forest floor, was tested in 1954. The Forestry Branch has undertaken to assess the value of this treatment and to investigate the practical relationships between spruce seed crop periodicity and reproduction on the experimental area. Two patches, with a total area of 27 acres, have been cut and treated to date and the necessary sample established. As other patches are cut each year, they will be included in the study. The seed crop each year will be rated ocularly and the seedfall by the catch of seed traps set out on the treated areas.

An establishment report has been prepared.

R. F. Ackerman

Problem 63

GROWTH AND YIELD IN SPRUCE, SPRUCE-ASPEN AND LODGEPOLE PINE STANDS

Information on the growth and yield of the main forest cover types in Alberta is essential to the management and conservation of the forest resources of the province. During the preceding five years, a number of long-term permanent plot studies designed to provide information on these problems have been established. During the current year none of these projects can be classed as having been active, since no field work or analysis has been entailed. However, remeasurement in the future will provide considerable information on this problem.

Project A-17: Growth and yield of lodgepole pine in the B.19 section of Alberta

A number of the sample plots connected with this study were visited and painted boundaries enclosing an isolation strip around the plots were located.

R. F. Ackerman

Problem 64

THE ECOLOGY AND SILVICS OF COMMERCIAL TREE SPECIES IN ALBERTA

Fundamental research into forest ecological relationships is a prerequisite to silviculture. A detailed knowledge of the natural tendencies in forest development assists in adapting them efficiently to our ends.

The problem is divided into two aspects, the broad one of successional relationships in the various forest associations, and the detailed one of specific silvical characteristics which underlie those relationships.

To study the successional aspect, a general survey of selected stands was undertaken on the various lodgepole pine associations found in Alberta. It is planned to investigate all the major forest types of the province in a similar manner. To study the silvical characteristics of

species, various small experiments have been initiated in recent years. In these, the emphasis so far has been placed on western white spruce and lodgepole pine.

Project K-70: Lodgepole pine rooting habits

During the 1952 field season a series of 27 rooting systems of open-grown lodgepole pine on various rooting media were excavated. Age-development of roots was assessed by comparing trees of varying ages on similar rooting media. Detailed comparisons of maps of both vertical and lateral root systems illustrated several trends. Lodgepole pine exhibited a typical tap root form in youth, gradually changing to a heart-shaped form at ages of 30 to 40 years when the development of sinkers became pronounced. Vertical rooting was inhibited and an earlier transition to the heart-shaped root took place in the presence of extreme dessicating layers, impermeable zones, and high water tables. Lodgepole pine appeared in general to be windfirm. However, conditions which inhibit vertical rooting also contributed to lack of windfirmness. The results of this study have been prepared for publication. (Binder 1167) 91 pages.

D. I. Crossley

Project A-24: Seasonal growth of lodgepole pine in Alberta

This study was established in 1952 to determine the annual period of diameter growth of lodgepole pine in two typical locations, the Subalpine and the Foothills regions of Alberta. Daily readings of diameter growth on a selected sample of trees were taken with dial-gauge dendrometers during the 1952, 1953 and 1954 growing seasons. Measurements of rainfall and relative humidity were also made. The value of waterproofing materials applied to the measurement location of the tree trunk was tested, and control readings on green unbarked poles in a vertical position were carried out. Results show that heretofore unexpected fluctuations in dial-gauge readings exist and cannot be definitely accounted for. Further research appears necessary to establish the validity of dial-gauge readings of diameter growth. The results to date will be prepared for publication.

D. I. Crossley

Project A-25: Ecology of lodgepole pine

This study of the role of lodgepole pine in forest succession in Alberta began in 1953 and continued through 1954. The sample covered most of the range of the species in the province. In the first year the investigation took the form of a broad, subjective survey. Many generalizations evolved from this survey and these were checked in the second year by intensive sampling methods.

Four phytogeographic divisions of lodgepole pine were delineated and the associated vegetation of each was described. The broad effects of stand history, particularly fire, were evaluated in terms of stand structure. Finally, the overall specific reaction of pine and associated tree species were assessed and combined to provide a picture of forest succession in the four divisions.

A final report was submitted for publication. (Binder 1020) 8 pages.

K. W. Horton

Problem 65

THE EVALUATION OF SITE

A knowledge of site is basic to all silvicultural research and has practical application throughout the entire field of applied forestry. Site evaluation is receiving priority by various research organizations throughout Canada. The problem in Alberta is to study and attempt to apply in the field the various methods of site classification that promise some measure of success.

Past studies in Alberta have been confined to the vegetative features of growth, particularly dominant height, and results have been inconclusive. Recent studies indicate that a physiographic site classification may be used as a basis to assess productivity of lodgepole pine and white spruce. Future studies will attempt to derive a practical method of site evaluation for the mixedwood stands of northern Alberta, the Foothills Section and the Subalpine Forest Region. Emphasis will be placed on the evaluation of site in lodgepole pine stands.

