Canada
Department of Northern Affairs and National Resources
FORESTRY BRANCH

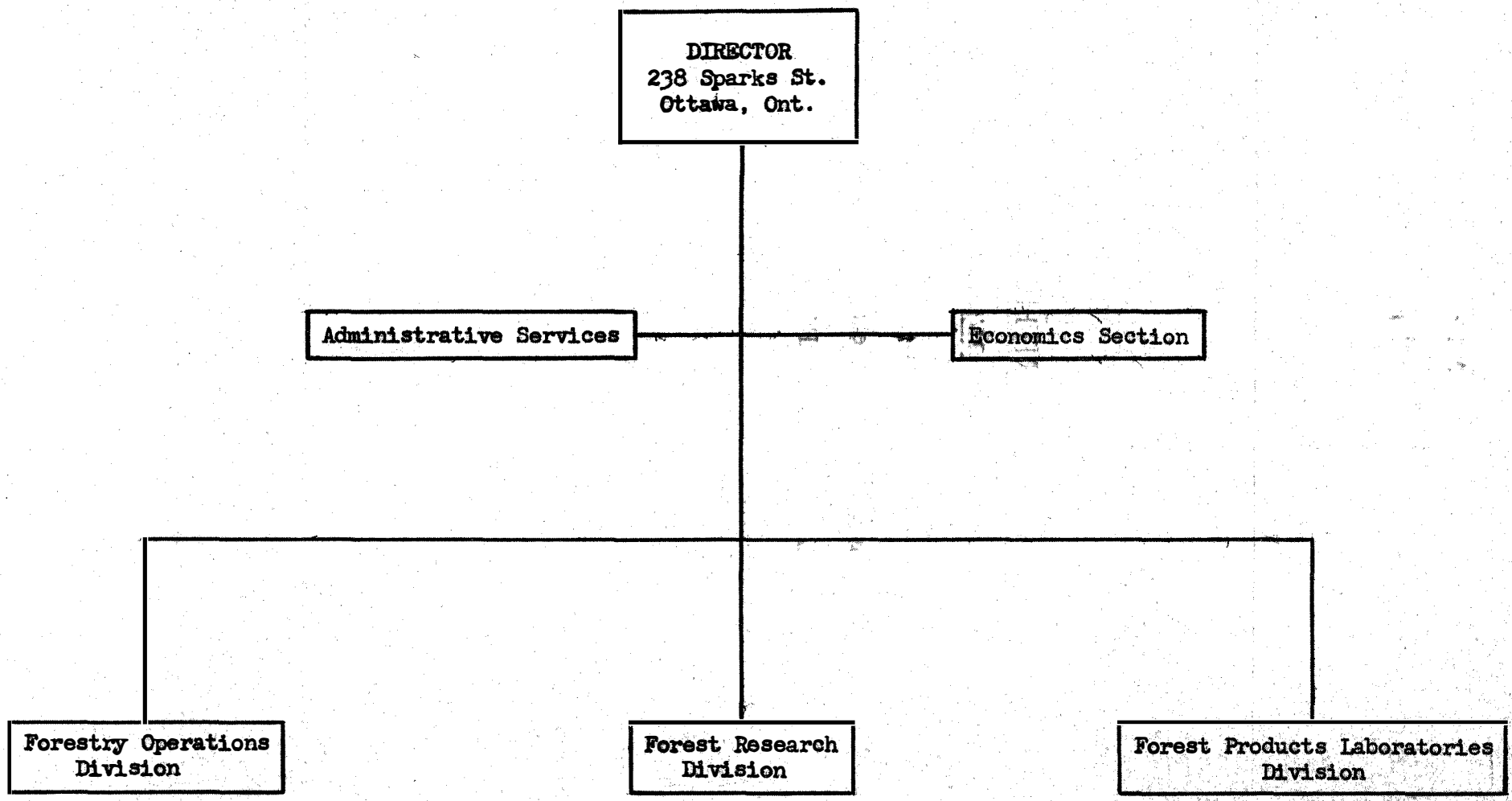
SEVENTH
ANNUAL REPORT
on
Active Forest Research Projects
YEAR ENDED MARCH 31, 1956

Ottawa

JULY, 1956

ORGANIZATION CHART

FORESTRY BRANCH



Canada

Department of Northern Affairs and National Resources

Forestry Branch

FOREST RESEARCH DIVISION

Seventh

ANNUAL REPORT

ON

ACTIVE FOREST RESEARCH PROJECTS

Year Ended March 31, 1956

Issued under the authority of

The Honourable Jean Lesage

Minister of Northern Affairs and National Resources

Ottawa, July, 1956

PREFACE

This is the seventh 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, 1956. 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 1955-1956, 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 the 1954 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

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Forest Inventories Section

Forest Research Division — Forestry Branch

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Ottawa

Section Head: H. E. Seely

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A. F. Berg	5
F. D. MacAndrews	4
L. J. Nozzolillo	4
J. M. Robinson	2, 5
G. B. Sully	1
J. C. Wagar	5
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FOREST INVENTORIES SECTION

Summary

Some 200 sample plots were measured by a field party during the year in order to supply data for stand volume tables, which are being prepared primarily for use by the air photo interpreter. The work included a great deal of mapping of individual crowns and basal areas. A relascope was tested for the determination of basal area.

A comparison of various inventory sampling methods was made in a company's timber limits. No practical differences were found between the mean values secured from sample plots located by the random method and those by the "selected line method", which is based on lines drawn between prominent map features in such a way as to cross the stand or stands to be sampled but in which personal judgement plays no part in the selection of locations.

A technical note entitled "Air Photo Overlays" was prepared for publication.

Forest inventories of northern areas were conducted by the Section in co-operation with the Northern Administration and Lands Branch. Forest maps prepared during the year covered a total area of 4,640 square miles and 641 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 of Banff National Park covering 2,050 square miles were prepared. Forest maps of the Acadia Forest Experiment Station; the Utopia Military Training Ground, New Brunswick; and the St. Joseph's Island Ordnance and Naval Reserves, Lake Huron, comprising 35, 16, and 4 square miles respectively, were 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.

The data of stand volume tables, including information on site, age, and various forest conditions, may be employed in the preparation of supplementary tables showing the ratios 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 of 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 sample plots per year, usually in two or three regions, are being measured for stand volume 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

The stands of that portion of Algonquin Park which adjoins the Petawawa Forest Experiment Station have warranted attention, particularly because white, red, and jack pine occur abundantly in a variety of conditions. Accordingly, some 200 sample plots were measured in Algonquin Park during the year. In about 20 per cent of these plots the individual crowns and basal areas were mapped on a quarter of the area of the plot. This was done to compare crown area with basal area for trees of various crown classes.

It is expected that the application of stand volume tables will be facilitated if suitable ocular estimates can be made of basal area and canopy density. It has been found that such estimates can be made of canopy density with a suitable degree of accuracy but that satisfactory ocular estimates of basal area are more difficult. Accordingly, a tube-shaped relascope based on the Bitterlich angle method and named the "Panama Angle Gauge" was tested in the determination of basal area. It was found that inaccuracies occurred because of diffusion of light at the gauge aperture, lack of a suitable peep-sight and limited field of view. A model was constructed in which these defects were largely overcome but the operation of the instrument remained disappointingly slow. A study was made of literature on various relascopes including the Spiegel Relaskop, which provides a comparatively simple method for making slope corrections but apparently has not been equipped with a peep-sight to secure a sharp simultaneous view of scale and tree. The relascope plot has a very irregular boundary difficult to determine. Consequently the use of the relascope will presumably be restricted to the determination of the basal area of the stand rather than that of plots established in rectangular dimensions.

G. B. Sully
J. C. Wright

Problem 2

DETERMINATION OF MOST SUITABLE METHODS OF AIR PHOTOGRAPHY

Research in the use of various cameras and films is being conducted to facilitate the identification of tree species and to increase the accuracy of fine tree measurements in air photographs. The greatly superior quality of air photographs taken with the new Wild R C 5 camera was proved during the photo interpretation of areas totalling several thousand square miles. New printers employing automatic dodging controlled by photo-electric cells are being tried.

Investigation has shown that large-scale photographs taken for sampling purposes would prove very valuable in forest surveys if the blurring caused by the travel of the aircraft during the instant of exposure could be prevented. At the request of the Forestry Branch a test was arranged through the Associate Committee on Photographic Research, National Research Council, whereby the Royal Canadian Air Force employed an image motion compensating device in photographs taken at the scale of 250 feet to 1 inch. Results are quite promising but may become more conclusive when new cameras equipped with improved lenses and shutters, together with new fast films, are employed. Incidentally it appeared that advances in technique have provided a better accommodation of the highlights and shadows of the winter landscape. A new shutter which has continuously revolving blades and which permits exposures to at least 1/500th of a second is to be tested for its value in minimizing image motion and the effect of camera vibration.

Under a similar arrangement it is proposed that a test be made by the Royal Canadian Air Force of the value of Ektachrome Camouflage Detection Film in the identification of dead trees, particularly those killed by insect or fire.

Project 2/3: Corrections for lack of resolution

Field checks have indicated that a low contrast between object and background is accompanied by a decrease in sharpness as the scale of the air photograph becomes smaller. Otherwise it was found that there was little to choose between the detail of photographs taken at the scale of 400 feet to the inch and that of photographs of various smaller scales, possibly because image motion had about the same effect in all cases.

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 suitably designed stereoscopes; projectors and other devices to facilitate the transfer of forest type lines from the air photographs 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. A number of useful instruments have already been constructed by the Section.

An article entitled "Air Photo Overlays" was prepared by Mr. W. U. Hardy for distribution as a Technical Note.

The Filotecnica Salmoiraghi Planimeter, Model 236A (Milan, Italy) is a polar planimeter which has proved to be a very valuable instrument, particularly because the zero setting can be made instantaneously. A test showed that errors arising in the zeroing are negligible.

Problem 4

INVESTIGATION OF FOREST SURVEY TECHNIQUES

Comparisons of field sampling procedures and of the forest inventory value of information obtainable from air photographs of various scales are being commenced. Sample air photographs are being collected to aid the identification of tree species. 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. A forest inventories method 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, the Northwest Territories, and the Wood Buffalo National Park. A modification of the method is being employed by the Province of Nova Scotia. (See "A Forest Survey Method", Technical Note No. 8, Forest Research Division.)

Work is being done by the Section on the improvement of mapping practices, with particular reference to routine and checking and the standardization of legends and notations. The work includes a compilation of definitions of various terms used in forest inventory, photogrammetry, and site classification. The first result has been a "Selection List, Forest Map Legends", which is serving to facilitate the drawing up of a statement of legend and notations as required for each forest map.

F. D. MacAndrews

Project 4/9: Subjective and selected line methods, Eagle Depot

This project is unique in that it is, so far as is known, the first attempt to compare inventory sampling methods in a company's timber limits in which the stands have been stratified from air photographs.

Forest maps were prepared covering 113 square miles, thus completing the forest mapping of the Eagle Depot Area, which comprises 123 square miles and is situated within the limits of the Canadian International Paper Company, southwest of Maniwaki, Province of Quebec.

About 350 fifth-acre sample plots were measured within a single stratum. Thus far comparisons have been made only of the mean basal areas of 50 plots measured by each of the five methods employed. These consisted of two random methods, one employing square plots and the other long plots, a subjective method, a continuous strip method, and the "selected line" method.

The forest was found to be quite highly disturbed but the disturbance was so well distributed that few plots were unaffected and the variance shown by the fifth-acre plots was quite limited.

A lack of a very pronounced difference between the random methods and the subjective method, in which the plots were chosen representatively on a personal examination basis, became evident. This lack may be ascribed to the limited variance, which restricted the advantageous selection of representative plots by the air photo interpreter.

The selected line method is based on lines drawn between prominent map features in such a way as to cross the stand or stands to be sampled but in which personal judgment plays no part in the selection of the starting point of the plot. See the above-mentioned Technical Note No. 8. The selected line method gave an estimate of the mean basal area which was about equal to the average of the means of the two random methods. A more favourable endorsation of the selected line method could hardly be expected, especially because the estimates of the two random methods are surprisingly close to each other. Incidentally the computed Standard Error of the Mean of the selected line method, which theoretically has no valid meaning, fell between the Standard Errors of the two random methods. The cost of the Selected Line Method was less than one-half that of the random methods.

A considerable systematic error was indicated as between the continuous strip method and the other methods, the former having shown lower values. A check appears to be warranted to determine whether the concentrated nature of the sample and the uniform direction of the lines may be contributing factors. L. J. Nozzolillo

Problem 5

FULFILMENT OF DEPARTMENTAL SURVEY REQUIREMENTS

Although these surveys are not strictly research activities, they are included here because they account for about half of the time of the Section and are incidentally helpful to research.

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. The forest inventory method referred to under Problem 4 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 190,000 square miles. The inventories are usually given forest map designations instead of regular project numbers, and individual project plans are seldom prepared.

In co-operation with the International Business Machines Company and the Dominion Bureau of Statistics, a punched card was designed for the computation of timber volumes on whole areas, supplementary to the existing card, which brings the computation to the stage of volumes per acre.

A preliminary investigation was made of recently improved facilities available locally for the colouring of forest maps by the silk screen process.

Yukon Territory

Forest maps covering 440 square miles in the central Yukon were prepared by the aid of field data previously obtained in nearby areas.

Northwest Territories

Field work was conducted in co-operation with the Northern Administration and Lands Branch, Department of Northern Affairs and National Resources and 339 sample plots were measured in forest stands situated on the Liard River. Data from these sample plots were presented in suitable form to the Dominion Bureau of Statistics for transfer to punched cards employed in computation and tabulation. The computed data were applied in the revision of the provisional forest maps which had been used in the field.

Wood Buffalo National Park

This Park extends north and south of the Alberta-Northwest Territories boundary and is administered by the Northern Administration and Lands Branch.

Field work and map revisions were conducted in a manner similar to that described above in reference to the Northwest Territories and 320 sample plots were measured in an area near Pine Lake.

Provisional forest maps of areas totalling 3,950 square miles were prepared, partly for use by the 1956 field party.

Forest maps of an area of 250 square miles of contiguous Alberta provincial lands situated near Fort Smith were also prepared.

Data to facilitate sales of large quantities of saw timber situated on the Peace River were compiled from forest inventory maps previously prepared by the Section. Sales of Peace River timber reached a total of more than 500,000,000 feet B.M.

Banff National Park

Provisional forest maps covering 2,050 square miles and including a narrow perimeter of contiguous Alberta provincial lands were prepared and forwarded to the National Parks Branch for field checking.

Other Inventories

Detailed forest maps of the Acadia Forest Experiment Station, comprising 35 square miles, were prepared from air photographs and field data.

Forest maps of the Utopia Military Training Ground, New Brunswick; and St. Joseph's Island Ordnance and Naval Reserves, Lake Huron, comprising 16 and 4 square miles respectively, were prepared.

J.M. Robinson
A.F. Berg
J.C. Wagar

Fire Protection Section

Forest Research Division — Forestry Branch

238 Sparks Street

OTTAWA

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
D. E. Williams	6, 7, 8, 10

FIRE PROTECTION SECTION

Summary

The development and production of simplified fire danger and fire hazard tables for specific forest areas of the country continued to absorb the greater part of the effort of the Section. The demand for simple, accurate fire danger tables has increased considerably and the number of agencies interested in the Branch danger rating system is also increasing. It is therefore essential that the primary effort should be expended to ensure that the danger tables produced are the most accurate and up-to-date possible. The new fire danger tables for Newfoundland, New Brunswick, Ontario, and Manitoba were assembled into final form for printing.

Field parties operating in Whitecourt, Alberta, and Bittern Creek, Saskatchewan, experienced much more favourable weather than during the 1954 fire season. One more season at each of these stations is expected to provide sufficient data to complete the main projects.

At the Kananaskis Forest Experiment Station a meteorologist, seconded to the Branch from the Department of Transport, continued studies of topoclimate in mountainous areas, particularly in regard to low nocturnal humidities. An attempt is being made to correlate nights of low humidity with the direction of winds aloft. The long-term study of drought at Kananaskis was continued.

At the Petawawa Forest Experiment Station, tests were undertaken to determine the effect of field use on the resistance to leaching of mildew proofers currently used on forestry hose. Work was also continued on the effectiveness of various vegetation inhibitors and soil sterilants. The third in a series of fire fighting training movies was filmed at this station during the summer.

At Head Office, work was curtailed owing to the absence of Mr. Mactavish on educational leave and to the vacancy created when Mr. Ward left the Branch. A considerable proportion of the time of the remaining technical staff was expended in work which included the production of a commentary for the training film, reports and minutes for the Associate Committee on Forest Fire Protection, and other items indirectly related to research.

Problem 6

PREPARATION AND SIMPLIFICATION OF FOREST FIRE DANGER TABLES

This problem has been of major proportion since it was first considered by the Section in 1926. The evolution of the fire danger table has been necessary in order to keep pace with changing fire protection demands.

The present requirements are that the system be accurate yet depend only on simple measurements of fire danger weather factors. The increasing demand makes it imperative that the Branch produce the best possible system, which must be both dependable and free from unnecessary complication.

Project 4 - 7: Moisture content determination in flash fuels

The study of moisture content of flash fuels under various climatic and weather conditions produces data for several purposes, but mainly for the preparation of fire danger tables. Moisture measurements were made daily during the fire season at a number of selected sites near Bittern Creek, Saskatchewan, and Whitecourt, Alberta.

It is expected that field work at these Stations will be completed during the 1956 fire season.

D. E. Williams
J. S. Mactavish

Project 4 - 8: Moisture content determination in heavy fuels

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

Detailed analyses of these data will not be made until the completion of the 1956 field season.

D. E. Williams
J. S. Mactavish

Project 4 - 9: Drought studies

An analysis was made of the data obtained at Whiteshell, Manitoba, from observations of moisture content fluctuations of a windfall (weigh-beam) log. Similar analyses will be made of data on hand relating to other drought indicators.

One of the most promising indicators of drought conditions is the fluctuation of water table levels. Continuous water table measurements were made at three field stations during the past season. It is proposed to use new recording instruments to continue this study.

D. E. Williams
J. S. Mactavish

Project 4 - 10: Experimental fires

Small-scale test fires in selected forest types provide the major basic information required for the preparation of fire danger tables. Such tests were obtained daily during the fire season at selected sites in Alberta and Saskatchewan.

It is expected that the 1956 season will provide the remaining data necessary for preparation of tables applicable to the specific areas under study.

D. E. Williams
J. S. Mactavish

Project 4 - 13: Physical fire danger indicators

Three sets of hazard sticks of the type currently used by the Alberta Forest Service were observed under a variety of exposures at Whitecourt, Alberta. The season was such that a good quantity of pertinent data was obtained. These observations will be continued until the field program has been completed.

J. S. Mactavish

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

New simplified fire danger and hazard tables were used in a provisional form for four areas from Saskatchewan east to Newfoundland.

Sets of tables for five different areas were prepared in final form. Sample charts and weather records were designed to suit the new tables.

Production and distribution of the new tables will take place as soon as printing has been completed.

J. C. Macleod
D. E. Williams

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

Great care must be taken to ensure that the instructions accompanying danger tables are complete and concise. Provisional instructions prepared for the new tables were checked over carefully and revisions were made in accordance with criticisms noted by staff members who conducted trial runs. Care was taken to ensure that instructions were consistent in wording and detail for all tables.

J. C. Macleod
D. E. Williams

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 fire stations in all -- were checked and filed. A few minor tabulations of the data were made.

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

J. C. Macleod

Project 9 - 1: Phenological studies

The spring development and fall curing of forest vegetation have a great effect on fuel inflammability. These and other seasonal effects are taken into consideration in preparing fire danger tables. Phenological observations are made weekly at all fire research stations.

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

D. E. Williams
J. S. Mactavish

Problem 7

WEATHER IN RELATION TO FOREST FIRE DANGER AND FIRE BEHAVIOUR

The effects of various weather factors on forest fire danger and on fire behaviour have been investigated, and correlative methods of determining these effects have been developed and applied. Special methods and techniques for obtaining many of the required measurements have been developed.

Further studies of weather as it affects other phases of fire control are required. Presently under study are: 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

A number of weather factors measured in conjunction with fire danger and fire hazard measurements form the independent variables of the danger and hazard tables. For danger index computation and other purposes, 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 national parks and from some other federal stations.

File reports only are prepared on this continuing project.

D. E. Williams
J. S. Mactavish

Project 4 - 2: Evaporimetry

The use of daily evaporation data as a variable in fire danger rating was discontinued by the Branch in 1946. Evaporation, however, can be an excellent interpreter of the effect of certain fuel drying factors and for this reason observations of this phenomenon have been continued in the field.

D. E. Williams
J. S. Mactavish

Project 4 - 3: Effect of dew on forest inflammability

The formation of dew at night can be a major factor causing a rise in moisture content of fuels in the open. Data were obtained on dew deposition at Petawawa, Bittern Creek, and Whitecourt. Detailed studies were undertaken at the latter station to determine variations in quantity of dew deposited with height above ground.

Morning test fires in grass at Whitecourt and in caribou moss at Bittern Creek were observed to determine the wetting and duration effects of dew in flash fuels.

D. E. Williams
J. S. Mactavish

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

The occurrence of nights when the relative humidity remained abnormally low in the Kananaskis river valley has been found to be related to the occurrence of west winds at mountain-top level, indicating a chinook type of effect. With west winds aloft the humidity remained low on two nights out of three.

By a study of vertical temperature gradients, (which determine the stability of the air stream), as well as further ground observations in 1956, it is expected that the conditions under which low nocturnal humidities occur will be determined more exactly. L. B. MacHattie

Project 4 - 5 - 2: Effects of site variations on fire weather observations

A preliminary investigation was made at the Petawawa F. E. S. to ascertain the order of magnitude of the variations in humidity, temperature, and wind ventilation associated with the topographic variations of that area.
L. B. MacHattie

Problem 8

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

Statistics of numbers of fires and acreages burned do not give a complete picture of the severity of a fire season. An accurate system of rating fire season severity, based on actual fire weather, is required by forest protection administrators to enable them to assess the efficiency of their fire control organizations.

When a severity rating can be assigned to fire seasons it will be possible to obtain a measure of the effectiveness of changes made in specific phases of fire control programs.