Project K-74: The effect of stocking on dominant height as a site index

The file report on this project submitted in 1954 has been revised for publication under the title "Assessment of site productivity in dense lodgepole pine stands". (Binder 1131) 18 pages.

L. A. Smithers

Project A-29: The evaluation of site and growth of white spruce in the mixedwood section of Alberta

This project was initiated in 1953 and field work has been carried out during 1953 and 1954. The basic approach to the problem has been the correlation of yield figures and stem analysis data from sample plots, with soil, climatic and vegetative information describing the physiographic conditions of the sample plots. During the 1954 field season, 125 of these samples were obtained and an analysis of the height growth of dominant white spruce in association with the physiographic conditions was carried out. Although some evidence of relationship between these factors was noted, a considerable amount of unexplained variation occurred. Further field work and analysis of this phase of the project will be required. A brief interim report has been prepared. (Binder 1113) 8 pages.

J. Quaite

Problem 66

REFORESTATION

In the Province of Alberta many areas have been rendered incapable of natural restocking through logging practices and through fire, and if the land is to produce merchantable forest products, artificial regeneration will be necessary. Because much of northern Alberta is potentially arable for agricultural products, and because the Eastern Rockies Forest Conser-

vation Board is primarily interested in water yield from its mountain watershed, there is a definite need for a clarification of land use. Until such time as this takes place, reforestation research has been limited to the Kananaskis Forest Experiment Station and has taken the form of provenance studies, and the testing of reforestation methods.

Project K-23: Conversion of aspen to Douglas fir

This project was established in 1939 to investigate means by which aspen stands, of little potential value, could be converted to a more valuable tree species. The three following methods of conversion were tested: 1) preparation of seed spots, scattered residual Douglas fir to act as the seed source; 2) preparation of seed spots, seeded by hand; and 3) planting. To investigate the influence of the overstory, these three methods were tested in clearcut, girdled, thinned and undisturbed areas.

Although conclusive results were not possible, planting proved far superior to both natural and artificial seeding. Survival of planted stock was higher on those areas left with an overstory, due to the more favourable moisture conditions.

A final report has been submitted. (Binder 1183) 23 pages.

R. F. Ackerman

Project K-35: Growth and development in plantations

Commencing in 1938, numerous small plantations have been set out at the Kananaskis Forest Experiment Station. The main purpose of these plantings is to test various strains and species, both exotic and indigenous, in the subalpine forest region of Alberta. In the spring of 1954, small plantings of lodgepole pine, white spruce, Douglas fir and ponderosa pine were made on various locations throughout the Station area. The plantations are measured for height growth and survival each year until definitely established, and thereafter at 5-year intervals.

An interim report is planned for 1955.

R. F. Ackerman

Project K-51: Seed-spotting as a method of forest reproduction on mountain lithosols

Annual tally of seed-spots was carried out. However, no analysis was made and no new results obtained.

D. I. Crossley

Project K-64: Direct seeding as a means of forest reproduction on mountain lithosols

Annual tally of survival was carried out on this project. No analysis of the data was made and no report has been prepared.

D. I. Crossley

Problem 68

DETERMINATION OF THINNING METHODS FOR LODGEPOLE PINE STANDS

Dense young lodgepole pine stands resulting from fire, or logging and fire, present a distinct problem in the Province of Alberta. Stagnation and the accompanying reduction of both diameter and height growth usually occur before the stand has reached an age of 40 years. The increased rotation for the production of poles, piling, and ties, caused by slow individual tree growth, may well result in serious management problems in Alberta in the future.

The problem is to determine whether, under different economic conditions, the rotation period may be shortened by thinning, and how this may best be done. Inasmuch as these conditions prevail throughout the Subalpine and Foothills regions of Alberta which represent the main forest reserves of the province, the problem is of major importance to the establishment of forest management in Alberta.

Studies have already been established to determine the effects of thinning in middle-aged stands, and new research into the behaviour of young stands under various thinning practices has been undertaken. The investigation methods to be employed include small-scale trials as well as observational studies of natural development under various conditions.

Project K-3: Thinning in dense lodgepole pine stands at Kananaskis Forest Experiment Station

During the period 1937-1950, a series of thinning experiments in both young and semi-mature dense lodgepole pine stands was established. Data are now available from these studies, in many cases covering 15 years' remeasurement. Analysis has shown that diameter growth response to treatment has been excellent, and that growth stimulation has been comparable to that of ponderosa pine and red pine in other areas. Height growth has also shown a response to thinning. Mortality in terms of both volume and number of stems in fully stocked stands was comparable to that of other intolerant pines. Under existing economic conditions in Alberta, a single heavy thinning to 1500 stems per acre is recommended in young stands to produce small transmission line poles on a 100-year rotation. In pulpwood stands, where salvaging of mortality and thereby increasing total yield, is of primary concern, it is recommended that thinning be delayed to ages of 50 to 75 years when up to 15 cords of pulpwood may be removed without sacrificing future growth. During the current year, five of the sample plots connected with this study were thinned a second time. The growth and development of these stands will be measured in five years' time. During the current year a report has been prepared for publication summarizing the results of these experiments.

L. A. Smithers

Project K-56: Wholesale thinning of young lodgepole pine stands mechanically, chemically and with fire

This project was initiated in 1949 to study the effects of various methods of thinning on dense 14-year-old lodgepole pine. Note-

worthy results were obtained through the use of various chemical sprays. Further studies on the use of chemical sprays to reduce stocking were undertaken in 1950 and 1952. The results of these chemical treatments have been summarized and a report for publication has been prepared (Binder 1170, 13 pages). The analysis shows that satisfactory reduction in stocking (98 per cent mortality) can be achieved by the application of specific dosages of 2,4-D in a diesel fuel carrier. While mortality of pine resulting from lethal spraying appeared to have been completed by the fourth year after application, decimation of young spruce associated with the pine was still continuing in 1955. Limited studies on cost of materials indicated that a dosage of 2 gallons of 2,4-D, 75 gallons of water and 25 gallons of diesel fuel at a cost of $10.90 per acre, provided the most acceptable reduction in stocking (96 per cent) consistent with a minimum cost of materials.

D. I. Crossley

Project K-57: The development of a 77-year-old lodgepole pine stand following an empirical thinning

In 1949, five sample plots were established in a lodgepole pine stand which had been heavily thinned in 1941.

At the same time a comparable series of control plots were located in an unthinned portion of the stand. The growth between 1941 and 1949 was studied by means of stand reconstruction, increment borings, and stem analysis. A silvicultural leaflet entitled "Severe thinning in an overstocked lodgepole pine stand" was published in 1950. These sample plots were remeasured in 1953 and an interim report (Binder 1124, 8 pages) on the project was prepared. The analysis showed that although annual diameter growth on the treated area during the 1949-53 period was somewhat less than during the 1941-49 period, it was still appreciably higher than that of the untreated stands. In spite of the heavy thinning, no reduction in gross volume production on the untreated area was noted. A file report has been prepared.

J. Quaite

Project A-34: Development after thinning of young lodgepole pine stands in Alberta

This project was initiated during the 1954 field season when three replicates of seven thinning treatments were established at Mackay, Alberta, in a thrifty 22-year-old stand of lodgepole pine, which had resulted from fire. Four of the treatments involve single thinnings in 1954 to spacings of 5' x 5', 6' x 6', 8' x 8', and 12' x 12'. The two remaining thinnings are multiple-treatments involving in one case two thinnings at ages 22 and 50 years, and in the other thinning at 10-year intervals. Remeasurement data will indicate the most desirable spacing for single thinnings designed to produce poles on a 100-year rotation, and will also indicate any benefits to be derived from multiple thinnings. The area will be examined frequently and remeasured at 10-year intervals. An establishment report will be submitted.

L. A. Smithers

Problem 69

MISCELLANEOUS RESEARCH INCLUDING THE PREPARATION OF A MONOGRAPH ON LODGEPOLE PINE IN ALBERTA

The ultimate objective is to prepare a manuscript on lodgepole pine containing all available information pertinent to the management of this species in Alberta. The preliminary work directly involved has been the completion of a skeleton outline and a literature review.

Project A-20: Field herbarium

A portable collection of forest plants has been built up since 1947 for field identification purposes in connection with forest research work. Two hundred and thirty-five species had been collected up to 1954 and 25 have since been added, making a total of 260, representing more than 50 families. The collection of species not yet represented in the herbarium will be continued.

K. W. Horton

Project A-33: Lodgepole pine monograph

A series of specialized studies designed to provide information essential to the preparation of this monograph have been analysed and valuable information has been obtained. Arrangements have been made for the participation of the Forest Biology Division, Department of Agriculture, which will prepare special sections dealing with insect enemies and diseases of lodgepole pine.

D. I. Crossley

Project K-40: Meteorological observations

Weather records at the Kananaskis Forest Experiment Station have been kept since 1938, for use in the programs of the Fire Protection Section and the Meteorological Division of the Department of Transport. Data on temperature, precipitation, relative humidity and wind were summarized for the years 1940 to 1954, inclusive, to provide detailed information on the local climate for correlation with silvicultural investigations. Past and future phenological and provenance studies will benefit directly. Routine daily records will be continued as in the past.

A periodic report was prepared.

K. W. Horton

ORGANIZATION CHART

FOREST RESEARCH DIVISION