Project 2 - 3: Fire prevention efficiency

Project 2 - 4: Rating severity of fire seasons

Additional preliminary analyses required for these projects have been completed.

A file report has been prepared on the work to date.
D. E. Williams

Problem 9

FUEL TYPE CLASSIFICATION

A fuel type map is an essential part of a fire control plan and, at present, comparatively few people are able to prepare such maps and even then the methods are time-consuming. The problem is one of devising methods whereby non-specialist forest protection personnel may prepare such maps without prohibitive expenditure of time and labour.

A file report on the progress made has been prepared, but the loss of professional personnel has necessitated the postponement of work on this problem.

Problem 10

INCREASING THE EFFECTIVENESS OF FOREST FIRE CONTROL

From time to time the Section receives requests from protective agencies and associations to undertake projects concerned with the testing of fire control equipment and techniques. Some of these projects require a considerable expenditure of time, but most are of short duration.

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

Field observations in southeastern Manitoba were completed in 1952. Analyses of these data were conducted at headquarters and the results were published in 1955 in Technical Note No. 22, "Fire Hazard Resulting from Jack Pine Slash."

D. E. Williams

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

During the past two years, a number of makes and types of back-pack tanks and hand pumps were given intensive field trials at one of the fire research stations. Careful studies of the units were made to determine their particular characteristics and details of design and performance in order that direct comparisons could be made.

The initial manuscript for a technical note on the subject has been prepared.

J. S. Mactavish

Project 6 - 4: Detection tower location device

The sectional light-weight mast developed in co-operation with the National Research Council was given further field trials at the Petawawa Forest Experiment Station and by the Canadian International Paper Company on their limits near Noranda. A new winch designed for raising and lowering the mast

sections was installed and tested and the camera mount was modified. A new technique was designed to afford easier manipulation of the cord used to trip the trigger on the camera turntable.

Reports on the field trials were presented to the Associate Committee on Forest Fire Protection at its annual meeting.

J. C. Macleod

Project 6 - 6: Chemical vegetation inhibitors

This is a continuing project designed to determine the relative merits of a number of chemical preparations used for sterilizing the soil or retarding vegetative growth on roadsides and fire guards. A number of plots, previously established, were retreated in 1955, but no new plots were established. All plots were checked during the season and several areas were selected as potential sites for future large-scale tests.

A manuscript was written by Mr. E. J. Ward describing the effect of various vegetation inhibitors on inflammability; the publication should be available in 1956.

J. C. Macleod

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

The hose failure questionnaire form, prepared at the request of the Associate Committee on Forest Fire Protection, was again sent to several hundred forest fire rangers and wardens across the country. When samples of failed hose accompanied the returns, they were analysed by the National Research Council to determine the part played by mildew in causing the failure.

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

Hose tests made by the National Research Council have shown that some of the mildew proofers used by hose manufacturers will leach out of the hose after short periods of use. Since it was felt that leaching conditions in the laboratory might not fully represent those encountered in actual use, a field test procedure was developed and studies were made to determine which mildew-proofing treatment was most resistant to leaching. Results indicate that it will take at least one more season to complete the major part of this project.

In conjunction with the work on the above project, a check was made to determine the effect on fibre strength of successive wetting and drying of unlined linen hose.

J. C. Macleod

MISCELLANEOUS

During the past year, a considerable proportion of the time and effort of the technical staff had to be devoted to the many tasks of the Section which cannot be properly classified as research. However, several of these tasks are undertaken as projects, and the more important are listed hereunder.

Project 1 - 1: Forest fire statistics - preparation

Project 1 - 2: Forest fire statistics - analysis

The task of obtaining, tabulating, and recording forest fire statistics from all parts of Canada has been one of the routine tasks of this Section for many years. The second project, unlike the first, is not done on a continuing basis, but parts of the statistical data are analysed from time to time as individual requirements arise.

Each month throughout the fire season, estimates of the number of fires occurring and the area burned are collected from protection agencies, totalled for the country, and made available to the press through the facilities of the National Research Council. In this way the press and other agencies are kept supplied with topical information regarding the Canada-wide forest fire situation. The annual bulletin "Forest Fire Losses in Canada", covering the 1954 fire season, was written and published.

J. C. Macleod

Project 9 - 3: Forest fire protection abstracts

A periodical bearing the above title is issued twice yearly. It contains abstracts of articles published in trade magazines and elsewhere which may have some application in forest fire control. The abstracts are produced in loosefeaf form suitable for insertion in binding covers supplied by the Branch. Two issues were prepared during the year under review.

It is planned that Volume 7 will be the beginning of Book II of this series. Book II will introduce revisions such as an improved binding arrangement, better pagination, and an improved method of indexing.

J. C. Macleod

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

Number three in a series of 20-minute fire protection training films was produced for the Branch by the National Film Board, under Branch supervision. The film, "Forest Fire Suppression", was designed to give training on fire fighting strategy and the organization of fire suppression forces. A considerable amount of time and effort on the part of research officers of the Section was expended on script preparation, advice and assistance during filming in the field, and on the preparation of the commentary.

J. C. Macleod
D. E. Williams
J. S. Mactavish

Silviculture and Management Section

Forest Research Division Forestry Branch

238 Sparks Street

Ottawa

Section Head: A. Bickerstaff

Associate Section Head: V. H. Phelps

Research Foresters	Assigned Problems
W. G. E. Brown	15, 16, 17
J. L. Farrar*	18, 19
J. W. Fraser*	18, 19
K. T. Logan*	18, 19
L. Matte	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 there was no major changes on emphasis on any of the above tasks. The consolidation of research findings on a cover-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 seedbed 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 continued, with most work being done on provenance studies and propagation techniques with spruce and hard pines. Work in management and regulation included the preparation and revision of plans for small areas of different forest cover types. In the field of mensuration and statistics, mathematical functions were developed for tree volumes and growth relationships, studies made to check the applicability of different mensurational techniques in measuring and forecasting forest development and growth potential, and punch card and sense marking techniques for the measurement and analysis of sample plots tested.

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 12 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 12

DERIVATION OF STANDARD VOLUME TABLES THROUGH REGRESSION

In contrast to most existing volume tables, those derived by means of regression are free from the errors resulting from graphic methods and inadequate appraisal 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 new ones devised. One has been fitted to volumes of about 1,700 trees by the method of least squares using mechanical computation, and volume tables have been computed. Additional trials are being made, and there are indications that a simplification of a known function will give satisfactory results.

L. Matte

Problem 13

THE APPLICATION OF STATISTICS TO PROBLEMS IN FOREST RESEARCH

Sound forest research cannot be carried out without the use of statistical methods. However, these methods were developed in other fields, and they need to be adapted to the problems encountered in forest research. These can be divided into three groups: sampling surveys, small-scale experiments, and large-scale experiments.

Careful studies have shown that most of the sampling methods can be applied to forest surveys. The standard designs of experiments can be used, with small-scale experiments, while a solution to the treatment of large-scale experiments appears to lie in a combination of experimental designs and sampling methods, together with regression analysis.

The work done on this problem has involved advice on various projects throughout the Division.

Project H-102: Test of punch card and sense marking techniques for permanent sample plot measurement and analysis

The test was conducted on 25 permanent sample plots of Project P-224. Data collected in the woods were sense marked on previously prepared International Business Machine punch cards. The cards were then machine punched by the Bureau of Statistics and most of the compilation done by automatic machine calculation and tabulation. Compilation was greatly facilitated, but the time required for field work increased by 15 per cent.

Report

A test of punch card and sense marking techniques for permanent sample plot remeasurement and analysis. File report (Binder 1274) 9 pages. A. B. Berry

Problem 14

STUDY OF METHODS OF GROWTH AND YIELD DETERMINATION

Many methods of growth and yield determination are in use. All are known to have weaknesses, but it is difficult to make objective comparisons between one method and another. One improvement would be to replace graphical analysis by the fit of a growth function, which would permit tests of significance of such concepts as site, cover type, and stand density.

Project H-106: Regression functions for growth and yield relationships

Few attempts have hitherto been made along this line, and none have succeeded. Assuming that the behaviour of forest stands is not necessarily different from that of populations met with in actuarial work, it was found that the first form of Makeham's function used in actuarial work turns out to be, for all practical purposes, an excellent fit for growth relationships based on age.

Since this function is not readily adaptable to the method of least squares, a new function giving non-significant differences from Makeham's function has been devised, which lends itself to the application of the least squares method.

Tests have shown that this new function may be used for the construction of yield tables.

Basic computations are continuing and, when enough data have been accumulated, a report will be prepared. L. Matte

Problem 15

FOREST CLASSIFICATION

The Forest Classification of Canada, Bulletin No. 89, by W. E. D. Halliday, has been out of print for more than a year and requests for copies are numerous. It is of particular interest to foresters and ecologists in Canada concerned with the distribution of species, variations in strains, growth and yield, and forest management practices, as it is based on the distribution of the forest types, climate, physiography, and soil.

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

Project H-8: Forest classification

Revision to December 1955 of the forest classification map, incorporated important changes in Ungava, the northern boundary of the Forest and Tundra Section, in the Northwest Territories, and the division of sections into districts. Descriptions of the sections and districts, including a review of the climatic conditions, are being prepared.

The division of sections into districts has proceeded and a complete working set of 1 : 1,000,000 topographic maps have been prepared for Canada showing the section and district boundaries. The boundary lines are in pencil and will be suitable for photostatic reproduction. At the same time it will be feasible to alter them at any time on the original maps.

A review of the climatic conditions in the forest sections and in some cases in the districts has been carried out and a tabular list of 18 climatic values prepared. This will accompany the report proposed above.

Reports and Maps

1. Table of climatic data for the forest sections and in some cases districts. Project H-8.

2. Maps, scale 1: 1,000,000 topographic, showing forest section and district boundaries.

3. Revised map, 1 inch = 100 miles, of the forest sections to December 1955.

W. G. E. Brown

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

This project is being carried out in co-operation with other Branch personnel, and involves the collection of samples of specific parent materials, which are stored at the Petawawa Forest Experiment Station, and analyzed as time permits. Chemical analysis has not yet been done, but it is hoped that this will be accomplished in the not too distant future. Standard samples of various soil textures were prepared and distributed to the district offices.

W. G. E. Brown

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

Field work was continued in the St. Maurice Watershed. A report is being prepared to describe the method of using soils in a site classification that will be practical for growth and yield, regeneration and engineering. It will replace S. & M. 53-2.

New methods have been investigated for reproducing stereopairs of air photographs to show land-type and site-type boundaries.

Instruction in this type of work was given to foresters employed by various companies. Similar co-operation will be extended during 1956 in the Lake St. John and Anticosti areas (H-8).

Co-operative work in the Lievre watershed on site typing has continued. A large part of the northern area has been site typed in detail. It is planned to continue this work on the southern portion of the watershed which extends into Forest Section L.4. See also Project H-72, Ontario Research Unit.

W. G. E. Brown

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

Work proceeded satisfactorily on the site classification of the Headquarters Silvicultural Area, and a map of the detailed forest site types is being prepared. (See also Project P-242 for Petawawa Forest Experiment Station). Individual cards for each type were set up showing the cover type, age, lesser vegetation, soil, topography, site class, and probable silvicultural treatment required to ensure production of red and white pine. A new set of aerial photographs, ten chains to one inch, taken in the spring of 1955, were used for the mapping and were found satisfactory.

Maps

Site type map, and cards for the Headquarters Silvicultural Area at the Petawawa Forest Experiment Station. W. G. E. Brown and M. Bowen

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

Sites were investigated in Forest Section B.8 as part of the general scheme of forest site classification for Canada and also to provide background information for future growth and yield studies. W. G. E. Brown

Problem 16

OBSERVATIONS ON ASSOCIATIONS AND TREE RESPONSES AND FACTOR BEHAVIOUR

This problem deals with the ecology of forest associations and tree species.

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

The report on the ecological relationships of red and white pine on various soils and in various local climates was revised for inclusion as a chapter in the red and white pine monograph (Project H-87). Proposals for future work include a detailed study of root development throughout a range of soils, sub-types, and local climates. This will be carried out mainly at the Petawawa Forest Experiment Station in cooperation with the staff of the station. (See also Project H-87).

Reports

Revised report on the ecology of the pine types. (Binder 1123) 44 pages. W. G. E. Brown

Reproduction of red and white pine in the Great Lakes--St. Lawrence Region, prepared for the International Union of Forest Research Organizations. 12 pp., W. G. E. Brown and K. T. Logan.

Problem 17

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

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

The aim 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.

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

Project Q-57: Soil treatments in white spruce plantations, at Proulx

Twelve fertilizers or treatments were tested on duplicate trees on a moist sand site where white spruce growth has been poor. The results of these treatments will be assessed in the fall of 1956. W. G. E. Brown

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

Sites on Manitoulin Island were examined and some preliminary mapping done. The information will be incorporated in the report for Project H-94 by the Ontario Research Unit.

Project H-72: Growth and yield survey in Forest Section B.7

Instruction was given to foresters of the Consolidated Paper Corporation, on their Casey and Metabatchouan limits, on site typing of growth and yield plots, which are to be used with those of other companies in the preparation of yield tables for the forest section. W. G. E. Brown

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

Typical forest site types, chlorotic and stunted trees were examined at the Valcartier Forest Experiment Station and suggestions made for future studies. W. G. E. Brown

Project H-77: Growth and yield survey, Goulais River Area

The landforms and site types were examined and described and a preliminary forest site type map made. (See also Project H-77, Ontario Research Unit.)

Map

Map of the Goulais area showing the forest site types.
W. G. E. Brown and J. Jarvis

Project NF-27: Heath land site improvement

An examination was made of heath land to determine if the treatments proposed for its improvement were compatible with the sites. Some changes in the treatments were proposed. (See also Project NF-27, Newfoundland District.)
W. G. E. Brown

Project NF-20: Newfoundland forest site classification

The forest cover, lesser vegetation, soil, potential and present productivity were examined as a check for site-typing from aerial photographs. It is considered that a satisfactory site classification can be obtained from aerial photographs, supplemented by some ground investigation. (See also Project NF-20, Newfoundland District.) A report was prepared by Mr. Gill before he retired from the Branch, and it will be slightly revised for publication in 1956 (Binder 1251) 35 pages. W. G. E. Brown

Additional Reports

Publication

An article entitled "Roads and Lands" was published in Timber of Canada. A paper was given on the subject at the annual meeting of the Pulp and Paper Association of Montreal, in March.
W. G. E. Brown

Petawawa Forest Experiment Station

Forest Research Division Forestry Branch

Chalk River, Ontario

Superintendent: A. B. Vincent

Research Foresters	Assigned Problems
*A. B. Berry	23, 24
M. G. Bowen	23, 24
*J. L. Farrar	18, 19
D. A. Fraser	18, 19
*J. W. Fraser	18, 19
M. J. Holst	20, 21, 70, 72
*K. T. Logan	18, 19
C. W. Yeatman	20, 21, 70, 72

*These officers, attached to the Ottawa office, work chiefly at Petawawa.

PETAWAWA FOREST EXPERIMENT STATION

Summary

Several types of intensive field studies are in progress which require measurement of the environmental factors. These include studies on the condition of yellow birch, flowering habits of spruce, growth of pine on different moisture regimes and under variations in crown canopy density, and an investigation concerned with ventilation and temperature profiles of a natural "frost pocket". No appreciable change in the condition of yellow birch occurred in 1955. There are indications that 1955 was a good year for flower-bud formation of spruce. After three years, moisture regime has had little effect on the growth of white pine seedlings, though the response to increased light is marked.

Work is continuing on the responses of species to changes in the environment under controlled conditions. Full exposure to wind and sunshine depressed height growth of 2- and 3-year-old seedlings of white pine, white spruce, and red maple. On older seedlings height growth was about the same in full light and half shade, but dry weight was much greater in full light. Lack of germination in a mull soil was attributed to oxygen depletion by soil organisms. Spruce and birch seedlings are being grown in soil with radioactive calcium added. A drought treatment before exposure to frost resulted in increased damage to young spruce and pine seedlings. Work on the effect of photoperiod and antiauxins on the induction of flower buds in spruce is being continued. Artificially lengthened days caused spruce and pine seedlings to continue growth later in the season.

New specimens were added to the herbarium, with most emphasis put on tree seedlings.

Spruce-breeding continued to constitute the main part of the tree-breeding program. The value of diversification was illustrated by the red spruce provenance experiment for which an adequate number of transplants were produced only at the Acadia nursery. Elite specimens of white spruce were selected and propagated by grafting. A provenance experiment was sown in the nursery, and a one-parent progeny test was field-planted. Similar work is under way with black spruce. Hybrids between black and red spruce were investigated. Two provenance experiments with Norway spruce were set out as 2-0 seedlings, and three more were sown in the seedbeds. Development is proceeding on a hybrid spruce which is frost resistant and not subject to weevil damage.

One parent progeny tests with red pine showed surprising differences in view of the well-known uniformity of that species. A jack pine provenance study is being carried out. Various treatments are being tried in order to induce flowering in young pine. These include day lengthening, adding fertilizer to soil, changing its pH, withholding water, root pruning, and stem girdling.

Highly successful grafting techniques have been worked out, applicable to a variety of conditions.

Preliminary work is continuing on the 1,000-acre area set aside for the demonstration of silvicultural cutting methods. A site-map of the area has been prepared; the right-of-way has been cleared for the basic road system;

and dead and down timber has been salvaged on about 65 acres. Compartment 5 of the 65-acre woodlot was cut as scheduled.

Twenty-nine permanent sample plots concerned with a variety of silvicultural experiments were remeasured.

An outline of the years' work by problems and projects follows:

Problem 18

DETERMINING THE DIFFERENTIAL RESPONSES OF TREE SPECIES TO THE ENVIRONMENTAL FACTORS

Progress in silviculture, site classification, and tree breeding will be hastened if a fund of knowledge is available concerning the inherent behaviour of trees and the variations which occur as the environment varies. Information is gained through field observations, laboratory investigations of function and anatomy, and growing trees under controlled environment. Radioactive isotopes are being used in the study of the internal processes of trees. The environmental factors whose effects are being studied are light, temperature, soil moisture, and ventilation both separately and in combination.

Project P-15: Petawawa herbarium

During the current season, 42 species of trees and high shrubs were collected and mounted for instruction and display purposes in Riker mounts. Thirty-one specimens of forest vegetation were also collected, identified, mounted and indexed. Various juvenile seedling stages of 30 native tree species were collected and mounted. This herbarium now contains some 600 specimens.

J. W. Fraser

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

During the 1955 field season, juvenile seedlings of 30 species native to the Petawawa area were collected, pressed, and photographed. Some microphotographs were taken of characteristic toothing or gland formations. Some mock-ups have been prepared and will be submitted for approval of the technique used and quality of pictures obtained.

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 investigate responses of tree species to light and develop techniques for studying such responses. The most promising techniques will be expanded and used in separate projects to demonstrate the light requirements of tree species. Ventilation is often affected by methods used to alter light. Three experiments have been designed to separate the effects of light and ventilation. Results to date show that white pine, white spruce, and red maple grow best during their first three years if they are protected from wind, intense light, or both. This is not necessarily true of older seedlings.

No single technique has proved entirely satisfactory for use in testing light requirements of all species. Using small cage-type shelters, a sound experimental design is possible but an elaborate set-up is required to test a single species. Large walk-in shelters will be tried next year. Large shelters will permit less replication, but they have several advantages: many species can be tested simultaneously, there is better ventilation, less border effects, and they are more convenient.

Publication:

An Integrating Light Meter for Ecological Research. K. T. Logan. Forest Research Division, Technical Note No. 13. 1955. 4 pages.
K. T. Logan

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

The following publication was issued:

Effect of Watering, Shading, Seedbed Medium and Depth of Sowing on Red Pine Germination. Canada, Dept. Northern Affairs and National Resources, Forestry Branch. Technical Note No. 15, 1955. 3 pages. by J. W. Fraser and J. L. Farrar

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

This is a general project for exploring the responses of trees to variations in soil moisture and for developing techniques related to the manipulation and measurement of soil moisture. Promising leads are developed under separate project numbers. An experiment on the effects of soil drought on month-old red pine and white spruce showed that bringing the soil to the permanent wilting point before subjecting the plants to frost substantially increased the damage due to the frost. Root tips of large trees were excavated and successfully introduced into glass tubes filled with soil so that daily root growth could be measured. J. L. Farrar

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

White pine seedlings were grown in the woods in four levels of light and three of moisture. Light conditions were created by cutting the overstory and/or underbrush. The experiment was laid out on three moisture regimes - moist, somewhat moist, and very moist. Seedling growth and environmental factors were measured. Height growth and leader diameter increased with increasing light, but moisture regime showed little effect. Soil moisture studies with Colman units showed interesting effects of vegetation on soil moisture in wet and dry years.

K. T. Logan

Project P-372: Frost resistance of young seedlings

Investigations of natural frost effects on survival and development of seedling stock continued on the area known as the Centre Lake Frost Pocket. Measurements of temperature, evaporation, etc., were taken throughout the season so that microclimatic conditions and frost development could be tied in to topography. As in 1954, the season was not normal so that the necessity of a further season's measurements must be considered if this area is to be properly evaluated for frost studies. Planting of 2-0 red and jack pine and white spruce was only partially successful because of abnormally hot and dry conditions. The use of different sizes and types of test tubes and other containers for growing seedlings for frost tests in sub-zero cabinets was investigated.

J. W. Fraser

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

A paper entitled "The diffusion pressure deficit of water in roots" was presented at the Annual Meeting of Canadian Plant Physiologists, October 31, 1955, Ottawa (Binder 1214, 11 pages).

A paper entitled "Movement of water between tree roots and soil" is being prepared for publication by the Forestry Branch. J. L. Farrar

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

A manuscript entitled "Ecological Studies of Forest Trees at Chalk River, Ontario, Canada. III--Annual and Seasonal March of Soil Moisture Under a Hardwood Stand" (Binder 1280) 12 pages, was completed and submitted for publication. A fourth part in this series--"Annual and Seasonal March of Soil Temperature under a Hardwood Stand" is almost finished.

No appreciable change in the condition of yellow birch occurred in 1955. D. A. Fraser

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

Fiberglas soil units used in field studies have been calibrated using wilting point index as indicated by sunflowers and birch seedlings. Completion of this project requires the use of growth chamber and greenhouse facilities which will be available in September, 1956. D. A. Fraser

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

An invitation paper entitled "Translocation of Minerals in Trees" was presented at the Annual Meeting of Canadian Plant Physiologists, October 31, 1955, Ottawa. This paper was enlarged and accepted for publication as a Forestry Branch Technical Note. (Binder 1241, 21 pages.)

A report on the first course for non-U.S. citizens on "Use of Radioisotopes in Biological Research at the Oak Ridge Institute of Nuclear Studies" was submitted. (Binder 1206, 21 pages.)

Spruce and birch seedlings are being grown in soil with radioactive calcium added. D. A. Fraser

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

During the current season emphasis was placed on the soil temperature factor by carrying out identical experiments at three temperature ranges: 45-50°F; 70-75°F; 95-100°F. Jack and red pine seeds were sown in coarse sand, nursery soil, and mull at normal moisture capacity and sealed into 14-ounce cans placed in water baths for 10, 12, and 16 days. No germination occurred at 49°F., nor did any occur in mull at any temperature. The latter was attributed to the action of soil organisms in depleting the oxygen supply below the essential minimum. J. W. Fraser

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

Five light conditions were created in the nursery through use of lath and screen shelters. Four-year-old white pine seedlings were planted in the shelters and their growth studied during the ensuing four years. At the end of that time, a proportion of the seedlings were carefully dug up and oven-dry weights determined. Oven-dry weights of both roots and tops increased proportionally with an increase in light up to full daylight. Height growth, on the other hand, showed little increase beyond about 40 per cent of full daylight. The results are now being prepared for publication.

K. T. Logan

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

An experimental plot of white and black spruce on different moisture regimes is being studied for flowering and growth characteristics. There are indications that 1956 will be a good flowering year.

Work on the effect of photoperiod and antiauxins on the induction of flower formation in young spruce trees is being continued.

D. A. Fraser

Project P-386: The effect of temperature on germination, growth, and development of native tree species

Work on development of instrument shelters was continued from May to December. This was done in the new nursery area in conjunction with daily records of rainfall, evaporation, temperature and humidity. At the same time, similar information was obtained daily on a normal grass-covered site at Thomas Field. Recording 3-pen soil-thermographs were installed at both locations to check the best method of installation and operation on a year-round basis.

J. W. Fraser

Problem 19

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

This is a companion problem to No. 18. Both problems deal with certain of the environmental factors. Problem 18 deals with the effect of these factors in the tree; Problem 19 deals with the occurrence of these factors under natural conditions, and their modification by silvicultural procedures. There is a close relationship between the investigations under this problem and site classification. Thus far, work has been confined to that which is essential for carrying out certain projects in Problem 18, and is reported under that Problem.

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

K. T. Logan

Project P-372: Frost resistance of young seedlings

J. W. Fraser

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

D. A. Fraser

Problem 20

SELECTION, BREEDING, AND GENETICS OF SPRUCE

Current work continues to concentrate 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

The seedbeds of the red spruce provenance experiment were successful only at Acadia, while those at Valcartier and Petawawa were rather poor. Although twice the amount of seed necessary was sown, it is doubtful if the experiment can be planted according to plan.

One hundred and seventy-five grafts of red spruce were made.

M. J. Holst

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

Cone collections planned for the fall were abandoned owing to the paucity of cones. It is hoped that the hot and dry summer will induce a heavy flowering in 1956.

A day-length experiment with 1-0 stock of a variety of white spruce provenances was conducted (Exp. No. 145) exposing the seedlings to 8, 12, 16 and 20 hours of light. No clear differences appeared between provenances, although the differences between treatments for all provenances were quite marked.

Two one-parent progeny tests (Exp. No's. 71-A and 71-B) and a provenance test including white and Norway spruce (Exp. No. 73) were field planted. An experiment was planted using yellow tipped and healthy white spruce (Exp. No. 164) in an attempt to determine the cause and effects of the yellowing.

A provenance experiment with Labrador, Quebec and Ontario white spruce was sown in the nursery (Exp. No. 144). It is expected this material will be used for the study of the variation of botanical characters.

Exp. No. 165, similar to Exp. No. 73 above, was planted at Harrington Forest Farm, P.Q.

The following article was published:

Some Provenance and Selection Problems in Eastern Canadian Tree Breeding. M. J. Holst. Pulp and Paper Magazine of Canada. Woodlands Review. pp. 18-23. November 1955.

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

Ten white spruce plus trees were selected within and about Algonquin Park, and 1,000 grafts were made from them.

It is proposed to make a further search for plus trees within areas which have a climate similar to that at the Petawawa F.E.S. It is hoped that cones may be collected from previously selected white spruce.

M. J. Holst

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

A black spruce provenance experiment (Exp. No. 143), including Labrador, Newfoundland, Quebec and Ontario provenances, was sown in the nursery.

M. J. Holst

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

A one-parent progeny test (Exp. No. 72) of black spruce and red x black spruce hybrids was planted. Some herbarium material was collected for further study.

It is proposed to cross black spruce with southern red spruce.

The following paper was published:

Notes from a trip to the Southern United States, January 1953. C. C. Heimburger and M. J. Holst. Forestry Chronicle 31(1): 60-73. 1955.

M. J. Holst

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

Stock from the following experiments were shipped as 2-0 seedlings for transplanting and the subsequent establishment of plantations:

Exp. No.	Title	Agent
57	Provenance experiment including five races of Norway spruce to be planted in Quebec	Forestry Branch Valcartier F.E.S., P.Q. (also Nicolet and Drummondville)
166	Observation plots of German and Austrian Norway spruce originating from plus stands, Gore Bay, Ontario.	Ontario Paper Co. Gore Bay, Ontario.

The following experiments were sown:

142	Comparison of branch types of Swedish Norway spruce from Hedesunda	Forest Ranger School Dorset, Ontario.
141	Same title	Petawawa F. E. S.
131	Observation test of nine Norway spruce provenances.	Forest Ranger School Dorset, Ontario.

M. J. Holst

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

Acquisition of material continued, based on the hypothesis that weevil resistance can be transferred to Norway spruce from white spruce (or Picea pungens) by means of an intermediate crossing bridge. Sitka spruce is a

possibility, but as it is a coastal species it is not hardy in a continental climate. It is likely Picea kojami or P. koraiensis would be better for the purpose. However, it has been difficult to locate material of these Asiatic species.

Two single tree progeny experiments (No's. 120-A and 120-B) were planted. Nine hundred and sixty-three grafts were made of 13 Norway spruce selected in New York and Quebec for their high resistance to weevil damage. The collection of slender, hardy, and potentially weevil-resistant Norway spruce now totals about 30.

Norway spruce at Hudson's Place (P.A. 118) were self-pollinated in an attempt to define weevil resistance and weevil susceptibility.

In order to further the development of a crossing bridge between white and Norway spruce, the following material was propagated:

Picea kojamai and Picea omoreka - 80 grafts
Picea sitchensis . . . . . - 20 grafts
Three population samples of
Russian Norway spruce . . . . - 209 grafts

Sitka spruce is susceptible to both the eastern white pine weevil and the western Sitka spruce weevil. White x Sitka spruce hybrid seed from stands in Denmark were put on trial for hardiness and weevil resistance in the following localities:

Acadia, N. B.	Exp. No. 134
Quebec	Exp. No. 135
Newfoundland	Exp. No. 136
New York	Exp. No. 138
Petawawa, Ontario	Exp. No. 139
Dorset, Ontario	Exp. No. 137

These hybrids, together with selected white spruce and Norway spruce provenances, were also sent to:

Green Timber Nursery, B. C. Exp. No. 129
Forest Industries Nursery, Wash. D. C. Exp. No. 127

The following work is proposed for 1956-57.

1. To cross local white spruce and Norway spruce with pollen collected in various arboreta of Picea kojamai, Picea koraiensis and a northern type of Picea jezoensis.

2. To select more weevil-resistant Norway spruce.

3. To graft population samples of Picea kojamai, Picea koraiensis, and northern Picea jezoensis.

The following reports were written or published:

1. An Observation of Weevil Damage in Norway Spruce. M. J. Holst. Forestry Branch, Tech. Note No. 4. 1955. 3 pages.

2. Breeding for Weevil Resistance in Norway Spruce. M. J. Holst. Zeitsch. Forst genetic 4(2):33-37, 1955.

3. Notes on the Norway Spruce-White Pine Weevil Relationship in the Adirondacks. Alumni News. New York Ranger School. In print.

4. Travel Report for a Trip to New York and Quebec Made in the Fall of 1955 by Mark Holst. File Report. 10 pages. M. J. Holst

Problem 21

SELECTION, BREEDING, AND GENETICS OF HARD PINES

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

Hybridization with red pine was planned for the spring, but flowering occurred about two weeks earlier than usual and pollen requested from outside did not arrive in time to be of use.

The nursery provenance experiments (Exp. No. 68 and 68-A), and nursery one-parent progeny test (Exp. No. 69) were followed with phenological observations. A rough check of these data indicates that differences in height of various provenances are not only related to differences in summer temperature index (or length of growing season) but also seem to be related to inherent differences in growth cycle.

The one-parent progeny test showed surprising differences. It is usually very difficult to see differences in growth and quality in any one stand, as most stands originate from few mother trees after fires. The trees are therefore closely related. Instead of testing a number of trees from one stand, one tree from each of several stands scattered within the Petawawa F.E.S. area was tested. The differences in height-growth displayed in this small experiment were clearly related to growth cycle, i.e. the trees of exceptional height also displayed exceptional growth curves.

A number of red pine provenances were subjected to various day lengths, but the experiment failed, perhaps because of too heavy (rich) soil and over-watering.

In 1956 it is proposed 1) to conduct phenological observations on the red pine nursery provenance experiment (Exp. No. 74-A); 2) write a report on red pine provenance experiments; 3) propagate promising single trees; and 4) plant two field provenance experiments (Exp. No's. 74-B and 74-C).

M. J. Holst

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

The jack pine nursery provenance experiment was followed with phenological observations to study the shoot growth pattern in relation to total height of the various provenances. The data have not yet been compiled (Exp. No. 70).

The jack pine provenance problem is now under intensive investigation in the Lake States. The Forestry Branch was offered some of this plant material

for planting in Canada. Sixteen jack pine provenances were planted at Petawawa F.E.S. in an experiment with a statistical design (Exp. No. 125), and observation plots with the same 16 provenances were planted at Valcartier F.E.S. (Exp. No. 132) and at Harrington Forest Farm (Exp. No. 133).

About 1,000 grafts were made of jack pine population samples (Exp. No. 130). This material is intended for future provenance hybridization.

M. J. Holst

Project P-141: Provenance experiments with exotic hard pines

Fifty-six grafts of the group Lariciones and hybrids were field planted in the Pine Graft Arboretum, P.A. 115.

An observation and selection plantation of single-stemmed mugo pine is to be planted in 1956 (Exp. No. 184).

One hundred and thirty-five grafts are to be planted in the arboretum.

M. J. Holst

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

Phenological observations were made on Experiment No. 69, nursery one-parent progeny test, throughout the growing season. The data were summarized and a report is to be written. M. J. Holst

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

A few crosses were made on rootstocks and scions in the greenhouse, including Scots pine and red pine crossed with Virginia pine.

It is proposed to pollinate Petawawa red pine with southern (Lake States) red pine, and with Pinus densiflora and P. thunbergii.

The following report was published:

The Breeding of Hard Pine Types Resistant to European Pine Shoot Moth. (Rhyaconia buoliana Shiff.) M. J. Holst and C. C. Heimburger. Forestry Chronicle 31(2):162-169. 1955. M. J. Holst

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

In an attempt to overcome the juvenile phase in pine seedlings, a number of experiments were initiated with red, jack, and Scots pine using a combination of varying day lengths, soil fertility and pH, and shock treatments,

(Exp. No's. 148, 150, 152, 154). The flower-inducing effect of a combination of fertilizer and root pruning on standard size nursery plants of red, jack, and Scots pine was also investigated (Exp. No. 156), and the same combination was studied in man-height plantations of Scots pine (Exp. No. 157), red pine (Exp. No. 159), and jack pine (Exp. No. 160). Various fertilizers applied in three doses were given to one of the young red pine plantations in Drury Forest which was thinned for seed orchard purposes by the Ontario Department of Lands and Forests (Exp. No. 167).

The effects of the treatments used in the experiments established in 1955 will be measured in 1956. It is proposed to establish further experiments to induce flowering.

M. J. Holst

Project P-146: Interspecific hybridization in the group Insignes

Jack pine was crossed with Virginia pine in the greenhouse. It was again observed that jack pine abort the flowers readily.

It is proposed to repeat the crosses on jack pine with Virginia pine.

Twenty grafts were field planted in P.A. 115, and 430 grafts are to be planted in the spring of 1956.

M. J. Holst

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

To meet requests for information about Scots pine provenances suitable for Christmas trees, our Scots pine provenance experiment was measured and rated for important Christmas tree characteristics (Exp. No. 170). The conclusions of this study were that although none will give 100% utilization, there was a great difference between provenances. It is suggested that plus trees should be selected and propagated for seed orchard purposes.

Five Scots pine Christmas trees were selected and grafted (117 grafts). The total number of potential elite Christmas trees is now forty.

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.

The work in 1955 consisted mainly in increasing the collection of various conifers.

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

White pine nursery experiment No. 32 was measured at the end of the growing season.

M. J. Holst

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

The seed of one lot of improved Alp larch was distributed for trial at Petawawa; New York; Dorset, Ontario; and Drummondville, P.Q. (Exp. No. 172).

The following report was written:

Observation of various provenances and single tree progenies of Larix for further selection. M. J. Holst. Establishment report for Exp. No. 35. (Binder 1203) 7 pages.

M. J. Holst

Project P-150: Selection of suitable Douglas fir for Eastern Ontario and elsewhere

2-0 Douglas fir was lined out in the transplant beds in the spring.

M. J. Holst

Problem 72

DEVELOPMENT OF TECHNIQUES AND THE MAINTENANCE OF FACILITIES FOR TREE BREEDING

Project P-4: Acquisition and distribution of plant material

Aspen pollen was sent to Sweden, Denmark, and France, and extensive collections of balsam fir seed were made for the benefit of reforestation projects in Greenland and Iceland.

Other small requests for plant material were filled.

M. J. Holst

Project P-51: Nursery work

A total of 81,300 2-0 seedlings were transplanted. Fifty per cent were spruce, 40 per cent hard pines, and 10 per cent larch.

The nursery was enlarged by 3.9 acres by cutting and clearing a red pine stand south of the nursery. This makes a total of 15.6 acres.

M. J. Holst

Project P-60: Techniques in forest tree breeding

Experiment No. 124 was conducted to investigate the inter-species grafting of red, jack and Scots pine. A total of 184 grafts were made. The preliminary results indicate that: red and jack pine do very poorly on each other; jack pine does best on jack pine, Scots best on Scots, but red pine does best on a Scots pine rootstock.

The following reports were presented:

Scion Storage and Graft Protection in Spring Grafting of Red Pine. M. J. Holst. Issued as Technical Note No. 29. 11 pages.

Phenology of Rootstocks and Grafts in a Timing Experiment with Autumn and Winter Grafting of Norway and White Spruce. M. J. Holst. (Binder 1117) 21 pages.

Greenhouse Grafting of Spruce and Hard Pine at the Petawawa Forest Experiment Station. M. J. Holst, J. A. Santon, and C. W. Yeatman. Issued as Technical Note No. 33. 24 pages.

Forest Tree Breeding in Canada. M. J. Holst.

M. J. Holst

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

The test plantations established in 1955 have been listed under the appropriate project headings above.

A total of 21,500 plants were planted in eight experiments at Petawawa F. E. S. Four hundred and fifty grafts were planted in the pine graft Arboretum. Some 16,500 2-2 transplants were shipped out for field planting at Valcartier F. E. S. and at Harrington Forest Farm. About 74,600 2-0 seedlings were sent to Gore Bay, Valcartier, and Harrington Forest Farm for transplanting and for subsequent field planting.

Plantation areas have been cleared and partly cultivated for the 1956 planting program.

The following reports were written:

Report on Spring Planting 1955. File report (Binder 1194) 10 pages. C. W. Yeatman.

Brush Spraying--1955. File report. C. W. Yeatman. 3 pages.

M. J. Holst and C. W. Yeatman

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. The timber removed is either used by the Station or sold.

Project P-82: Corry Lake woodlot

This 60-acre woodlot has received regular treatment since 1942. This year, Compartment 5 was marked and cut over as prescribed in the management plan. Next year it is proposed to revise this management plan for future work. An assessment of past work and its results will be made and published.

M. G. Bowen

Problem 24

SILVICULTURAL TREATMENTS OF STANDS

The importance of silviculture in Canadian forestry is rapidly increasing. There is need for more knowledge to aid the development of silvicultural skills and to determine the treatments best suited to various conditions. These treatments must be tried and compared.

Project P-37: Logging for jack pine and mature conifers in white birch--balsam--spruce--pine type

This project was initiated to study the results on the residual stand after logging for jack pine and other mature conifers. The two transect plots were measured in 1938, 1945 and 1955. A report will be prepared.

Project P-242: Headquarters silvicultural area

The objects of this project are to experiment, practice, and demonstrate silviculture on an intensive yet practical basis on a variety of sites in one large area.

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

An area of some 1,000 acres in the vicinity of the Station headquarters has been definitely set aside and some 4,000 acres adjacent have been reserved. A preliminary plan has been written and site maps prepared to assist in applied silviculture.

Two and one-half miles of right-of-way were opened up and the timber removed as a salvage operation. Further salvaging was done on a 65-acre area that had been damaged during Hurricane Hazel and which is now being subjected to a general improvement cutting. It is planned to extend the basic road system a further 3½ miles next year and to complete the following:

1. Maps showing data useful for silvicultural and other operations.
2. Selection and sampling of treatment areas.
3. Location of access trails.
4. A comprehensive silvicultural plan and related working plans.

M. G. Bowen

Project P-325: Strip cutting of jack pine, effect on reproduction

Technical Note No. 1, "Strip-cutting in a mixed pine stand", by J. W. Fraser and J. L. Farrar, (16 pages) has been distributed. The project has since been closed and the data transferred to P-34.

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

A report was submitted by E. S. Atkins on the results of this study: "A preliminary investigation of the relationship between growth of white pine regeneration and soil fabric in Eastern Ontario". (Binder 1228) 9 pages.

MISCELLANEOUS PETAWAWA PROJECTS

Project P-220: Debudding of red pine

The objective in debudding trees is to produce a knot-free butt log. Three plots were established to study the debudding of red pine. The debudding on two of the plots was discontinued in 1950 as the trees had produced a 16-foot clear log. The third plot was debudded again in May 1955. The treatment on this plot will be continued for another year by which time most of the trees will have the required 16-foot clear log.

Diameter and height measurements were made on all plots during the year. Preliminary analysis of the data shows that debudding has reduced the diameter, height, and volume of the trees but this may be offset by an increased return from the clear log when the trees reach maturity. A. B. Berry

Project P-224: Work on permanent sample plots

The primary object of this project is to periodically remeasure and maintain most of the permanent sample plots on the Station which have been used for specific research projects. Information is obtained on the growth and other changes in individual trees and stands in a variety of cover types and conditions.

During the year all the trees on a total of 29 permanent sample plots were remeasured and the data were compiled using IBM mark-sensing techniques. Next year another 29 permanent sample plots will be dealt with in the same manner according to the remeasurement schedule. A. B. Berry

Project P-225: Natural Areas

The objectives here are to reserve from cutting areas which are representative of important cover type--site type combinations in the region, and to observe and study their ecology.

Seven areas had been established prior to 1954. One additional area was established in 1954 and the sampling completed in 1955. It is proposed to establish additional areas at the rate of one a year for the next ten years.

A. B. Berry

Ontario Research Unit

Forest Research Division Forestry Branch

238 Sparks Street

Ottawa

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

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

*Transferred to Maritimes District Office, July, 1955.

ONTARIO RESEARCH UNIT

Summary

The preparation of a bulletin on the white and red pine cover type in Ontario and Quebec was continued, and publication is expected in 1957.

At the request of a large company, operating in white and red pine, a co-operative cutting experiment was set up to investigate methods of regenerating pine on dumped till.

The Goulais River Observation Area is to be remeasured in 1956. The area was reconnoitred in 1955 to determine the land forms, site and cover type relations, and road conditions.

The second annual regeneration survey of a yellow birch cutting experiment area at Kennisis Lake was carried out. The 1955 growing season was one of the hottest and driest on record, but, even on the drier sites of the treated section, yellow birch seedlings put on excellent height growth, and some of the 2-year seedlings are now more than 3 feet tall. Deer browsing is becoming a serious problem, and 3 deer exclosures were erected to assist in the assessment of future damage.

A new project (also at Kennisis Lake) was initiated to find means of improving yellow birch stocking of cut-over land. The experiment is on land that was logged 9 years ago and failed to regenerate to yellow birch. Trees were frill-girdled and poisoned, leaving a uniform residual stand providing 30 per cent shade. Seedbeds were prepared by a D-6 caterpillar tractor equipped with a bulldozer blade. Alternate 1-chain strips were scarified, and since no yellow birch seed trees were present, the scarified areas were seeded.

In 1936-38 a cutting experiment was carried out, in the black spruce swamp type at the Petawawa Forest Experiment Station, to determine the effects of commercial, clear, and partial cutting, combined with three methods of slash disposal. The results show satisfactory black spruce reproduction under all treatment-combinations and heavy mortality wherever more than 50 per cent of the stand was removed in partial cutting.

An investigation of methods of preparing height/diameter curves was completed and a report will be written in 1956.

Plantations of 11 pulpwood companies were examined near Iroquois Falls, Kapuskasing, Fort William, Savanne, Goulais River, Agawa River, Manitoulin Island and the Lievre River. Representative samples were examined in detail and emphasis was given to growth measurements and observations of stand and site conditions. The work will be extended to other areas and completed in 1956.

A total of 2,250 white spruce seedlings were planted by the saddle, half saddle, and wedge methods. The different planting methods have not been reflected in appreciable growth differences, but first-year survival was 20 per cent less for the full saddle than for the other two methods. Winter mortality was light. Most of it occurred during the hot-dry summer of 1955.

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 not reproducing after cutting. 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.

A survey of white and red pine areas in Ontario and Quebec was made to gather data on the silvics, ecology, growth, yield, and response to different types of disturbances. The information and experience gained is a necessary preliminary to intelligent research planning, and will also form the basis of a bulletin on the cover types. Current work is being directed toward the preparation of this bulletin. In addition to the results of the survey, it will include a review of literature, previously unpublished results from a variety of research projects, and recommendations for silviculture.

The bulletin forms the groundwork for long-term objectives in the white and red pine cover types. These are directed toward developing and testing methods of regenerating pine, and of improving their growth on the sites on which they normally occur. Regeneration studies are being carried out on two important land types, and preliminary results will be available within two years.

Project H-87: Preparation of a bulletin on the white and red pine cover type

The data have been compiled and analysed, and drafts of individual sections prepared. Preparation of this report took much longer than was expected, and the publication will not be available until 1957.

G.H.D. Bedell

1955-56 Reports

(1) Silvics of White and Red Pine - Chapter II. J.L. Farrar. Based in part on material supplied by other contributors. (Binder 1261) 31 pages.

(2) Regeneration of White and Red Pine - Part 1: Natural Regeneration. K.T. Logan. (Binder 1213) 38 pages.

(3) Growth and Yield of White and Red Pine (2nd draft). R.J. McCormack. (Binder 1126) 39 pages.

(4) Chapter VII - Part III - Harvest Cuttings - Review. R.J. McCormack. (Binder 1229) 4 pages.

(5) Chapter VIII - Recommendations for Silvicultural Management - Natural White and Red Pine Stands. R.J. McCormack. (Binder 1249) 7 pages.

(6) Review of Applied Silviculture in the White and Red Pine Types. R.J. McCormack. (Binder 1121) 4 pages.

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

At the request of a large company operating in white and red pine, a co-operative project was set up to investigate methods of regenerating a dumped till land type. Seed trees were marked, the area was scarified during the summer of 1955, and was logged in the late fall of the same year. Seedfall was estimated.

Germination and survival on the treated area will be followed and compared to that of an adjacent control area. No results will be available for at least two years. A statement on this project is included in head office report. R.J. McCormack

Reports

(1) Recommendations for Treatment of Glacial Till Areas. R.J. McCormack. 4 pages.

(2) Report on Pine Problems in the North Bay District. R.J. McCormack. 3 pages.

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

Many outwash sands suitable for pine are occupied by poor aspen stands, and means of type conversion are being studied. During the summer of 1955 further tests of regenerating pine by seeding, and by planting with seedbed stock, were tried. Both spring and fall treatments were investigated, and some of the seed was treated with a rodenticide. An extremely hot-dry summer resulted in excessive mortality, and further experimentation will be necessary. R.J. McCormack

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

Further studies of local climate effects on the phenology and growth of white and red pine were carried out in 1955. Measurements of climatic factors were extended to include air movements and surface temperatures. A report on the results of two years' measurements will be available early in 1957. R.J. McCormack

Petawawa Pine Projects

A series of projects was examined, and the following reports written:-

Reports

(1) Browsing in Natural Pine Stands at Petawawa, Ontario. R.J. McCormack and A.B. Berry. (Binder 1209) 7 pages.

(2) Releasing an Understory of White and Red Pine - Project P-27. R.J. McCormack and A.B. Berry. (Binder 1235) 11 pages.

(3) Growth and Development of an Understory - 15 Years After Removal of a Mixed Pine Overstory - Project P-34. R.J. McCormack. (Binder 1227) 8 pages.

(4) Growth and Development of a White and Red Pine Understory After Four Intensities of Overstory Removal. R.J. McCormack. (Binder 1253) 17 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. Present logging methods usually leave a residual stand of this defective maple which could only be used for such products as dissolving pulp, firewood, and charcoal. These overmature and defective trees suppress advance growth so that it, in turn, becomes defective before reaching maturity. The scarcity of yellow birch regeneration is mainly due to seedbed conditions, and to its inability to compete with sugar maple advance growth, particularly when under the shade of a comparatively heavy residual stand.

Treatments are being tested to regenerate the various sites to trees capable of producing merchantable timber.

Project H-77: Growth and yield survey Goulais River Area, (Forest Section L.10)

The Goulais River Observation Area, north of Sault Ste. Marie, is to be remeasured in 1956. In 1955 the land forms were described and relations of sites and cover types were determined. In addition, a 4-man party relocated 175 line plots, reblazed the lines to and between them, and repaired some of the access roads. A site map of the area has been prepared from air photographs. (A statement on this project is also included under Head Office report).

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 yellow birch

Reports

(1) An Ecological Approach to Tolerant Hardwood Silviculture. J.M. Jarvis. (Binder 1150) 64 pages.

This report is being published as a technical note. It summarizes the findings of a survey of tolerant hardwood stands in the northern part of the Great Lakes—St. Lawrence Forest Region in Ontario and Quebec. The forest sections have been divided into physiographic districts, and those in which tolerant hardwoods are most common have been described. The ecological characteristics of the hardwood species are discussed and recommendations made for their silvicultural management in each physiographic district.

J.M. Jarvis

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

The second annual regeneration survey was carried out, and the quantitative data were supplemented by an observational assessment of yellow birch seedling survival and development. Treated areas are still more than 70 per cent stocked - the stocking on the controls is 35 per cent. Furthermore, growth rate and chance of survival are much better, even on the driest sites of the treated area. The rapid height growth of the birch seedlings was maintained in spite of the extreme heat and drought in 1955, and some of them exceeded 3 feet in height at the end of the second growing season.

Deer browsing is becoming a serious problem, and 3 deer exclosures were erected to furnish means of assessing its effects.

J.M. Jarvis

Reports

(1) Deer Browsing on the Experimental Area at Kennisis Lake. J.M. Jarvis. (Mimeographed for limited distribution. S. & M. 56-3) 3 pages.

(2) Cutting and Seedbed Preparation to Improve the Stocking to Yellow Birch, Eyre and Havelock Townships, Haliburton County, Ontario. J.M. Jarvis. (Mimeographed for limited distribution. S. & M. 55-7) 4 pages.

(3) Cutting and Seedbed Preparation to Regenerate Yellow Birch in Haliburton County, Ontario. J.M. Jarvis. (Binder 1255) 18 pages.

This report is to be published as a technical note.

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

The experiment was carried out in two phases. The first, or establishment phase, was completed in the fall of 1954. The second phase was carried out in May, 1955. It included: (1) girdling and poisoning the marked trees in the treated areas; (2) laying out and tallying twenty-four 1/5-acre permanent plots; and (3) making a site map of the area. J.M. Jarvis

Reports

(1) Removal of Defective Trees to Improve the Yield of Sugar Maple Growing on Calcareous and Dolomitic Soils, Manitoulin Island, 1954. J.M. Jarvis. (Binder 1238) 42 pages.

This is an establishment report, providing a record of the data taken and briefly discussing the cultural treatments to be undertaken.

Project H-107: Girdling and seedbed preparation to improve the stocking to yellow birch in cut-over tolerant hardwood stands near Kennisis Lake

A series of experiments is being established to develop methods for improving the yellow birch stocking on tolerant hardwood sites. Some of these experiments (Project H-92) were established in uncut stands at the time of

logging. This particular project is on an area which was logged 9 years ago and has not regenerated to yellow birch. It is on land belonging to Hay and Company Limited, in Guilford Township near Haliburton, Ontario. In September, 4 sections of 10 acres each were laid out. Two were chosen at random for treatment and two were reserved as controls.

On the treatment area, the main canopy was reduced so that shading would be 30 per cent. Trees to be killed were frill girdled and poisoned; the girdling resulted in a reduction in basal area from 50 to 30 square feet per acre.

Seedbeds were prepared with a D-6 caterpillar tractor equipped with a bulldozer blade. Because of lack of yellow birch seed trees, the scarified areas were seeded. J.M. Jarvis

Reports

(1) Girdling and Seedbed Preparation to Improve the Stocking of Yellow Birch in Cut-Over Tolerant Hardwood Stands in Guilford Township, Haliburton County, Ontario. J.P. Peaker and J.M. Jarvis. (Binder 1271) 31 pages.

This is an establishment report covering the procedure followed in initiating the experiment.

Problem 44

SILVICULTURE AND MANAGEMENT OF THE BLACK SPRUCE COVER TYPE

Work in the black spruce cover type has been mostly concerned with growth and yield studies undertaken in co-operation with the provinces and with the pulp and paper industry.

The regeneration of cut-over areas, where advance growth is present, is not a serious problem. Advance growth is seldom present in adequate quantity except in overmature stands. As the need arises to cut stands at rotation age, for maximum production, regeneration problems will become more serious, and studies should be undertaken in the near future to meet this need. Considerable background information has already been obtained in connection with ecological observations in the intolerant mixedwood cover types.

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

Reports

(1) Northern Clay Belt Growth and Yield Survey. D.W. MacLean and G.H.D. Bedell. Technical Note No. 20. 31 pages.

(2) Preliminary Volume Tables for the Northern Clay Belt, Ontario and Quebec. A.B. Berry and D.W. MacLean. (Mimeographed for limited distribution S. & M. 55-5) 17 pages.

(3) Basic Data for Individual Yield Plots, Northern Clay Belt Growth and Yield Survey. (Mimeographed for limited distribution S. & M. 55-11.) 13 pages. D.W. MacLean.

Project P-328: Commercial cut in black spruce swamp effect on reproduction

AND

Project P-332: Clear cutting and partial cutting in black spruce swamps with various methods of slash disposal

These projects were undertaken at the Petawawa Forest Experiment Station to determine the effect of commercial, clear, and partial cutting, combined with three methods of slash disposal, on reproduction in black spruce swamps. Cutting was carried out in 1936-38, and the plots have been measured four times. The results show: (a) satisfactory black spruce reproduction, regardless of method of cutting or slash disposal; and (b) heavy mortality of residual stand is associated with partial cutting (where 50 per cent or more of the volume was removed). A.B. Berry

Reports

(1) Reproduction and Growth in Cut-over Black Spruce Swamps at the Petawawa Forest Experiment Station. A.B. Berry and J.L. Farrar. (Binder 1129). 10 pages.

This report is being published as a technical note.

Problem 45

SILVICULTURE AND MANAGEMENT OF THE INTOLERANT MIXEDWOOD COVER TYPES

The intolerant mixedwood cover type, consisting of various mixtures of trembling aspen, white birch, black and white spruce, and balsam fir, is a major source of wood for the forest industries in the boreal forest of Ontario. Each of the species that comprise the type has different silvical characteristics, and most of the current management practices tend to discourage spruce and to favour one or more of its associates. This situation is causing concern to company and governmental agencies.

A few cutting experiments have been initiated, but more are needed, particularly in stands of rotation age. During the past three years ecological observations have been made to provide background information useful in planning additional silvicultural experiments.

Growth and yield studies are continuing in co-operation with industry and the Ontario Department of Lands and Forests.

Project H-69: Nipigon growth and yield survey

Fifty yield plots were site typed. D.W. MacLean

Project H-89: Harvest cutting methods and seedbed preparation for the increased regeneration of spruce on mixedwood slopes, Heron Bay, Ontario.

Eight organizations are co-operating in planning and carrying out this large-scale cutting experiment in an overmature mixedwood stand near Heron Bay, Ontario.

The work assigned to the Ontario Research Unit in 1955 was limited to ecological observations. These were concerned with the seed crop,

the scarified strips, and the development of the cut-over areas.

D.W. MacLean

Reports

(1) The Black River Experimental Area Third Ecological Report. D.W. MacLean (Mimeographed for limited distribution. S. & M. 56-1.) 6 pages.

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

An observational assessment of the effects of environmental factors on the development of the various species of the aspen--birch--spruce--fir type is being carried out in Forest Sections B.4, B.8 and B.9. Particular emphasis has been given to the influence of these factors on the establishment and survival of reproduction, in order to provide background information for silvicultural experiments.

The project was begun in 1953. During the first two years a study was made of undisturbed stands and burns. In 1955 emphasis was placed on cut-over areas. A progress report will be completed in 1956.

D.W. MacLean

Problem 46

SILVICULTURE AND MANAGEMENT OF THE JACK PINE COVER TYPE

Jack pine has become an important species in the manufacture of pulp and paper in Canada, and is increasingly utilized for ties and lumber. It occurs to a large extent in stands of high yield per acre on poor sandy sites that would not produce an equivalent volume of any other species.

Jack pine cones remain unopened on the tree, and the species seldom reproduces itself adequately in the absence of forest fires. As a result, the majority of the cut-overs tend to regenerate to less desirable species.

Project H-72: Growth and yield survey, Forest Section B.7

(Co-operative with James Maclaren Company, Consolidated Paper Corporation Limited, and the Canadian International Paper Company Limited)

The Forestry Branch has been co-operating since 1948 in the establishment of growth and yield plots in the Quebec portion of Forest Section B.7. Six hundred and sixty yield plots have been established by the companies. Forestry Branch personnel co-operated by instructing company foresters in site typing and in plot establishment techniques, and by site typing some of the plots. In 1955 the Consolidated Paper Corporation established 180 plots, the International Paper Company 90 plots, and the James Maclaren Company re-established 15 plots. Forestry Branch personnel site typed 40 of these.

Insect and disease epidemics (jack pine sawfly, spruce budworm, and birch die-back) will have a serious effect on the use of remeasurement data for the preparation of stand density yield tables, and it may be necessary to use empirical yield tables based on single measurement. D.W. MacLean

Project H-75: Management plan of the West Branch Spanish River Unit (KVP Company)

The 1954 seed spotting experiment was extended in 1955 by the seeding of 100 seed spots. One-half, chosen at random, were seeded with seed treated with red lead, in order to ascertain if this treatment will provide protection from birds and rodents. J.R.T. Andrews

Project H-108: The use of controlled burning to secure jack pine regeneration (KVP Company)

An area of 100 acres of cut-over was prepared for burning in the spring of 1955. Various numbers of seed trees per acre had been reserved from cutting. Part of the area was burned, and it is planned to burn the remainder in 1956, to test controlled burning of such areas as a means of establishing jack pine reproduction. J.R.T. Andrews

Problem 47

GROWTH AND YIELD METHODS

The growth and yield studies of the Ontario Research Unit are mostly concerned with improving methods of preparing yield tables, particularly by the stand density index technique, and in investigating systems of forest classification suitable for use in collecting and analysing growth and yield data, and in applying the resulting yield tables.

The stand density index technique employs a numerical standard of stocking (either basal area or SDI) that is not subjective and allows for all degrees of stocking. As a consequence it appears to be gaining popularity for use in the wild even-aged stands of the Boreal Forest.

During the past seven years the Forestry Branch and co-operating companies have established 1,900 semi-permanent growth and yield plots in four forest sections. This sampling appears adequate for research purposes, but several companies are establishing additional plots each year for the preparation of yield tables. The Ontario Research Unit is co-ordinating this work, and when sampling is adequate will prepare the yield tables. To assist in co-ordinating the work, a summary of sampling by forest sections, sites, cover types, and age classes has been prepared and distributed to all co-operating agencies.

Although techniques used in the field appear to be satisfactory, the preparation of stand volume tables by the currently used manual methods is very time-consuming. The use of punched-card equipment is being investigated. A report will be prepared in 1956 describing the results of an investigation of the method of preparing height/diameter curves.

Reports

(1) Empirical Stand Density Yield Tables for the Boreal Forest of Eastern Canada. G.H.D. Bedell and D.W. MacLean. A paper prepared for the 1956 Congress of the International Union of Forest Research Organizations. (Mimeographed for limited distribution. S. & M. 55-12). 6 pages.

(2) Empirical Stand Density Yield Surveys - Extent of Sampling in Ontario and Quebec. D.W. MacLean and W.G.E. Brown. (Limited distribution S. & M. 56-2). 14 pages.

Problem 48

ARTIFICIAL REGENERATION OF POTENTIALLY PRODUCTIVE LANDS

During the past year work was limited to the examination of plantations established by pulp companies, and to experimental planting.

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

Eleven companies have submitted the detailed description form (Form B) for individual plantations. On the basis of forms received prior to the 1955 field season, plantations were examined in areas near Iroquois Falls, Kapuskasing, Fort William, Savanne, Goulais River, Agawa River, Manitoulin Island, and Lievre River. Some of these plantations were established in the 1920's and 1930's, but the majority were less than 7 years of age. Representative sample plots were examined and emphasis was given to growth measurements and observations of stand and site conditions. The work will be extended to other areas and completed in 1956. The main species were white, black, and Norway spruce. Owing to the very young age of most of the plantations, early height growth will be used to compare plantation development and success under particular site conditions. W.M. Stiell

Project P-235: Survival and development of plantations

This is a continuing study of 1,000 acres of plantations established in the period 1922-40 at the Petawawa Forest Experiment Station. Thirty-eight permanent sample plots were remeasured in 1955, and periodic observations and measurements will be made. W.M. Stiell

Reports

(1) The Petawawa Plantations. W.M. Stiell. Technical Note No. 21. 46 pages.

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

Nine acres were machine-planted with 9,000 red pine at controlled spacings of 5 x 5, 6 x 6, and 7 x 7 feet, for the study of growth and form under these conditions. Labour, planting stock, and the planting machine were supplied by the Company - the Forestry Branch provided a tractor and driver, and supervised the planting. Because of an abnormally hot and dry summer, survival was only 29 per cent (similar survival rates obtained throughout the district). Failures will be replaced in 1956. W.M. Stiell

Reports

(1) 1954 planting on A.E.C.L. property, Chalk River. W.M. Stiell. (Binder 1231). 8 pages.

(2) 1955 planting on A.E.C.L. property, Chalk River. W.M. Stiell. (Binder 1259) 7 pages.

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

Tallies of height and survival were made of 2,250 white spruce planted by the saddle, half-saddle, and wedge methods. Growth differences were negligible. The only important difference was found in the results of the 1954 fall planting: one-year survival with the saddle method was 20 per cent lower than survival with the other two methods. Most of the mortality occurred during the dry summer of 1955, and not in the preceding winter.

W.M. Stiell

Problem 49

SILVICULTURAL TREATMENT OF PLANTATIONS

There has been a marked expansion of the Canadian Christmas tree industry, and frequent requests are received for information on growing and selling Christmas trees. To meet this need, a report has been prepared containing information applicable to conditions throughout Canada.

Report

(1) Christmas Trees in Canada - Culture and Trade. W.M. Stiell. (Binder 1263). 29 pages.

Problem 53

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

Ontario Research Unit work on these bulletins was completed and they will be published in the near future.

Miscellaneous Publications and Reports

(1) A Method of Determining Approximate Merchantable Volumes. G.H.D. Bedell and A.B. Berry. Technical Note No. 14. 4 pages.

(2) Rubber-base Paint for Tree Marking. J.M. Jarvis. An article in the Forestry Chronicle, September, 1955. 1 page.

(3) Thinning Aspen Stands at Petawawa, Ontario - Results After Twenty Years. R.J. McCormack. (Binder 1217). 14 pages.

(4) Thinning Aspen Stands at Petawawa, Ontario. R.J. McCormack and A. Bickerstaff. 4 pages.

Newfoundland District Office

Forest Research Division Forestry Branch

6 Freshwater Road

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

* Resigned, December 1955.

NEWFOUNDLAND DISTRICT OFFICE

Summary

The silvicultural research program in this District during 1955 centred on large-scale cutting experiments, an examination of additional areas to determine their suitability for future cutting experiments, forest site investigations, and a reproduction survey of old cut-overs in Southern Labrador.

Two of the cutting experiments are situated on pulpwood limits in Central and Western Newfoundland, one in a 40-60 year old fir stand and the other in a similar-aged black spruce stand. Both experiments have been designed to determine the effect of partial cutting and clear cutting in immature stands. Cutting commenced in 1954 and will be finished in the late spring of the current year. A third cutting experiment was established in multi-aged fir stands at Salmonier in Eastern Newfoundland to determine the long-term effect of clearcutting. Other work was carried out to determine the suitability of all-aged spruce-fir stands for future large-scale cutting projects.

Site investigations were carried out to determine the applicability of several systems of classifying forest sites on representative areas throughout the province.

Cut-over areas at Port Hope Simpson and at Mud Lake in Southern Labrador were studied.

Work carried out on continuing projects was as follows. Remeasurement of direct seeding plots on the Hampden burn showed no appreciable changes in the stocking of 1953 fir seedlings. The first remeasurement of a direct seeding experiment established on a scarified heath barren at Terra Nova revealed poor germination of black spruce, larch and alder seed, fair to good germination of Douglas fir and western hemlock seed, and good germination of white birch seed. Three additional seedbeds were prepared and seeded at the small-scale nursery at Mount Pearl. Compartments 4 and 5 of the managed woodlot at King's Cove were thinned. The final examinations of the five phenological stations in various parts of the province were completed.

The following new projects were initiated: a seedbed study on portions of clearcut strips in even-aged black spruce stands; treatment of chlorotic balsam fir with fertilizers and trenching; direct seeding with exotic species on prepared plots; a trial of herbicides, fertilizers, and mechanical disturbance to improve well drained heath soils; and a project designed to classify non-forested areas as to their suitability for reforestation.

Manuscripts approved for publication included reports on a three-year study of the Avalon Peninsula forestry problems, and the results of a direct seeding experiment on an area in Western Newfoundland which had been cut-over and burned-over prior to seeding. A third manuscript entitled "Forest Reproduction in Newfoundland" is being revised.

Problem 5

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 an adequate system of site classification not only as a basis for yield studies but also as a basis for research in cutting methods and reforestation.

Tentatively, the attack on the problem will consist of testing the applicability to Newfoundland conditions of various systems of forest site classification developed elsewhere and determining which system shows the most promise. This work would be followed by the actual classification of limited areas for illustration purposes.

Project NF 17: Premilinary regional phenological comparisons

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

A progress report covering the 1955 work and a final report covering all annual examinations have been prepared.
(Binder 1247) 36 pages. J.M. Gill.

Project NF 20: Newfoundland forest site classification

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 any system of site classification until a fair knowledge of the various vegetative types of Newfoundland had been acquired. In 1955 the sites on five areas in various sections of the province were mapped on air photographs in accordance with Mr. W.G.E. Brown's "Suggested Scales for Physiographic Site Classification". Sites were checked on the ground during the field season and adjusted where necessary. Soil composition and soil moisture were the two most important factors used in the adjustment of individual site ratings.

A progress report covering the 1955 work has been prepared. (Binder 1251) 35 pages.

J.M. Gill.

Project NF 33: Chlorosis investigation

Ash analyses ade in February and March, 1955, showed that chlorotic balsam fir needles contained much less phosphate, less iron, less potassium, but more calcium, than healthy needles. A nitrogen test yielded inconclusive results. During the 1955 field season, groups of chlorotic

balsam fir on the Torbay Experimental Area were selected and the ground area beneath and adjacent to each group of trees was treated with one of the following fertilizers: sodium nitrate, superphosphate, and iron sulphate. A trench was dug around one chlorotic tree to determine the existence of any relationship between drainage and chlorosis.

A memorandum has been prepared covering the work carried out in the 1955 field season.

J.M Gill

Project NF 40: Recognition and classification of suitable sites for artificial reforestation

Work on this project in 1955 consisted of preparing a preliminary classification for denuded sites and rating them as to their suitability for reforestation. The primary breakdown of sites was organic soils, rock soils, and transported soils. Secondary divisions under each primary heading were recognized. These were described in full, and given a reforestation rating.

A progress report has been prepared. (Binder 1232) 24 pages.

J.M. Gill

Problem 26

DEVELOPMENT OF CUTTING METHODS FOR PULPWOOD LIMITS

Clearcutting in Newfoundland is 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 following clearcutting. As a result, these are being progressively cut in 100-foot-wide strips in an attempt to obtain regeneration.

The first two of a series of co-operative large-scale cutting experiments by the Forestry Branch and the pulp and paper companies were begun in 1954. The experiments are being carried out in stands of balsam fir in one area, and black spruce in the other both of which are somewhat younger than those in which the companies normally operate. The two experiments were scheduled for duplication in 1955 to complete the establishment of the project. However, cutting could not be finished in one area due to a labour shortage.

One object of these projects is to determine whether or not immature stands can be economically logged and yet reproduce to desirable tree species. Response to treatment of the residual stand following partial cutting is another aspect of the study.

The areas selected for the experiments were examined in detail during the 1953 field season. Five additional areas were examined during the 1955 field season to determine their suitability for large-scale cutting experiments to begin in 1956.

Project NF 15: Planning of a large-scale experimental cutting program for pulpwood limits

Four areas in western Newfoundland supporting all-aged spruce-fir stands and one area in central Newfoundland supporting patches of mature and immature balsam fir were examined during the 1955 field season. One area in western Newfoundland has been chosen for a large-scale cutting experiment to commence in 1956.

W.A. Dickson

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

Fifteen square blocks, each ten acres in size, were established in 56-year-old black spruce stands on the Badger Division of the Anglo-Newfoundland Development Company Limited. Three blocks were clearcut in accordance with local standards, three were partially cut, and three were laid out as uncut controls in 1954. On the partially cut blocks, 40 per cent of the merchantable volume was marked for cutting. Although the largest trees were marked, care was taken to see that an even and relatively closed crown canopy would be present in the residual stand.

Three additional blocks were prepared for clearcutting and three others marked for partial cutting in 1955. However, logging operations could not be completed due to unforeseen labour difficulties. The co-operator now hopes to complete the balance of the cutting on or before June 1st of the current year.

A memorandum covering the 1955 work has been prepared.

W.A. Dickson

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

Fifteen square blocks, each ten acres in size, were established in 40-60 year old balsam fir stands which border the northeast 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 were partially cut, and three were laid out as uncut controls in 1954.

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

In 1955 the balance of the cutting, three clearcut and three partially cut blocks, was completed. The blocks will be remeasured during the coming field season.

A memorandum covering the 1955 work has been prepared.

W.A. Dickson.

Project NF 31: Large-scale cutting experiment, No. 3

Thirty eight one-tenth-acre permanent sample plots were established in multi-aged balsam fir stands on the Salmonier watershed in eastern Newfoundland. The area was subsequently clearcut by a private contractor under the direction of the Department of Mines and Resources. The plots will be periodically examined to study stand development trends.

An establishment report has been prepared. (Binder 1277) 26 pages.

W.C. Wilton.

Problem 27

DETERMINATION OF SUITABLE SPECIES AND TECHNIQUES FOR REFORESTATION IN NEWFOUNDLAND

In this province the area of forest land constitutes a relatively small percentage of the total land area. Furthermore, a high proportion of

the forested area is composed of scrub growth and non-commercial species. Undoubtedly many of these areas could support commercial forests.

This creates a problem involving the selection of species for reforestation, selection and evaluation of planting sites, and the evolution of proper reforestation techniques whether by direct seeding or planting. The search for suitable species is continuing. Concentrated effort will also be exerted to determine a suitable method for classifying planting sites. It is hoped that by using small-scale test plots, reliable information can be accumulated to serve as a basis for any large-scale reforestation program which may be undertaken at a later date.

Project NF 14: Experimental planting in peat lands

This project, to explore the possibilities of successfully afforesting areas of fairly well drained peat, began in 1953. Attempts in 1953 and 1955 to create furrows with a heavy land-breaking plough have proven unsatisfactory as the upturned peat tended to roll back into the furrow after the plough had passed. No further ploughing is planned until more suitable equipment is available. Additional work in 1955 consisted of planting Scots pine seedlings on turf which had not rolled back into the furrows. Half of the planting stock received an application of one ounce of superphosphate around the base of the trees while the remaining half were not fertilized.

A memorandum describing the work carried out in 1955 has been prepared.

J.M. Gill

Project NF 18: Experimental seeding, balsam fir

This is a direct seeding project established in 1953 on a well drained site which had been clearcut and subsequently burned-over. Three rates of broadcast seeding and seeding on prepared spots were carried out. Results to date show that seedspotting, though requiring the least amount of seed, has given better stocking than any of the three rates of broadcast seeding which have been practised.

The results of the 1955 examination and a comparison with previous examinations have been outlined in a memorandum.

W.A. Dickson

Project NF 23: Southwest gander black spruce seedbed study

This project is being carried out to determine the changes in the stocking of regeneration which occur on 100-foot-wide strips cut in even-aged black spruce stands.

An establishment report describing the plot layout and data recorded has been prepared. (Binder 1136) 14 pages.

W.A. Dickson

Project NF 24: Small-scale nursery establishment

The need for a small-scale nursery, to provide a supply of planting stock for use in later experiments, was found to be necessary following the closing of the Provincial Government nursery in 1952. An area, 50 feet by 50 feet, was placed at the disposal of the Forestry Branch by the local Dominion Experimental Farm for this purpose. Two seedbeds measuring 50 feet by 3.5 feet were established in 1954 and three more of similar dimensions in 1955.

A diagram showing where the various species of seed were sown has been prepared.

W.C. Wilton

Project NF 27: Heath land site improvement

The object of this project is to eradicate ericaceous shrubs on heathland and to improve the site by use of herbicides, fertilizers, and mechanical distrubance. During 1955, areas which received the various treatments as well as untreated control areas were planted with red pine, Norway spruce, and sitka spruce.

An establishment report describing the experiment in detail has been prepared.

W.C. Wilton

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

Seedspotting of 18 exotic species on prepared spots was carried out in May, 1955 on parts of three clearcut blocks on the Torbay Experimental Area where the slash had been previously burned.

An establishment report describing the project design has been prepared. (Binder 1276) 11 pages.

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 Anglo-Newfoundland Development Company Limited at Terra Nova were scarified by means of a rock rake operated with a D-7 tractor. The mineral soil was exposed on 75 per cent of the area which was seeded with 12 pounds of white birch seed, and lesser amounts of Douglas fir, western hemlock, black spruce, eastern larch, and alder seed.

An examination in 1955 indicates poor germination of black spruce, larch, and alder seed, fair to good germination of Douglas fir, and western hemlock, and good germination of white birch seed.

A memorandum covering the 1955 examination has been prepared.

J.M. Gill.

Problem 28

NEWFOUNDLAND COASTAL FORESTRY PROBLEMS

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

Project NF 6: Managed woodlot, Bonavista Peninsula

A 90 acre woodlot, subdivided into ten compartments, was designated by the Provincial Government as a reserved area in 1951. It is being used to demonstrate the improvements that can be made in forest stands when placed under proper management. From 1951 until 1954, three compartments, 1, 2, and 3, were thinned and the brush was burned. During the late fall of 1955, thinning operations were carried out in compartments 4 and 5.

The work carried out each year has been recorded in a diary on the project.

W.C. Wilton

Project NF 26: Experimental cutting of coastal forest lands

Small-scale experiments to test various cutting methods have been carried out in low-grade spruce-fir stands on the Torbay Experimental Area.

The experiments included clearcutting in strips, thinning in blocks at two different intensities, pruning and Christmas tree cutting. This latter experiment consisted of felling balsam fir, leaving one whorl of living branches on each stump.

An establishment report has been prepared for the project.

W.C. Wilton

Project NF-1: Assessment of Bonavista peninsula forestry problems

"Forestry Problems of the Bonavista Peninsula, Newfoundland", by W.C. Wilton and H.S. Lewis, was issued in 1956 as Technical Note No. 26.

MISCELLANEOUS PROJECTS

Project NF 34: **Labrador reproduction survey**

To study reproduction on cut-over lands in Labrador. Areas cut for pitprop and pulpwood at Port Hope Simpson and for sawlogs at Mud Lake were sampled.

A comprehensive file report has been prepared.

E. Smerlis.

Project NF 35: **Newfoundland District herbarium**

This is a continuing project carried out in conjunction with other research activities. Specimens of plants collected each year by the various field parties are identified and mounted during the winter months. More than 100 different species of plants were added to the collection in 1955.

W.A. Dickson

Maritimes District Office

Forest Research Division, Forestry Branch

Post Office Building

Fredericton, N. B.

District Forest Officer: H. D. Heaney

Research Foresters	Assigned Problems
G.L. Baskerville (1)	29, 30, 31
G.C. Cunningham (2)	
M.H. Drinkwater	30, 33
O.L. Loucks (1)	31
H.G. MacGillivray	32
J.W. McLeod	29, 30, 32
I.C.M. Place (3)	29, 30, 31
A.B. Vincent (4)	29, 30, 31
B.C. Wile	29, 30

(1) Appointed May, 1955

(2) Transferred from Ontario Research Unit as Senior Research Officer, July 1955.

(3) Resigned July, 1955

(4) Appointed Superintendent Petawawa F. E. S., November, 1955.

MARITIMES DISTRICT OFFICE

SUMMARY

Work on the ecology and silviculture of fir and spruce continued to be a feature of the research program of the Maritimes District. Early in the year, a report analysing the results obtained from reproduction studies in the Green River watershed in northwestern New Brunswick was submitted for publication. Later, articles describing the germination of spruce and fir seed following different stratification periods and reporting the results of a direct seeding of white spruce on a controlled burn were submitted to the Forestry Chronicle and the Woodlands Review.

A report discussing the mode of origin and the condition of old-field stands of white spruce in Nova Scotia has been drafted.

Because of changes in personnel only one-third of the spruce--fir monograph has been prepared. Work is being continued but it cannot now be completed before the latter part of 1956.

The data from plots in a controlled burn were analysed and a report prepared. A study was carried out to provide information on the ecology of the important mosses of the forest floor and to discover the relationship between their growth habits and the incidence of fir and spruce seedlings.

In co-operation with the Province of Nova Scotia and one of the larger operators, a project is being undertaken to develop methods of cutting operable stands of field spruce to ensure adequate regeneration and not result in excessive windthrow.

Quadrats located in stands exposed to different degrees of budworm attack were re-examined. A study of the normal mortality in fir thickets not currently under attack by the budworm was established.

The appointment of a site specialist has permitted an expansion of work in this important field. At Green River, site-type descriptions were made in Forest Sections B.2 and L.6b. Research Block 1 was site typed from aerial photographs and analyses are being made of the line plot data to show whether correlations exist between stand composition, yield and site type. A site demonstration area was selected, site typed, and a trail cleared across it.

At the Acadia Station, site-typed investigations during the past 20 years were reviewed and proposals made for a modified classification which would recognize the same site types in all forest districts, while allowing for normal differences in climate, soil, and indigenous vegetation.

During 1955, the provenance studies were concentrated on the red and black spruces, although collections of seed of white spruce and fir were made. The search for budworm-resistant fir and white spruce was continued. Studies of methods of propagating conifers by vegetative means were expanded to include work in grafting. Tests of frost hardiness in planting stock of various provenances were started.

Plans have been completed and the necessary co-operation arranged for a comprehensive study of methods of regenerating yellow birch on formerly productive sites in Nova Scotia.

Problem 29

GENERAL SILVICULTURE OF SPRUCE AND FIR IN THE MARITIMES

Because of the importance of fir and the various spruces to the economy of the Maritime Provinces, studies relating to their silviculture and management constitute a major part of the research program of the District. Much information has been gathered on various aspects of the ecology and silviculture of the principal species but some of it is unpublished and the remainder is so scattered in various publications as to be virtually inaccessible to most foresters. The problem is to present a synthesis of this information.

A comprehensive report, entitled "Balsam Fir and White Spruce Reproduction on the Green River Watershed", has been completed. It discusses the findings from a number of projects dealing with the regneration of fir and spruce in Northwestern New Brunswick. Progress was made on the spruce--fir monograph but owing to staff changes it was not possible to complete the text in 1955.

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

This project is a bookkeeping device for referencing and filing material for the monograph. Literature reviews on most of the topics to be covered have been completed and a draft of the first three chapters prepared. The sections dealing with insects and diseases have been received from the Division of Forest Biology, Science Service, Canada Department of Agriculture.

Owing to the removal of the senior author to a position outside the Forestry Branch, the text will not be ready before the latter part of 1956.

I. C. M. Place

Project M-201: Acadia working plan survey

Remeasurement of this project will not start until 1957. Due to the magnitude of the investigation, preliminary planning is essential. In 1957, approximately 550 tenth-acre plots will be remeasured each year for five years. The data will be utilized to prepare management plans for the Acadia Forest Experiment Station and for yield tables that will be applicable to similar stands within the region.

B. C. Wile

Project M-292: Seedbed study - the germination and early development of spruce and balsam fir, Acadia

This project began in 1948 and consisted of a considerable number of semi-controlled experiments on the influence of natural seedbeds on regeneration. The following reports were submitted.

1. The Influence of Seed-Bed Conditions on the Regeneration of Spruce and Balsam Fir, by I. C. M. Place, issued as Bulletin No. 117. 87 pages.

2. Some Effects of Prolonged Stratification on Spruce and Fir Seed, by H. G. MacGillivray. (Binder 1197) 8 pages.

Project M-293: Succession of lesser vegetation and seedbed development, Acadia

No quadrat charting was scheduled for 1955 because measurements are made only every second year. However, measurements of humus development and depth of humus horizons are carried out under the direction of Mr. MacGillivray. The quadrats will be remeasured and photographed in 1956, and a report prepared analysing the data collected to that date.

O. L. Loucks

Project M-294: Woodlot working plan, experimental woodlot, Acadia, 1944

Sixty acres of softwood, mixedwood and hardwood types are divided into six compartments and operated on a 12-year cutting cycle. This woodlot is on the Acadia Forest Experiment Station, hence the close control over cutting enhances the demonstration and research values of the project.

In 1955, a third compartment was inventoried and the trees marked for cutting. A post-cut inventory will be made before the next growing season.

Project M-308: Selection and shelterwood cutting in a 70-year-old spruce stand, P.S.P.'s 63-71, Acadia.

In 1955, five years after establishment, the plots were remeasured. An interim report will be prepared in 1956. B. C. Wile.

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

This experiment at the Acadia Forest Experiment Station was designed to yield information on the duration of seed fall and the distances seeds are dispersed in central New Brunswick. Routine collections were made in 1955 and missing posts and stolen traps replaced.

Report

Seed dissemination of spruce and balsam fir. 1 page.
J. W. McLeod

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

The reproduction has been sampled each year since 1951, when three one-fifth-acre plots were clear cut and the slash burnt. The treatment destroyed much of the coniferous advance growth, although proportionally more spruce than fir survived. The altered seedbed conditions did not favour spruce over fir; the number of new seedlings of both species is increasing slowly. Results are much the same on all plots, regardless of whether they were burnt in the spring, summer or fall. Unless developments over the next five years are more favourable, burning to increase spruce under the conditions of this experiment is of doubtful value.

Reports

The use of fire to control the composition of reproduction in stands of spruce and fir. (Binder 1278) 38 pages.

Effect of controlled fire on the composition of reproduction in stands of spruce and fir. (Binder 1279) (proposed Tech. Note) 6 pages.

B. C. Wile

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

In 1950, an area of 320 acres was cruised and divided into 20 compartments to be operated selectively under 20-year cutting cycles. By 1954, cutting had been completed on four compartments. The management plan is being modified to provide for a demonstration of "high yield" silviculture. Under the modified plan, four compartments will be managed under selection systems, eight will be used to demonstrate four variants of the shelterwood system, and two compartments will be clear cut. Clear cutting of one compartment is now in progress.

B. C. Wile

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

Report

Mulching and screening of white spruce seed spots on cut-over lands. Submitted to Woodlands Review. 2 pages.

J. W. McLeod

Project M-327: A preliminary study of current diameter and height growth of spruce and fir as influenced by crown volume, weight, and form, and by the competition of surrounding trees, Acadia

Using data collected for spruce and fir in three stands of different densities, numerous tests have been made for correlation between various measures of crown size and stem growth. The efficiency of the crowns for producing stem wood has been determined for both spruce and fir. A report is being prepared.

B. C. Wile

Project M-342: A study of the ecology of important mosses of the forest floor

This project was undertaken to gather information on the ecology of the important mosses on the floor of spruce--fir stands at the Acadia Forest Experiment Station and to discover the relationship between their growth habits and the occurrence and development of spruce and fir seedlings. Greatest emphasis was placed on Pleurozium schreberi and several of the Sphagnums, but notes were taken on all species of mosses, liverworts and lichens encountered. Six conditions, representative of the more moist sites,

were sampled by means of 20 one-quarter-milacre quadrats systematically located in each condition. Additional data were collected on a series of transects, used to sample the continuum between several different sites and conditions, and from a number of observation plots which were examined periodically during the growing season.

The data and observations indicate that the occurrence of certain mosses can be correlated with various site factors and that some species provide better seedbeds than others. In general, coniferous seedlings were most numerous and had their best development on shallow, compact moss mats. A report is being prepared.

F. Berbee
(Bryologist)

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

Five years after treatment the main stand was remeasured and the reproduction tallied on twelve 0.4-acre plots in a diameter-limit cutting made by Fraser Companies, Limited. Spruce and fir reproduction has not benefited from the treatment. Mortality has been excessive in the main stand and there is now little volume left. Windfall has caused most of the mortality. A report has been prepared.

G. L. Baskerville

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

The purpose is to determine whether the stocking of spruce in the stands at Green River can be increased by planting strip roads. In 1955, sixteen hundred 2-2 transplants were set out in the spring, and four hundred 2-2 and four hundred 2-3 transplants were planted in the fall. Mortality varied from 10 to 53 per cent in the 1953 plantings and was chiefly owing to the competition of ground vegetation and to snow crushing this cover over the seedlings. Planting will be continued for another two years.

Report

Preliminary planting trials with white spruce on strip roads, Green River, 1953-1957. (Binder 1239) 10 pages.

G. L. Baskerville

Project M-440: The effect of site on stand composition and yield, Green River

A demonstration area of 700 acres was selected and a trail showing the site-type boundaries cleared across the area. Soil pits were dug in representative site types. A report is being prepared.

G. L. Baskerville

Problem 30

SILVICULTURE OF IMMATURE STANDS OF SPRUCE AND FIR

Dense stands of immature spruce and fir occupy large areas in all three Maritime Provinces. Due to clear cutting, outbreaks of various insects and diseases, and the abandonment of farm lands, the acreage is increasing rapidly. In the future these stands will supply much of the wood required by industry but it is uncertain if they can be managed in an even-aged condition on short rotations for maximum production. Observations indicate that regeneration will be a problem in many areas and that heavy partial cutting, particularly in old-field stands in Nova Scotia, will be followed by windthrow and breakage.

During the year the initial draft of a report, "White Spruce on Old Fields in Nova Scotia", was completed. This report describes the mode of origin and the condition of the stands at various ages, and makes recommendations for their silvicultural management. In co-operation with the Nova Scotia Department of Lands and Forests and the Minas Basin Pulp and Power Company, a project is being undertaken to develop and demonstrate methods of cutting which will ensure adequate regeneration and not result in excessive windthrow. Three methods of cutting are being tested.

At Green River, observations are being continued on approximately 800 milacre quadrats exposed to different intensities of budworm attack, and a study of normal mortality initiated in thicket stands not currently infested by the budworm.

Project M-82: Regeneration cuttings in old-field stands of white spruce in Nova Scotia

This project is being undertaken in co-operation with the Nova Scotia Department of Lands and Forests and the Minas Basin Pulp and Power Company. The purpose is to develop and demonstrate methods of cutting operable stands to ensure satisfactory regeneration and to avoid excessive windthrow of the residual trees. The three methods of cutting being tested are: (1) clear cutting in alternate strips; (2) clear cutting in patches; (3) a light uniform shelterwood cut to leave about 70 per cent of the ground in shade.

During 1955, six 6-acre treatment areas were established, tallied and marked. The cutting was done during the winter. In 1956, two permanent one-acre plots will be established in each area to follow the development of the residual stand and a series of permanent 1/250-acre plots will be established to assess the regeneration.

The success or failure of the treatments should become evident within five to ten years. An establishment report will be prepared in the fall of 1956.

M. H. Drinkwater

Project M-301: The development of balsam fir thickets, Acadia

Sixteen one-fortieth-acre plots were remeasured in 1955 to give further information on growth and mortality in natural thicket stands. A report will be prepared.

B. C. Wile

Project M-401: Research block No. 1, Green River

Technical Note No. 6, "Development of a Balsam Fir and White Spruce Forest in Northwestern New Brunswick", by A. B. Vincent, was distributed in 1955.

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

The size and condition of the softwood reproduction was examined on some 800 milacre quadrats, distributed over four 20-acre plots exposed to different intensities of budworm attack. Damage to the reproduction seems to vary directly with the severity of the budworm attack in the overstory. Mortality had increased slightly over that recorded in 1954 for advance growth more than one foot in height; only six per cent of the smaller seedlings were killed. Annual examinations will be made while the infestation persists.

Report

Effects of the spruce budworm outbreak on softwood reproduction, Green River. (Binder 1269) 14 pages.

G. L. Baskerville

Project M-439: Mortality in the fir thickets arising from the spruce budworm outbreak of 1913-19, Green River

Nine 1/40-acre permanent plots were established in thicket areas not currently infested by budworm. Densities of 1,000, 3,000 and 5,000 trees per acre were sampled. All trees were tagged and the mortality and growth will be assessed every five years. No results will be available until after a remeasurement.

G. L. Baskerville

Project M-441: Ground spraying for the control of mountain maple, Green River

Twelve 0.4-acre plots were treated with 2,4,5-T herbicide by means of a swingfog generator. Severe wilting was observed on mountain maple three weeks after treatment. A minimum of 2 years is required before mortality can be assessed. A progress report is being prepared.

G. L. Baskerville

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 should be the basis of growth and yield investigations and a guide to silvicultural practices. The

problem is to develop a technique which can be adapted to any part of the Maritime Provinces and used both by industrial and research foresters.

The appointment of a site specialist to the research staff has resulted in a considerable expansion in site-type investigations. Vegetation, physiography, and climate have been used in site-type descriptions and this will be continued. Previous work has been reviewed and plans made to complete the descriptions of the forest districts next summer. These districts will then serve as convenient geographic units in which to establish detailed site classifications at the local level.

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

Reclassification of the forests of the Maritime Provinces is a necessary preliminary to more detailed work in site classification, and the delimiting of sections and districts provides units in which to devise detailed classifications. Little progress was made in 1955, but the field work is to be completed in 1956 and a report subsequently prepared.

O. L. Loucks

Project M-226: Site classification, Acadia

Investigations in site classification at the Acadia Forest Experiment Station during the past 20 years were thoroughly reviewed. Refinements in site-type descriptions and definitions were proposed to enable the recognition of similar sites in all districts.

Report

Site classification, Acadia Forest Experiment Station. (Binder 1267) 46 pages.

O. L. Loucks

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

Data from the 25 sample areas were regrouped on the basis of a preliminary site classification. There was some indication of a correlation between height, age, and site for both white spruce and balsam fir.

Report

Review of stem analysis plots at Green River. (Binder 1234) 7 pages.

O. L. Loucks

Project M-440: The effect of site on stand composition and yield, Green River

Five land types, three in Forest Section B.2, and two in Forest Section L.6b at Green River were described. Seven or eight site types were recognized in each land type, following the site classification method set up for Green River in 1953.

With these descriptions, Research Block 1 was site typed in detail from aerial photographs. The data from the line plots in each site type were used to make comparisons of stand composition, reproduction, lesser vegetation, and yield. A report on this investigation is being prepared.

Report

Report of Green River site classification work. (Binder 1237) 23 pages.

O. L. Loucks

Problem 32

DEVELOPMENT OF IMPROVED STRAINS OF SPRUCE AND FIR

Because of the importance of the forest industries to the economy of the Maritime Provinces and the accessibility and strong recuperative powers of the forests, great possibilities exist for the practice of intensive silviculture. Spruce and fir are widely distributed, and undoubtedly local races with desirable characteristics exist. The problem is to locate those strains most fitted to Maritime conditions, and to determine which characteristics are heritable, so that the knowledge can be used in cutting the stands to preserve their genetic worth.

Efforts will be made to locate outstanding trees to serve as potential sources of breeding material and to preserve them in genetic arboreta, and to establish provenance tests using diverse lots of seed from throughout the range of species. Since a knowledge of vegetative propagation is vital to the program, studies are being made to adapt techniques developed elsewhere to local conditions.

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

Several trees which had been selected previously at Green River were reclassified and six new ones selected. Efforts are being made to propogate these trees by grafting.

H. G. MacGillivray

Project M-72: Spruce and balsam fir provenance experiments

These studies deal with the variations between the different geographic races and strains of the white, red, and black spruce and balsam fir. The method consists of assembling seedlots from different sources for each species and establishing plantations under uniform conditions within the local range of soils and climates.

Collecting for the red spruce provenance experiment was not completed as 1955 was a very poor seed year.

Seedbeds have been reserved at Acadia for the sowing of balsam fir seed in the spring of 1956. This seed was collected in Newfoundland and New Brunswick for a study of the genetic aspects of the slow growth after a certain age of Newfoundland fir. Seedlots from Labrador, Quebec, and Manitoba may also be used in this study.

A small experiment was initiated to correlate cone size, seed size, seedling weight and cotyledon numbers.

H. G. MacGillivray

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

The purpose is to locate and preserve trees outstanding in quality and vigor in the stands in the Maritime Provinces. The breeding value of these trees will be tested by means of progeny tests.

During 1955 an attempt was made to interest foresters in Nova Scotia and along the Bay of Fundy coast in New Brunswick in locating superior red spruce. Considerable field work is planned for 1956.

Several experiments in different methods of vegetative propagation have been carried on under this project. These include the aerial layering of spruce and fir, rooting of fir by an interrupted mist method, fall and winter grafting of white, red, and black spruce on white spruce root stocks, and the field grafting of spruce and fir.

H. G. MacGillivray

Project M-78: Co-operation with other research organizations involving the acquiring and supplying of plant materials

This project was started in order to provide a system of keeping records of the exchange of plant material. During 1955 several lots of material were received and several sent to different research organizations.

H. G. MacGillivray

Project M-224: Phenological observations, Acadia

Routine observations were made on several species of conifers, hardwoods, shrubs and herbs. The objectives are to obtain a biological yardstick for comparing the weather from season to season, to collect 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-225: Nursery, Acadia

This is a continuing project set up for cost estimates on maintenance of the nursery. In 1955, some two hundred thousand 2-0 seedlings were given to the New Brunswick Forest Service and 11,000 were transplanted at Acadia. About twelve thousand 2-2 transplants were lifted and used for various purposes.

Reports

Raising trees in small nurseries. Draft of a proposed publication. (Binder 1153) 13 pages.

Nursery, Acadia. 3 pages.

J. W. McLeod

Project M-320: Induction of flowering and seeding of red pine, spruce and balsam fir by strangulation and bark ringing, New Brunswick

An experiment to induce early flowering in white spruce was started in the spring of 1955. Ten sets of three trees each were marked. The trees within each set were quite similar in size and age. Within each set, two types of girdling were attempted; the third tree was left as a control.

H. G. MacGillivray

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

The study of the morphological characteristics of red spruce was extended to trees in a typical red spruce, beech, sugar maple and hemlock stand. Preliminary results from previous studies of red and black spruce indicate that the range of variation in several of the characteristics of these species overlap.

H. G. MacGillivray

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

This project was started in 1954 in two white spruce plantations at the Acadia Station which had suffered severely from frost damage. The purpose is to find out whether the severity of damage is correlated with such phenological characteristics as the time of the bursting of buds, etc. Observations in 1955 were extended to various seedlots of red spruce set out in a frost pocket.

Report

Relation between frost hardiness of plants and certain phenological characteristics. (Binder 1146) 3 pages.

J. W. McLeod

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

The purpose is to find out whether the tendency of spruce to be heavily or weakly branched and the environmental conditions under which it is expressed can be recognized. In 1954, an expression of branchiness was formulated and measurements made on twenty-five 202 white spruce transplants as a check. In 1955, measurements were again made on twenty-five 2-2 white spruce transplants, and also on twenty-five white spruce in a 14-year-old plantation. The 2-2 transplants were set out in the field in the autumn to determine whether branchiness remains constant in a particular environment.

Report

Planting heavily and weakly branched 2-2 spruce seedlings, Acadia, 3 pages.

J. W. McLeod

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

Nineteen red spruce seedlots were obtained from Petawawa in 1954 and sown in 1955. Germination was good. An estimate in the fall indicated that an ample number of seedlings had survived the first summer. Cotyledon counts were made on a sample of seedlings from each seedlot. A statement on this project is also included in the report of the Petawawa Forest Experiment Station.

H. G. MacGillivray

Problem 33

THE MANAGEMENT OF TOLERANT HARDWOODS IN THE MARITIME PROVINCES

The tolerant hardwood stands of the Maritime Provinces are in a seriously decadent condition. Poor quality sugar maple and beech dominate nearly all the sites and tend to increase in number and volume as the more valuable yellow birch and the few sound sugar maple are either harvested or killed by disease and insects.

Research to date has been directed mainly toward fact-finding surveys to determine the reasons for the poor quality of sugar maple and the failure of yellow birch to regenerate satisfactorily, and to obtain information basic to the proper silvicultural treatment of the stands. Observations indicate that while soil fertility and climate probably accentuate certain inherent weaknesses in sugar maple, much of the poor quality material is the result of suppression, browsing, and intense competition during the early life of the young trees. The failure of yellow birch to regenerate is mainly due to unfavourable seedbed conditions and to the inability of the seedlings to compete with the more vigorous sugar maple, mountain maple and beech advance growth.

Yellow birch is the logical species to encourage as it is well adapted to the region, and the high market value of the timber permits the practising of intensive silviculture to ensure its establishment and future growth. This is predicated on the fact that dieback has ceased. If dieback continues, the alternatives are either to manage sugar maple to produce as much good quality timber as possible, or to introduce conifers into the forest.

Long-term projects are being undertaken to develop methods of regenerating yellow birch on cut-over tolerant hardwood sites, to improve growing conditions for established young stands of sugar maple and yellow birch, and to convert stands to softwoods.

Project M-59: Conversion of young tolerant hardwood stands to conifers by cutting and burning, followed by seeding and planting

Twelve one-fifth-acre plots were established in 1950. Six were clear cut and six retained as uncut controls. Burning was attempted in 1951 but was not completed successfully. Three methods of conversion were tested on the cut-over and uncut plots: (1) seeding of white spruce on prepared seed spots; (2) seeding of white spruce broadcast; and (3) planting white spruce (2-2 stock).

The first detailed examination of the treatment areas was made in 1955. A progress report is being prepared.

M. H. Drinkwater

MISCELLANEOUS PROJECTS

Project M-5: Seeding of burned-over lands, co-operative project, National Research Council, New Brunswick, and Dominion Forest Service (1923)

Thirty-one 1/10-acre sample plots, established 1924-25, at the Acadia Forest Experiment Station, on an area seeded with white spruce and white pine, were re-examined.

Report

Seeding of burned-over lands, co-operative project, N.R.C., N.B., and Dominion Forest Service (1923). (Binder 1281) 14 pages.

Project M-213: Thinning pure white pine, PSPs 19, 20/1937, near Acadia

"Thinning in a White Pine Stand", by B. C. Wile, was issued as Technical Note No. 5. 3 pages.

Projects M-18, 20 - 22, 24 - 27, 48 and 49. Managed woodlots throughout the Maritime Provinces

During and shortly after the war, the Forestry Branch prepared management plans for a number of demonstration woodlots and undertook to mark them annually for cutting. They are all located on federal experimental farms and illustration stations. Marking was done in 1955 in accordance with the plan. Management will continue on the farms, but will terminate in 1956 on the illustration stations.

B. C. Wile

Project M-223: Maritimes District herbarium

Collections of vascular plants from Green River, the Acadia Station, and parts of Nova Scotia were pressed and mounted on herbarium sheets. This material is being identified and inserted in the herbarium. Seventy-five ground bryophytes collected at the Acadia Station have been identified and added to the collection. A report describing the status of the herbarium will be prepared.

G. C. Cunningham

Projects M-273: M-274, M-275 and M-277: Permanent plantation plots 29/43, 25/43, 26/43 and 35/44, at the Acadia Forest Experiment Station

These plots were established in 1943 and 1944 with balsam fir, Douglas fir, white pine, red spruce, white spruce, Sitka spruce and Engelmann spruce stock. The plots, totalling about 11 acres, were cleaned of competing vegetation in 1955.

Report

Permanent plantation plots 29/43, 25/43, 26/43 and 35/44 (Projects M-273, M-274, M-275 and M-277). 1 page.

J. W. McLeod

Project M-298: Different degrees of thinning in red pine plantations, PSPs 41 - 46, Acadia

An investigation to compare the results of thinning in a red pine plantation established in 1934: two sample plots, thinned to different spacings in 1950, and one control plot, were remeasured. J. W. McLeod

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

Report

An article, Direct seeding of white spruce and red pine on cut-over lands, is being prepared.

J. W. McLeod

Project M-323: Acadia map revisions, baselines, road location, etc.

This is a maintenance project to provide for work on maps, baselines, road location surveys, and other things of a similar nature not covered by a specific project.

In 1953, 36 miles of baseline were brushed out and re-blazed, a permanent marker was set at the center of the base or grid line system, and the survey of Road 1 was completed. Work in 1954 and 1955 was confined to map revision in the office. The location for Road 6 was surveyed early in 1956. A map showing all research areas is being prepared. B. C. Wile

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

Technical Note No. 31, "Plantations of the Acadia Forest Experiment Station", by J. W. McLeod, was issued in 1956. 25 pages.

Project M-400: Forest management plan, Green River management area

"A Summary of the Management Plan for the Green River Area", by D. E. Nickerson and A. B. Vincent, was issued in 1955 as Technical Note No.7. 31 pages.

Quebec District Office

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QUEBEC DISTRICT OFFICE

Summary

Work continued along much the same lines as in the past. With completion of the first part of the observation area program in 1954, the three-year interval before beginning remeasurement allows for a period of consolidation and for further study of problems in the District.

Less emphasis has been laid upon site-type classification since the work in the Boreal Forest Section B.1 was completed. Bulletin No. 118 by Dr. A. Linteau, was published in 1955. While this covers Forest Section B.1, most of the types described in the report extend into the rest of the boreal forest and further work is in progress to outline the variations.

Preparation of normal yield tables for the Boreal Forest continued, with the addition of more plots and considerably more compilation and analysis to decide upon the best method of compilation. Correlations with stand density index were found useful to partly replace subjective observations from crown development, which is particularly important in interpreting aerial photographs.

Practically all work outside the Valcartier Station is in co-operation with pulp and paper companies. Through contacts with these companies and other Government agencies are encountered the various problems in forest management. Management of second-growth balsam fir stands that are so prevalent after clear-cutting, will perhaps require different treatment to what is now the practice in cutting overmature timber. Consequently, work is being concentrated in such stands to find out what can be done, and whether regeneration is satisfactory after clear cutting.

Several interesting cutting experiments by pulp and paper companies were studied. The Lake Kenogami experimental cutting of 1954-55 was written up after the plots had been examined last summer. This is a comparison of partial and clear cutting. The Lake Edward experimental cutting, begun in 1951 but suspended last year, continued on a much larger scale than ever before and the whole area has now been cut. This amounts to some six square miles of partial cutting (diameter limits 8" for fir, 16" for spruce and yellow birch).

In the boreal forest two experiments are in progress in second-growth balsam fir; one, on the Epaule river, to compare partial and clear cutting; the other on the Matane river to test patch clear cutting in which only mature stands are selected for cutting now, the next cut to be 10 years later. This area also covers some six square miles and cutting will start at the rate of about 3,000 cords annually.

Forest land on the Valcartier camp area has been considerably reduced as land is cleared for training purposes. However, cutting operations have continued under permits and depletion records have been maintained. The inventory system is based upon line-plots established when the area was taken over for management in 1933.

In ecology, white spruce seedbed conditions, and the application of chemical fertilizer to worked-out soils, are being studied. Potassium and

magnesium have been added to plantations at Grand'Mere and Valcartier, and preliminary results seem favourable. Nutrient content of plant leaves and humus in certain site-types has also received some attention.

The sub-office opened in the Forestry School of Laval University in 1954 has strengthened our contact with the University. Graduating students can assist in the work of the Branch, and our research supplement that of the University. Closer contact can also be maintained with the Forest Biology Division, Department of Agriculture, and provision has also been made for office accommodation for the Branch in the new building to be erected by that Department.

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 five 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.

Work on this project, begun by Dr. Heimburger at Lake Edward in 1936, was resumed in 1954 when 15 site-types were identified in Forest Section L.5 and L.6. Some field work was carried out in 1955 when 18 stands were studied but additional samples of all these types will have to be obtained before the field will have been covered.

Detailed studies of three white pine sites up the Ottawa river were made by a graduate student at Laval University.

A. Linteau

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

The report on this project was published in 1955 under the title "Forest Site Classification of the Northeastern Coniferous Section, Boreal Forest Region, Quebec." (Forestry Branch Bulletin No. 118) 85 pages.

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-25: Effect of frost upon white and red pine plantations at Valcartier.

A report on this project written by R. Pomerleau, Science Service, Department of Agriculture, and R.G. Ray was published by the Canadian Pulp and Paper Association under Woodlands Section Index No. 1504. This report attributes the extensive mortality of red pine at Valcartier to freezing temperatures during the growing season, and emphasizes the necessity of considering climatic factors and choice of species when selecting site for reforestation.

R.G. Ray

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.

By the summer of 1955 it was possible to observe some of the effects of treatment, notably the difference in the colour of the foliage. Even the slash treatment applied only the previous fall resulted in less chlorosis than on the control plots. In the fall of 1955 the seedlings on all plots were tallied and classified according to vigor and colour. Leaf analysis performed by a graduate student at Laval reveals a differential nutrient absorption which is in compliance with the observed vigour and growth conditions and evidences the value of the treatments applied. A short statement on this project is included in the Head Office report.

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.

In 1955, 17 plots were tallied on the Matane and Cascapedia Rivers. Some of the data collected for project Q-2 are also suitable for this project, but further sampling will be required before the relationships of stand composition, soil conditions, productivity levels and regeneration requirements can be determined.

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 $\frac{1}{4}$-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.

Laboratory analysis of foliage samples collected in 1955 yielded conclusive results regarding the potassium requirements. A larger fertilizing experiment has therefore been planned for 1956. The Head Office section includes a statement on this project.

A. Linteau

Project Q-65: Mineral nutrients in plant indicators as related to site quality

Preliminary work on this project was carried out at Laval University and reported upon in a thesis submitted to the university as one of the requirements for a master's degree in forestry. An abbreviated version of the thesis (Binder 1233, 23 pages) was submitted for publication by the Forestry Branch, but it was decided that the findings should be substantiated by further sampling and analysis. More samples were collected and the laboratory analysis has been completed. It is apparent that the accumulation of nutrients in the cells of the plants studied depends upon the properties of the plants rather than upon the properties of the sites.

D. Gagnon

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 yield 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 clear-cutting 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, and other experimental cuttings started by companies are being studied.

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

Stands in the Lake Kenogami Experimental Area which had been partially cut in 1923-24 were marked for a second cut in 1953. The operation was carried out during the fall and winter of 1954-55 by the co-operators, Price Brothers and Co. Ltd, a total of 784 cords being cut on the area of 149 acres.

The line-plots in the area were remeasured in June 1955, and a report on the operation was written under the title "Selection Cutting, 1954-55, Lake Kenogami Experimental Cutting Area". (Binder 1216) 17 pages.

The cut left a residual softwood stand of 179 trees per acre, with a volume of 700 cubic feet, augmented by a good stand of saplings and an abundance of seedlings. Under normal conditions satisfactory development of the stand could be expected. Unfortunately the future of the experiment is jeopardized by the current epidemic of the spruce budworm.

J.C. Boynton

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

In 1954 three transect plots were laid out and tallied in a young hardwood stand which followed clear cutting about 20 year ago. In the summer of 1955 the potential crop-trees (mostly yellow birch saplings) were banded with paint and released from competition by cutting all adjacent saplings which overtopped or threatened to overtop the selected trees. In the winter of 1955-56, scattered veteran trees were removed in a fuelwood operation.

R.G. Ray

J.C. Boynton

Project Q-44: Partial cutting in uneven-aged red spruce - fir - yellow birch at Lake Edward

The Lake Edward Experimental Area comprizes 5 square miles of mixed-wood forest which had been cut-over for pulpwood in 1910 under the existing diameter limit regulations. By 1950 the stands had developed to the stage were another cut was both feasible and desirable, and since the original partial cutting had resulted in satisfactory growth it was decided that another partial cut would be made. To simplify control of the operation the diameter-limit system was again used, but with limits selected to conform better to the condition of the stands and the characteristics of the various species. The limits finally adopted were 8" for fir, 16" for spruce and yellow birch. Hardwood sawlogs were to be cut, but all spruce and fir were to be made into pulpwood.

The operation which commenced in the fall of 1950 was completed during the winter of 1955-56 when the last section of the Experimental Area within the Lake Edward drainage basin was cut-over. Results will be determined by periodic remeasurement of the 343 permanent line-plots in the experimental area.

R.G. Ray

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. In the summer of 1954 some of the cutover stands were sampled by 112 tenth-acre line plots, and in August 1955 another 72 plots were established, 32 in an area clear-cut by the company to compare the results of the two cutting methods and 40 in young uncut stands. A file report entitled "Partial Cutting in Balsam Fir Stands on the Epaule River" was written by J.C. Boynton. (Binder 1262, 57 pages). The first remeasurement, to determine the extent of wind damage, the amount of regeneration and the density of underbrush, is scheduled for 1959. Thereafter the growth and development will be followed by remeasurement at 10-year intervals.

J.C. Boynton

Project Q-67: Experimental cutting, Matane River

The purpose of this new experiment, a co-operative project with the Hammermill Paper Company, is to develop a method of patch-cutting in even-aged stands of balsam fir, particularly to determine how large an area can be successfully regenerated after clear cutting. The experiment also introduces a technique of classifying the stands by cutting classes (basically age-classes) in order to assign priority for cutting to the older stands.

In the fall of 1955 an area of nearly six square miles was surveyed and mapped by company personnel. Three hundred and forty-four line-plots were

laid out of which 160 were tallied to provide an estimate of the volume available in each of the three merchantable cutting classes and to follow the results of cutting. It is planned to cut and peel a volume of between 2,500 and 3,000 cords in the early summer of 1956. The line-plots in the cut-over area are to be remeasured later in the summer.

R.G. Ray

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-plots survey method for a series of growth studies throughout the province beginning in 1947. Since that time a total of 15 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. Interesting 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

In 1956, Technical Note No. 27, "Site Types, Growth and Yield, Lake Edward, Laviolette County, Quebec", by R.G. Ray, was published.

Project Q-33: Forest growth survey, Observation Area No. 3, Cyriac River

This observation area comprises 317 tenth-acre line-plots in uncut, cut-over and burned stands on the Cyriac River in the Laurentides Park. The cut-over stands are among the earliest examples of clear cutting to be found in the province, having been cut in 1925. The establishment report for the project, written in 1955 by R.G. Ray, is entitled "Report on the Establishment of Observation Area No. 3, Cyriac River". (Binder 1178) 57 pages.

R.G. Ray

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 technique 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.

A report was prepared by J.D. MacArthur covering several projects located at the Valcartier Forest Experiment Station, (Binder 1223) 10 pages.

Project Q-19: Growth and development of larch plantations at Valcartier.

A small plantation of native tamarack was established in 1936. Remeasurement in 1955 revealed that although survival has been good the growth has been disappointingly slow, the average tree being only 2.3" in diameter and 17 feet high.

J.D. MacArthur

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

Plantation plots established in 1934, 1935 and 1936 were re-measured in 1955. To date survival of white pine is approximately 50 per cent and average height growth is now 1 foot per year. White pine weevil and blister rust are prevalent. Most of the surviving white pine exhibit chlorotic foliage. This is attributed to soil nutrient deficiencies and it is hoped to experiment with chemical fertilizers as a means of correcting these deficiencies.

The red pine plantations show a survival of only 10 per cent. The heavy mortality is attributed to soil deficiency which causes slow growth and to frost killing. Many of the surviving red pine, however, are now growing well.

J.D. MacArthur

Project Q-22: Planting exotic species

A small plantation of 2-0 Norway spruce (700 seedlings was established in the Swamp Block.

J.D. MacArthur

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

Three plantation plots established in 1935 and 1936 were remeasured. On the sandy plains mortality has been severe. In the best plantation near the foot of Pinkney mountain (Pl.P.13) survival has been 76 per cent, the average height is 12 feet and mean annual height growth is 0.6 feet.

J.D. MacArthur

Project Q-26: Tree nursery, Valcartier

A small nursery has been maintained at Valcartier since 1947 to produce planting stock for reforestation projects. In 1955 two seed-lots (local white spruce and a Danish white spruce-Sitka spruce hybrid) were sown. Due to a very dry summer, losses in the seedbeds were severe, but the transplant bed suffered no unusual damage.

J.D. MacArthur

Project Q-42: Growth and Development of plantations at Drummondville, P.Q.

The plantations of the Southern Canada Power Company at Drummondville cover an area of approximately 1,800 acres. In 1951, twenty sample plots were established to obtain data on survival and growth of spruce, pine and larch. In 1955, seven more plots were established, one of which includes five different strains of Norway spruce. The seed came from superior European stands.

Report

Establishment of plantation plots in the Drummondville Plantations of the Southern Canada Power Company, Limited. (Binder 1268) 8 pages.

J.D. MacArthur

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

Failure in red pine at Valcartier has been attributed to impoverished soil and severe climate. Since 1951 jack pine has been planted in the failed areas in the hope of restoring the forest canopy with this hardier species. In the spring of 1955, 5,400 seedlings of Lake States provenance were planted and in the fall of the same year a further 26,000 seedlings grown from seed collected in western Quebec were planted. A comparison between the two strains will also be obtained.

J.D. MacArthur

Problem 39

FOREST MANAGEMENT

One of the responsibilities of the Quebec District is the management of the forested part of 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 have been undertaken to develop and demonstrate forestry practice, particularly "compartment" management.

Project Q-17: Valcartier working plan.

Activities under this project were restricted by the new military security regulations. Nevertheless, the line-plots in the compartment scheduled for remeasurement were remeasured and the inventory compiled. During the winter, cutting continued on a reduced scale, a total of approximately 26,000 cubic feet of softwood and 6,000 cubic feet of hardwood sawlogs, 780 cords of pulpwood and 320 cords of fuelwood being cut. Much of this material was removed from areas being cleared for military purposes.

About 1½ miles of new access roads were cleared and partly finished.

R.G. Ray
R.J. Hatcher

Project Q-41: Todd's Brook woodlot, Compartment C, Valcartier

The roads and trails in this managed woodlot were traversed and plotted on the large-scale map which is being prepared.

J.D. MacArthur

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

Since 1949 a very large number of samples has been taken in the Boreal Forest Region, the data being used for both this project and for project Q-35. In 1955 an additional 162 plots were measured, most of them in Section B.1.

Previous attempts to construct well-balanced curves that would represent good average values for the various site classes or site types have met with only moderate success.

In order to improve on the method, a stand density index chart has been worked out. Such a chart, based on number of trees per acre for a given diameter, eliminates the main cause of error in the ocular estimate of density and stocking, that is, crown development of the trees. Radial development of the crowns, independent of density, may vary for the same species on different sites, and also between species on a given site.

A definite and very close relationship has been found between total basal area, volume and stand density index. The concept of normality has thus become much more objective than before.

A. Linteau

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Research Foresters	Assigned Problems
J. H. Cayford	54, 56, 58
R. A. Haig[x]	54
J. S. Jameson	54, 55, 57, 59
H. J. Johnson	54, 55, 57
R. T. Pike	54, 58
J. S. Rowe	55, 59, 60

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Forestry Operations Division

MANITOBA-SASKATCHEWAN DISTRICT OFFICE

Summary

The establishment of a white spruce cutting experiment which involved treating six 10-acre compartments each year for three years was completed. Seed-bed scarification in the residual stands was part of the treatment. Several hundred regeneration plots on scarified and undisturbed seedbeds in uncut and cut-over spruce-aspen stands were re-examined. Foliage and basal sprays using herbicides were tested on Corylus and Corylus underplanted with white spruce.

A study of the growth of white spruce in relation to site was begun on three plots sampling dry, standard and very moist sites. Daily measurements of radii at breast height and of shoot and root lengths, as well as measurements of air and soil temperatures and of precipitation, were made in an attempt to establish correlations between ecoclimate and the responses of trees. Sixty fifth-acre plots were established in uneven-aged spruce-aspen stands and stem analyses of selected nearby trees were made in a study designed to develop a method of evaluating site in relation to stand growth.

Studies of the production, periodicity and dissemination of white spruce seed were continued. An index of cone production was calculated. White spruce seed obtained from 12 sources in central and western Canada was sown at three nurseries in the district to permit the study of the comparative morphology and growth of the seedlings for information on the intraspecific variability of the species.

Artificial regeneration experiments included plantings of 4,800 white spruce and 4,000 red pine, and broadcast seeding with jack pine in strips on three four-acre scarified blocks.

Regeneration plots were re-examined to assess the effects of different methods of cutting combined with scarification on the establishment of jack pine seedlings.

Regeneration was recorded on a red pine release cutting established in a red pine--jack pine stand. Treatment consisted of clear cutting strips and cutting jack pine on alternate strips. A cutting experiment in black spruce was established to determine the effects of different systems on regeneration. There were six treatments replicated once. Cutting blocks varied from two to seven acres in area.

Three Technical Notes were published during the year and three others are in various stages leading to publication. A major report was prepared on white spruce forest types, giving information on their ecological relationships; a contribution was accepted by a scientific periodical; a paper on site classification was prepared for presentation at the International Union of Forest Research Organizations.

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-113: Reforestation by planting, Spruce Woods Forest Reserve

Thirty-three plantations, those that remained of 63 established between 1904 and 1928, were examined in 1952 and 1953. Of all species planted, jack pine showed the best survival, growth, and form. Though survival of Scots pine and lodgepole pine was fair, their growth rates were poor. Norway spruce and white spruce plantations failed completely. A Technical Note No. 28, 29 pages, under the title "Planting of conifers in the Spruce Woods Forest Reserve", was issued.

J. S. Jameson

Project MS-124: Influence of scarification on white spruce regeneration uncut stands, Riding Mountain

One thousand regeneration plots, on bulldozed strips and on undisturbed control areas, under mature spruce-aspen stands, were remeasured. Scarification with a bulldozer blade created a better seedbed medium than disturbing the soil with an Athens plough, and both of these methods proved superior to undisturbed control areas. Seedbed receptivity has proved favourable for five years after scarification, and the more the mineral soil was bared the better were the results. The number of seedlings established in any particular year depended to a great extent on the previous year's seed crop. Heaviest mortality occurred during the first year after germination, but a small number of seedlings died in each succeeding year. The slow growth and continued mortality of seedlings suggested that factors other than those connected with the seedbed operated to deter the establishment of white spruce regeneration. A progress report (Binder 1256, 12 pages) was prepared. As 1955 was the first good seed year since the project was established, it is planned to continue observations on it.

R. T. Pike and R. A. Haid

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

Forty-five small plots, densely stocked to Corylus, were foliage sprayed with various herbicides in 1950 and 1952. Six tenth-acre plots, also densely stocked to Corylus, were underplanted to 3-2 white spruce in 1954. Three plots were foliage sprayed and three used as controls. Ammate, herbate ester of 2,4-D, and isopropyl ester of 2,4,5-T, all effectively killed hazel leaves and stems. Hazel was replaced in greater numbers by other species of underbrush but as it resprouted two years later it in turn replaced these other species. Coniferous species were not affected by any herbicide.

Basal spraying of Corylus was carried out on a tenth-acre plot with a 25-foot border in 1955, and in addition three tenth-acre plots were established to study methods of poisoning overmature aspen. On one plot the aspen were basal sprayed; on another they were frilled and sprayed; on the third the aspen were girdled. The herbicide used was 2,4,5-T in oil. A progress report was prepared. (Binder 1284) 30 pages.

R. T. Pike

Project MS-156: Influence of scarification on white spruce regeneration, cut-over stands, Riding Mountain

Three hundred and fifteen plots established in 1951 on bulldozed and ploughed strips under a cut-over spruce-aspen stand were re-examined to assess regeneration success. For at least four years the scarified seedbeds were more receptive to spruce germination than the undisturbed controls. The more completely the mineral soil was bared the better were the results. Hardwood regeneration following scarification was practically nil in this mixedwood residual stand. A progress report (Binder 1275, 15 pages) was prepared. As 1955 was the first good seed year on the experimental area since 1948, it is intended to make further field examinations of the plots.

R. T. Pike

Project MS-160: Planting white spruce in disturbed stands, Riding Mountain Experimental Area

On each of twelve 10-acre compartments logged in the fall of 1953 and 1954, 400 white spruce seedlings were planted out in the spring of 1955. The purpose was to study their survival under various environmental conditions.

Survival of plantations recently established on the Riding Mountain area has been good. An establishment report was prepared. (Binder 1242) 6 pages.

J. S. Jameson

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

An annual examination of regeneration plots was made to assess the results of cutting by different methods supplemented in some cases by scarification. Six 10-acre blocks make up the experimental area. One block was badly damaged by wind in 1954 and three were destroyed by fire late in 1955.

J. H. Cayford

Project MS-166: Cutting methods for management of white spruce, Riding Mountain

A cutting experiment, begun in 1953 and replicated in 1954, was completed by making another replication in 1955. Six 10-acre compartments were cut according to various methods, in order to study effects on regeneration, as well as on residual growth and mortality.

Early in the season it became evident that it was to be a good seed year for spruce. Scarification was therefore carried out on all compartments including the six to be logged in the fall. Five permanent sample plots were established on each of the 12 compartments cut over. A progress report (Binder 1272, 12 pages) covering the work done on all 18 compartments was prepared.

R. T. Pike

Project MS-177: Seeding jack pine, Sandilands Forest Reserve

Sixteen strips were seeded in each of three 4-acre scarified blocks in addition to the same number similarly treated in 1954. One randomly selected strip in each block was broadcast seeded each week during the summer. The results will be assessed by transect sampling in 1956 and later seasons.

J. H. Cayford

Project MS-179: Releasing red pine, Sandilands Forest Reserve

Regeneration was recorded on 40 tenth-acre plots established to study growth and mortality on an area in which red pine was released by a cutting consisting mainly of removal of the associated jack pine in strips and clear cutting alternate strips.

J. H. Cayford

Project MS-180: Planting red pine, Sandilands Forest Reserve

Approximately 4,000 red pine seedlings were planted on four sites occurring within the experimental area; these were in addition to 1,000 similarly planted in 1954 which was a cool damp season. To the end of the summer the 1955 plantings were successful on three of the sites in spite of dry warm weather.

J.H. Cayford

Project MS-182: Cutting methods for the management of black spruce, Duck Mountain Forest Reserve

Twelve cutting blocks varying in size from 2 to 7 acres were established in pure black spruce stands on upland (feather moss) sites in the Duck Mountain Forest Reserve, Manitoba. The following cutting methods were followed: (1) alternate strip (two variations), (2) shelterwood, (3) patch, and (4) group selection. One half of the merchantable volume was

removed from each block during the winter of 1955-56. The residual stand will be clear cut ten years later. The object of the study is to determine the effects of various cutting methods on the reproduction of black spruce and to assess growth and mortality in the residual stands. A progress report was prepared. (Binder 1245) 15 pages.

H. J. Johnson

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.

Considerable work was done earlier on white spruce and is being followed up with empirical studies, mainly under Problem 54. Preliminary studies of factors affecting jack pine and black spruce reproduction have been made.

Project MS-135: Factors influencing coniferous reproduction on cut-over and burned-over lands

Technical Note No. 3, by J. S. Rowe, entitled "Factors Influencing White Spruce Reproduction in Manitoba and Saskatchewan", was issued in 1955. 27 pages.

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

The results of the study were published as Technical Note No. 23 entitled "The Effects of Various Slash Disposal Methods on the Regeneration of Cut-over Jack Pine Stands". It was concluded that regeneration was poor regardless of the method of slash disposal. Areas where the slash was piled were found to have the most regeneration; however, this method of disposal created the highest fire hazard. It was recommended that one of the least hazardous methods of slash disposal be employed and natural reproduction be supplemented by planting.

H. J. Johnson

Project MS-158: Supply, periodicity and dissemination of white spruce seed, Riding Mountain

Studies were continued for the second successive year in two tenth-acre plots of mature white spruce. Lengths of cone-bearing crowns were

measured on the individual trees, and an index of cone production was calculated. Seed fall was sampled by means of 16 seed traps (each 3.3 feet square) per plot. As in the previous year, a moderate production of cones and seed was estimated, although more of the smaller trees were involved in 1955 than in 1954.

Further studies will continue in the same plots. An establishment report (Binder 1200, 11 pages) and a progress report (Binder 1244, 19 pages) were prepared.

J. S. Rowe

Project MS-175: Factors influencing black spruce reproduction on cut-over, burned-over, and undisturbed lands

The results of the study were incorporated in a revised report entitled "Some Aspects of Black Spruce Reproduction in the Central Boreal Forest Region" (Binder 1201, 25 pages). Several factors either singly or in conjunction with others can limit the amount of reproduction on an area. Some of the important ones are seedbed, density of stand, stand history, site, and climatic, biotic and pathogenic factors.

H. J. Johnson

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

Fifty-four plots in 12 areas were examined in 1954. These included cut-over, burned and undisturbed areas in mixed and pure stands. Studies were made to relate the presence and abundance of regeneration to the various habitat factors such as soil, parent material, soil moisture, ecoclimate, minor vegetation, method of cutting and severity of burn. The data were compiled and a report was written.

J. S. Jameson

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.

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. No field examinations under this problem were due in 1955.

Project MS-167: The effect of poplar on white spruce in a mixedwood stand

A contribution, "The Effect of an Aspen Overstory on White Spruce in Western Canada", was revised (Binder 1111, 16 pages) and will be submitted as a Technical Note. It shows that in mature stands an aspen canopy may reduce the volumes of white spruce by as much as 50 per cent as compared with those of nearby free-growing trees of the same age.

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 clear cut. 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 clear cut 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. Experiments are of a long-term nature, and much remeasurement work will be required in the future before reliable results are obtained.

Project MS-22: Thinning jack pine, Sandilands Forest Reserve

Three one-acre plots in a dense young jack pine stand on the Sandilands Forest Reserve were given the following treatments in 1927: (1) control, (2) grade C thinning and (3) grade B thinning. The plots were remeasured in 1949 and a final report on the project was prepared (Binder 1266, 12 pages). Results indicated that diameter and volume growth were greater on the treated plots than on the control but that the thinnings were too light to be used successfully as a single treatment.

H. J. Johnson

Project MS-134: Row thinning, Saskatchewan

A comparison of strip thinning with a tractor winch and manual spaced thinning was made in jack pine and black spruce stands in 1949. On the strips trees were winched to a landing in groups. As a result a favourable seedbed of disturbed soil without slash cover was left.

The twelve one-acre plots, nine in pine and three in spruce, were remeasured in 1954. A progress report and a proposed Technical Note were written and submitted in 1955 (Binder 1264, 41 pages and Binder 1265, 14 pages). The results for the five-year period were as follows: diameter, height and volume growth on the 30-year-old strip-thinned jack pine plot were equal to that in the space-thinned and approximately twice that on the control. The growth of the treated plots in the 40- and 60-year-old jack pine and the black spruce stands was not encouraging.

Regeneration on the cleared strips in the young jack pine and black spruce stands was good. Elsewhere regeneration was lacking.

J. S. Jameson

Project MS-146: Thinning aspen, Riding Mountain

Twenty fifth-acre plots in groups of four were established in 1950 in stands of pure aspen, 13, 19 and 23 years of age. One plot of each group was left undisturbed and the others were thinned to spacings of 8 by 8, 10 by 10, and 12 by 12 feet. An establishment report was recently prepared, (Binder 1246) 8 pages.

H. J. Johnson

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. Although 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 re-measurement will start 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-11: Yield of white spruce and balsam fir in an undisturbed stand, Duck Mountain

Distribution was made in 1955 of Technical Note No. 11, "Yield of White Spruce and Balsam Fir in an Undisturbed Stand, Duck Mountain, Manitoba", 3 pages, by R. T. Pike.

Project MS-151: Growth and yield of jack pine, Sandilands Forest Reserve

In 1950, more than 140 fifth-acre plots were established in jack pine stands to study growth and yield. In 1954, a severe wind destroyed 26 of them and in 1955 at least nine were burned. Work in 1955 consisted of examining the wind-damaged plots and replacing those that were of no further use. Twenty plots remained to be replaced when another fire halted the project by destroying a stand in which additional plots were to have been established.

J. H. Cayford

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 forests 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-164: White spruce forest types in the B.18 mixedwoods, their relationships to site and their regeneration possibilities

Field work on this project was begun in 1952 and was continued concurrently with studies of forest sites in 1953 and 1954. A report was prepared describing some of the most important types and giving information on their ecological relationships.

J. S. Rowe

Project MS-183: The evaluation of the growth potentialities of site

A portion of the Riding Mountain Experimental Area was site-typed in 1953 using Hills' method. Preliminary investigations at that time indicated very little difference in growth rates. In 1955, sixty fifth-acre sample plots were established in the uneven-aged spruce-aspen stands in an effort to develop some practical and reliable method of evaluating site in terms of stand growth. Stem analyses of a number of trees near each plot were made.

The data have been compiled and a report will be written.

J. S. Jameson

Project MS-184: Growth studies of white spruce in relation to environment

A study of the growth of white spruce in relation to site was initiated. Three tenth-acre plots sampling dry, standard and very moist sites were marked out, and on these the growth of the trees was compared by daily measurements of stem diameters, and of root and shoot lengths. Instrumental measurements of air and soil temperatures, and of precipitation, were taken in an attempt to establish correlations between ecoclimate and the responses of the trees.

An establishment report was prepared. The project will continue in 1956.

M. P. H. Wheaton (forest assistant)
and J. S. Rowe

Problem 60

MISCELLANEOUS PROJECTS

Project MS-174: Monograph: "The white spruce-aspen type"

The results of research in the important white spruce and aspen forest type in western Canada are being summarized for eventual publication.

J. S. Rowe

Project MS-187: Provenance of white spruce, in Manitoba and Saskatchewan

White spruce seed obtained from eleven sources in Saskatchewan and Manitoba and from one source in Ontario was sown at the Big River nursery in Saskatchewan, at the Wasagaming nursery in Riding Mountain National Park, and at the Pineland nursery near Hadashville in Manitoba. The comparative morphology and growth of the seedlings are to be studied for information on the intraspecific variability of white spruce. An establishment report was prepared. (Binder 1220) 11 pages.

J. S. Rowe

Miscellaneous Publications

Uses of Undergrowth Plant Species in Forestry. J. S. Rowe. Submitted for publication to "Ecology".

Browsing Damage, Riding Mountain National Park. J. S. Rowe. Mimeographed for limited distribution. S. & M. 56-3.

Photographing Soil Pits. J. S. Rowe. Mimeographed for limited distribution. S. & M. 56-4.

Classification of Site for Forest Management. J. S. Rowe. Article submitted for presentation at the 12th Congress, International Union of Forest Research Organizations, Section 21.

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, 64, 66
E. S. Atkins	67
K. W. Horton	64
J. Quaite	62, 63, 65
L. A. Smithers	61, 63, 65, 68, 69

ALBERTA DISTRICT OFFICE

Summary

Forest research in the Alberta District during the past year was mainly directed toward silvicultural problems in the Boreal Forest Region of the province; however, established studies in the Subalpine forest were continued. The general program was designed to produce new basic information which would lend itself to the development of sound silvicultural and management practices for the forests of Alberta. The main emphasis of the program was placed on the lodgepole pine, spruce and spruce-aspen cover types. During the year many studies which have been under way for several years were brought to a conclusion and considerable new information was made available. Emphasis was placed on integrating the results of these individual experiments into improved silvicultural techniques.

The problems of harvest cutting in mature stands of the lodgepole pine and spruce cover types and associated studies of seedbed preparation methods and slash disposal progressed favourably during the current year. It is now possible to make definite recommendations for basic silvicultural techniques adapted to these cover types. The next step in this field of research will be to establish relatively large-scale tests of these techniques. The outstanding development in the field of harvest cutting has been the uniform success of silvicultural treatments involving scarification as a form of seedbed treatment provided that such treatments are undertaken with a full recognition of the seed supply limitations inherent in the various species. Practical developments in this field have indicated that specially designed scarification equipment incorporating narrower, toothed blades, and more lightly powered equipment can potentially reduce the cost of scarification through increased efficiency and at the same time such equipment appears more suited to the requirements of slash disposal than was the conventional bulldozer previously employed in Alberta.

The general program of investigating the growth and yield potentials of the major forest cover types of the province has been continued. Changes in forest utilization practices of the province necessitated a complete review of the volume table situation and the necessary steps have been taken to bring this form of information into line with current practice in the province. In addition a number of individual projects on the growth and yield of the lodgepole pine and spruce cover types were carried out. New information on the response of partially cut Subalpine spruce stands was brought to light. A limited investigation of the yield potential of lodgepole pine stands was also undertaken.

Since any program of silviculture must be backed by continuing activity in the fields of ecology and silvics of species, the Alberta office continued its work in these fields. Emphasis was directed toward the spruce cover types and a broad reconnaissance of the ecological characteristics of white and Engelmann spruce was undertaken. In the field of silvics the stress was placed on the seeding characteristics of the spruce species. A long-range program designed to investigate many aspects of seed supply was undertaken.

It has become increasingly apparent that all phases of the research program of the Forestry Branch in Alberta must be based on a sound system of site classification. Such a system must provide great flexibility, being readily adaptable to various intensities of forestry work. All evidence to

date indicates that a classification system based upon physiographic conditions is the only method capable of providing a sound basis for both research and practical usage. Work in this field has therefore been intensified with primary consideration being given to the lodgepole pine and spruce cover types.

Although reforestation cannot be currently regarded as a subject of major importance in Alberta, there are a limited number of active research projects in this field and current investigations are being directed toward the simplification of reforestation techniques.

Management research in Alberta is currently concerned with co-operative study by the Forestry Branch and the Provincial Department of Lands and Forests. A demonstration management area has been selected in the Whitecourt District and a management plan for the area is being drawn up.

With the culmination of many of the investigations dealing with all aspects of lodgepole pine, it has been possible to begin the preparation of a manuscript for a monograph on this species, and it is expected that the project will be completed during the coming year.

Problem 61

THE DETERMINATION OF SUITABLE SILVICULTURAL TECHNIQUES FOR REGENERATING LODGEPOLE PINE

In spite of the fact that lodgepole pine stands regenerate readily following fire, reproduction in cut-over stands is seldom completely satisfactory. The attaining of natural regeneration is an essential step towards management of the forest. Studies to date have shown that while annual seedfall from non-serotinous lodgepole pine cones is usually inadequate to restock the area, nevertheless large amounts of viable seed are borne in the closed cones of this species. It has also been shown that with appropriate treatment, the cone-bearing slash can release this seed through utilization of natural sunlight conditions. Also, moisture conditions of the seedbed are in the majority of cases the limiting factor governing germination and survival of pine seed. Improved moisture conditions resulting from removal of vegetation and duff layers can greatly enhance the possibilities of natural regeneration. The pressing problem at present is therefore to determine practical methods for distributing logging slash in the desired manner to achieve the seed supply and at the same time to provide an economical means of removing the vegetation and duff layer and provide a mineral soil seedbed. Projects currently active in the Alberta district will provide limited information as to the results and economic feasibility of such silvicultural treatments.

Project A-23: Mechanical scarification to induce lodgepole pine regeneration

This study was established at Strachan, Alberta, in 1952 when an 85-year-old lodgepole pine stand was clearcut in strips. Scarification was employed on part of the area to improve seedbed conditions. Technical Note No. 34 (13 pages) was published on this project in 1956, providing interim results. During 1955 the area was remeasured and survival of seedlings was determined. Representative seedlings were selected for future height growth measurement. The area will be remeasured in 1958 to assess final results of the treatment.

L. A. Smithers

Project A-35: Regeneration of lodgepole pine after clear cutting, with mechanical scarification and fire as methods of seedbed preparation

This project was initiated in 1954 to determine the value of strip clear-cutting followed by seedbed treatment (scarification) and slash disposal, as a regeneration method for lodgepole pine in the Foothills section of Alberta. Preliminary results indicate that seedbed treatment is absolutely necessary if satisfactory regeneration is to be obtained. Removal of the slash and the present practice of lopping and scattering without seedbed preparation was futile. In addition it was found that, provided adequate seed, the abundance of regeneration varied directly with the amount of mineral soil exposed by treatment.

These prelinimary results have been described in detail in a file report. (Binder 1250) 7 pages. R. F. Ackerman

Project A-14: Management studies in a maturing lodgepole pine stand in the Foothills Region of Alberta.

During 1955, a technical note describing this experiment and a series of associated studies was distributed, entitled "Lodgepole Pine Studies at the Strachan Experimental Block in Alberta", by D. I. Crossley. (Technical Note No. 19) 13 pages.

Problem 62

THE DETERMINATION OF SUITABLE SILVICULTURAL TECHNIQUES FOR REGENERATING WHITE SPRUCE

Under current conditions the forest industries of Alberta obtain about 70 per cent of their annual production from white spruce, produced in both pure and mixedwood stands. Management practices for these stands must insure adequate regeneration for the sustained production of this species. Current logging practices do not produce satisfactory regeneration of spruce. Seedbed treatments which improve moisture conditions can bring about satisfactory regeneration in the presence of an adequate seed supply, but since adequate seed crops do not occur annually, current research is aimed at determining the limitations of annual seed supplies and the periodicity of heavier crops. Research is also under way to develop seedbed preparation methods which are applicable under existing economic conditions.

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

The final annual tally of survival of seedlings was completed in 1955 and the analysis completed.

A final report for publication is being prepared.

R. F. Ackerman

Project K-55: 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

The final annual tally of seedling survival and the analysis was completed in 1955. A final report for publication is being prepared.

Project A-5: Mechanical scarification to induce white spruce regeneration on old cut-over spruce stands

The results of this study were incorporated in Technical Note No. 24, by D. I. Crossley. 13 pages. R. F. Ackerman

Project A-6: Development of reforestation methods in the Sub-Alpine Region

Distribution was made in 1955 of Technical Note No. 2, "Seeding and Planting Spruce on Cut-over Lands of the Subalpine Region of Alberta", by A. W. Blyth. 11 pages.

Project A-12: Experimental cutting of white spruce in a mixedwood stand in Northern Alberta

A complete tally of reproduction on the scarified and unscarified regeneration plots was carried out in the fall of 1954. Scarification resulted in numerous, well established spruce seedlings while the seedlings on the unscarified plots were few in number and very anemic. A Report (Binder 1240, 10 pages), "Survival of White Spruce Seedlings Resulting from Scarification in a Partially Cut Mixedwood Stand", was prepared for publication.
J. Quaite

Project A-38: Broadcast burning and windrowing and burning to eliminate logging slash and induce spruce regeneration

This project was initiated in 1953, in co-operation with the Burmis Lumber Company and the Eastern Rockies Forest Conservation Board, to assess the value of clear cutting, followed by broadcast burning and by scarification, as a means of inducing spruce regeneration and reducing the fire hazard in the Subalpine region of Alberta. Preliminary investigation revealed that results one year after treatment were negligible due to the absence of a seed crop in 1953. However, the seedbeds remained receptive and following a medium to good seed crop in 1954, excellent spruce regeneration was obtained on both the burned and scarified areas. Definite conclusions must await remeasurement and mortality assessment.

These preliminary results have been described in detail in a file report. (Binder 1258) 12 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 the mature spruce-fir stands in the subalpine region of Alberta, clear cutting followed by slash disposal and scarification began in 1954. In addition, the experimental design permits investigation of the practical relationship between spruce seed crop periodicity and reproduction on the experimental areas.

To date, 27 acres have been cut and scarified, and with the advantage of a medium to good seed crop in 1954, have regenerated satisfactorily. In the coming years new areas will be added to this project.

Preliminary results have been described in detail in a file report.(Binder 1260) 13 pages. R. F. Ackerman

Project K-47: Seedbed treatment for spruce -- Lusk Creek

Technical Note No. 10, 7 pages prepared by D. I. Crossley, "Survival of White Spruce Reproduction Resulting from Various Methods of Forest Soil Scarification", was distributed in 1955.

Problem 63

GROWTH AND YIELD IN SPRUCE-ASPEN AND LODGEPOLE PINE STANDS

Steps are currently being taken to place a large area of the province of Alberta under a sustained yield management program. For this purpose a great deal of information on yields of both natural and partially cut stands must be obtained. The Forestry Branch is currently undertaking a program designed to produce yield tables for the more important cover types, also to demonstrate the growth potentialities of partially cut stands. It has been found that periodic remeasurement of semi-permanent plots provides the most reliable basis for gathering data of this type. It has also been demonstrated that some form of site classification with an ecological basis is essential to the long-term prediction of forest potentialities. Remeasurement of various growth and yield studies was carried on during the current year.

Project K-54: Experimental cutting of white spruce in a virgin stand

This project was established in 1949-51 in order to determine the growth, stand development and regeneration upon cutting a mature spruce stand in such a manner that various densities of residual stand were left. A silvicultural leaflet entitled, "Marking Costs in a White Spruce Stand " was published in 1950. In 1952 an establishment report was submitted. All sample plots were remeasured in the fall of 1955. In addition a 100 per cent cruise was made of all the mortality since logging on the 212-acre experimental area. A technical note entitled "Results of Partial Cutting in a White Spruce Stand of the Subalpine Region of Alberta" is being prepared for

publication. Results show that despite several good seed crops, regeneration has been a failure. Height and diameter release was negligible while mortality, due mainly to windfall and the accompanying bark beetle attack, amounted to 11 per cent of the residual volume of some two million board feet. It would appear that for the mature and overmature even-aged spruce stands of the subalpine region of Alberta, some system of clear cutting with provision for satisfactory stand re-establishment would be most practical. The project will be closed.

J. Quaite

Project A-43: Growth and development of a mature lodgepole pine stand under optimum site conditions

Because mature stands of lodgepole pine are being rapidly harvested in Alberta, a typical area supporting a 150-year-old stand of pine was investigated during 1955. On a selected 1/5th acre, all trees were felled and sectioned to determine height and diameter growth. Physiographic conditions were assessed and a typical root system was excavated. Records were kept by the Forest Biology Division, Science Service, Canada Department of Agriculture, of the various stains and rots present on the area. These data will serve as a guide in assessing the development of younger stands of pine. Comparisons show that while growth had been reasonably rapid and sustained, this stand was in no way superior to large areas of younger stands currently being produced in the area. A report will be prepared on this project during the coming year.

L. A. Smithers

Project A-9: A preliminary yield table for white spruce in spruce-aspen stands of Northern Alberta

Technical Note No. 18, 11 pages, was distributed in 1955, entitled "Yield of Even-aged Fully Stocked Spruce--Poplar Stands in Northern Alberta", by W. K. MacLeod and A. W. Blyth.

Project K-29: Form class tables, lodgepole pine, spruce, Douglas fir

Technical Note No. 9, "Standard Volume Tables for Lodgepole Pine in Alberta", 7 pages, by A. W. Blyth, was distributed in 1955.

Problem 64

THE ECOLOGY AND SILVICS OF COMMERICAL TREE SPECIES IN ALBERTA

Any long-term program of silvicultural research must be backed up by continued activity in the fields of silvics and ecology. To obtain an overall picture of the growing conditions associated with various cover types in Alberta broad surveys of the ecological relationships in the major cover types have been undertaken. In this field current activity has been directed toward the spruce types with special emphasis being placed on the comparative ecology of white and Engelmann spruce. The general program of studying the silvical characteristics of the commercial tree species has been continued.

Project K-9: Phenological observations

Records of phenological events at the Kananaskis Forest Experiment Station have been gathered annually since 1938. An interim report on this project was prepared in 1954 and gathering of these data was continued during 1955. Results of additional data will be summarized and reported upon at a later date. K. W. Horton

Project K-68: Lodgepole pine seed production and dispersal

This project was started in 1952 to provide information on the cone-bearing habits of trees of different ages, the periodicity of seed crops and the various factors influencing seed dispersal. The detailed results of this study have been published in two Technical Notes by D. I. Crossley, Nos. 25 and 35, "The Production and Dispersal of Lodgepole Pine Seed", 12 pages, and "Fruiting Habits of Lodgepole Pine", 31 pages.

In 1955 the field work was continued on this project on a limited scale, preparatory to the final report. R. F. Ackerman

Project A-40: The Comparative Ecology of Engelmann and white spruce in Alberta

This project was established during 1955 to compare the distribution, silvics and stand structure of Engelmann and white spruce stands. During the field season typical stands of white spruce, Engelmann spruce and spruces having intermediate characteristics were investigated. Taxonomic descriptions were made and stand descriptions prepared. Analysis of this information was undertaken in partial fulfilment of thesis requirements in the Department of Forestry at Oxford University, England. A progress report on the field work (Binder 1252, 8 pages) was submitted and a final report will be prepared during 1956. K. W. Horton

Project A-41: White spruce seed crop periodicity throughout the province of Alberta

Since the successful application of scientific and costly silvicultural techniques are dependent upon a fickle seed crop, this project was initiated in 1955 to investigate the seeding habits, particularly periodicity of production, exhibited by our main commercial species. Progress of this study has been satisfactory but another season will be necessary to complete the establishment.

An establishment report is being prepared. R. F. Ackerman

Project K-4: Effect of site upon forest succession -- reproduction after fire

Technical Note No. 16, by K. W. Horton, "Early Development in a Subalpine Lodgepole Pine Stand of Fire Origin", 6 pages, was distributed in 1955.

Problem 65

THE EVAULATION OF SITE

A knowledge of site is basic to all silvicultural research and has practical application throughout the entire field of forestry. Site evaluation is receiving priority from 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.

Site classification studies in Alberta in the past have been confined to the 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 of assessing productivity of lodgepole pine and white spruce stands. Future studies will attempt to derive practical methods of site evaluation for the mixedwood stands of northern Alberta, the Foothills Section of the Boreal Region, and the Subalpine Forest Region. Emphasis during the current year will be placed on the evaluation of site in the mixedwood region of Alberta with special attention being given to the interpretation of site conditions through the medium of aerial photographs, using landform as a basic classification factor.

Project A-29: The evaluation of site in the mixedwood section of Alberta

An interim report covering the analysis of the 1953-54 field work was submitted in 1955 (Binder 1113, 12 pages). Further analysis of the 1954 field data indicated that the fast growing portions of the height-age curves could be treated as straight lines. The correlation of physiographic site and the slope of these straight lines was much higher than the correlation between physiographic site and dominant height. This phase of the project will be investigated further in 1956.

Some 120 soil samples collected from various localities in Alberta were subjected to mechanical analysis. Representative samples of the various soil classes to be found in the wooded portions of Alberta were prepared for the district office and for field use.

J. Quaite

Project A-42: Height growth as an index of site in low-density lodgepole pine stands

This project was established in 1955 following preliminary studies of a similar nature in dense lodgepole pine stands. Approximately 100 sample plots were established in low-density lodgepole pine stands during the 1955 field season. In addition to the customary measurement of volume, basal area, and dominant height, the physiographic site conditions of each plot were assessed. Preliminary analysis shows that while physiographic site conditions exercised a distinct influence on dominant height development, this factor also varies considerably with the density of the stand. On a single physiographic condition, dominant heights in an even-aged stand varied from 52 to 77 feet in response to the influence of variation in number of stems from 75 to 1,500 per acre. A file report will be submitted at a later date.

L. A. Smithers

Project K-74: The effect of stocking on dominant height in lodgepole pine

Technical Note No. 30, "Assessment of Site Productivity in Dense Lodgepole Pine Stands", 20 pages, by L. A. Smithers, was issued in 1956.

Problem 66

REFORESTATION

In the Province of Alberta many areas have been rendered incapable of natural restocking through logging practices and fire, and if the land is to produce merchantable forests, artificial regeneration will be necessary. Because much of northern Alberta is potentially arable for agricultural products, and because the Eastern Rockies Forest Conservation 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. In this respect the results of seed-spotting experiments are currently being studied with great interest. It is believed that some form of direct seeding may eventually become a valuable reforestation method.

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 plantations have been measured annually for height growth and survival until definitely established and thereafter at 5-year intervals. In 1955 several plantings received annual remeasurement but no new planting was undertaken.

An interim report is planned. R. F. Ackerman

Project K-51: Seed spotting as a method of forest reproduction on mountain lithosols

In 1955 the final tally of seed spots was carried out and the analysis completed.

This data will be prepared for publication in 1956.
R. F. Ackerman

Project K-62: Provenance studies in European larch

This project was initiated in 1951 to compare the growth and development in plantations of ten strains of European larch. If results are promising, consideration will be given to a larger-scale planting program. Since establishment, animal damage has been heavy and it was found necessary to fence these plantations.

Results must await several years of measurement of growth and mortality. R. F. Ackerman

Project K-64: Direct seeding as a means of forest reproduction

The final annual tally of survival was carried out in 1955 and the analysis completed.

A final report for publication is being prepared. R. F. Ackerman

Project K-66: Arboretum

The arboretum was established on the Kananaskis Forest Experiment Station to grow in one place all available native and exotic species and races in order to establish their suitability to the area, and for future use in dendrological studies. Since establishment, 19 species have been set out and observations of growth and mortality made annually.

Due to the adverse conditions of the present site of the arboretum, the 1955 tally is considered to be the last. Consideration is being given to the choosing of a site more suitable to this type of work.

A final report will be prepared. R. F. Ackerman

Project K-67: White spruce seasonal planting comparisons

This project was initiated in 1952 to investigate the feasibility of broadening the planting season to include the months when root growth is at a maximum. The preliminary data were analysed in 1954 and Technical Note No. 32, 31 pages, by D. I. Crossley, "The Possibility of Continuous Planting of White Spruce Throughout the Frost-free Period", was issued.

In order to confirm preliminary conclusions, the planted stock was remeasured for height growth and mortality in 1955. As yet, these data have not been analysed. R. F. Ackerman

Problem 67

A FOREST MANAGEMENT PLAN FOR A WATERSHED IN THE MIXEDWOOD SECTION OF THE BOREAL FOREST REGION

With the rapid progress of forest management in the forests of Alberta, attention is currently being directed towards methods of preparing management plans. Research of this type is conducted on a co-operative basis with participation by provincial and federal forest services. During the current year a typical management area in the Whitecourt District was under consideration.

Project A-36: A management plan for a watershed in the mixedwood section of the Boreal Forest Region

The purpose of this project is to provide a field laboratory in the B-19 region where silvicultural and management practices can be studied and successful techniques adopted in similar forest areas. The project is co-operative in nature; plans will be prepared by the federal Forestry Branch and woods operations conducted by local industries under the jurisdiction and supervision of the Alberta Department of Lands and Forests.

The area, comprising about 138 square miles, was selected early in 1955, and is located some 40 miles west of Whitecourt, Alberta, between Highway 43 and the Athabasca River. White spruce, lodgepole pine, and aspen are the principal species with minor components of black spruce, balsam fir, and white birch.

Field work necessary for the preparation of a management plan was started in 1955 and will be continued in 1956. Accessibility of the area will be improved since Highway 43 has now been completed through the northern part of the area and a secondary road is being improved along the Athabasca river. An oil pipeline has also been located and this cuts through the western portion of the management area.

Preliminary type maps were made from aerial photographs by Alberta personnel before the 1955 field season. These maps were found to be a satisfactory basis for further inventory work. During the summer of 1955, some 775 one-tenth acre temporary plots were measured in stands totalling about 34 square miles.

Work in 1956 will consist of:

1. Preparation of a report summarizing information available to date on the forest cover types. A tentative cutting budget will be offered, setting conservative limits.

2. Preparation of a cutting plan for a specific portion of the area to be cut over in 1956-57.

3. Field work on checking and sampling cover types.

4. A reconnaissance study of cut-over areas in the region to determine the degree of restocking and species involved.

E. S. Atkins

Problem 68

DETERMINATION OF THINNING METHODS FOR LODGEPOLE PINE STANDS

Because of the importance of silvicultural procedure designed to regenerate forest conditions, the practice of thinning or what might be determined high yield silviculture must be relegated to a position of secondary importance. Past studies in this field have been analysed and information has been brought up to date. Existing studies will be continued on the assumption that the information provided will be of greater value at some future date. Future research in this field should be directed toward a more complete understanding of individual tree and stand growth in relation to density conditions, and should be designed in such a way as to provide fundamental information on growth behaviour rather than being confined to studies of silvicultural treatments. No new developments have taken place in this field of work during the current year.

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 in a dense 14-year-old lodgepole pine stand. The results of this study were summarized for publication in 1954 by D. I. Crossley (Binder 1170, 12 pages). During 1955 a sample of trees was selected for continued height and diameter growth measurement. A report on the project will be prepared when sufficient information on diameter and height growth release is available.

L. A. Smithers

Project K-63: Knot-free lodgepole pine by debudding

The purpose of this project is to determine the results produced by a technique known as debudding. Lateral buds are removed annually until a clear 16-foot log has been produced at which time a detailed analysis and comparison with similar untreated trees will be carried out. During the past year debudding of selected trees was continued and annual measurement of height growth took place.

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.

Project K-40: Meteorological observations

Weather records are maintained at the Kananaskis Forest Experiment Station to provide basic information for fire protection, and for meteorological and silvicultural experiments conducted on the station. These records have been kept since 1938. A report summarizing the data from 1940 to 1954 was prepared in 1955. The gathering of information was continued during the past year.

K. W. Horton

Project A-33: Lodgepole pine monograph

The purpose of this project is to prepare a summary of all existing information on lodgepole pine in Alberta. During the past three years a large number of individual experiments have been set up to gather the necessary information for this project. Many of these studies were brought to a head during 1954 and it has therefore been possible during the past year to begin the preparation of the manuscript for the monograph. A draft manuscript has been largely completed and it is expected that the monograph will be finished during 1956.

L. A. Smithers

ORGANIZATION CHART

FOREST RESEARCH DIVISION