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FORESTRY BRANCH
DEPARTMENT OF NORTHERN AFFAIRS AND NATIONAL RESOURCES

PROCEEDINGS OF THE SECOND MEETING OF THE COMMITTEE ON FOREST TREE BREEDING

Held in the Lecture Room, Forest Products Laboratory, Metcalfe and Isabella Streets, Ottawa, on March 1, 1954, at 9 A.M.

Attendance

Mr. H.D. Heaney, Chairman

Mr. A. Bickerstaff	Mr. J.M. Holst
Mr. A.J. Carmichael	Mr. E.A. Lewis
Dr. L. Chouinard	Dr. R.J. Moore
Dr. W.H. Cram	Mr. A.W. McCallum
Mr. J.L. Farrar	Mr. H.G. MacGillivray
Mr. J.A.C. Grant	Dr. H.A. Senn
Mr. J.D.B. Harrison	Mr. E.B. Watson
	Dr. L.T. White

Dr. C.C. Heimburger, Secretary

18. Welcome

Mr. Heaney welcomed Messrs. Carmichael, Chouinard, Lewis, MacGillivray and White and introduced them to the other members of the meeting.

19. Minutes

Dr. Heimburger read the minutes of the last meeting of the Committee. Two errors were found, one in Minute 7, p.4 where "Atomic Energy of Canada Ltd." is to be substituted for "Atomic Energy Commission", and one in Minute 13, p.5, where "in the minutes of" is to be inserted between "reference outlined" and "the 20th meeting" in line 13 from below. The minutes were then APPROVED. Mr. Heaney stated that the minutes of the last meeting were received rather late, in January, because of other, more pressing work of Dr. Heimburger and, therefore, not all of the recommendations of that meeting were acted upon.

20. Business Arising from the Minutes

Mr. Heaney read letters received from Dr. N.H. Grace and Dr. L.P.V. Johnson, University of Alberta, acknowledging receipt of the minutes of the last meeting and expressing congratulations and good wishes to the present Committee. A letter was also received from Mr. W.L. Kerr, Sutherland, Sask., expressing his regrets for being unable to attend the present meeting.

Since a large part of the agenda of this meeting constitutes business arising from the minutes of the last meeting, it has been subdivided as follows.

21. Terms of Reference

Mr. Harrison read the terms of reference drawn up by the committee appointed by the last meeting (see minute 13) and approved by the Forestry Branch with but a few minor changes. (see Appendix "A"). Mr. Harrison stated

further that the Forestry Branch does not direct the activities of the Committee but sponsors it. He also suggested that either the Chairman or the Secretary be officers of the Forestry Branch, in order to have the minutes distributed and other clerical work done.

Mr. Heaney then inquired about a repository for the records of the Committee. The files of the former Subcommittee on Forest Tree Breeding are still at the National Research Laboratories in Ottawa; some records may be at the Petawawa Forest Experiment Station and the Head Office of the Forestry Branch. It was suggested by the meeting that the Chairman and Secretary investigate the status of the records of the former Subcommittee and consolidate these at Head Office of the Forestry Branch.

22. Co-operation with the Woodlands Section, Canadian Pulp and Paper Association

Mr. Harrison reported on the study of forest plantations initiated by the Canadian Pulp and Paper Association (C.P.P.A.) in 1953 (see minute 3). The questionnaire adopted by the Woodlands Section of this organization consists of two parts, A) dealing with general information about plantations and B) with specific information from each plantation. The response has been very favourable and several of the member Companies were interested in establishing plantations and obtaining information from them.

The Woodlands Section of the C.P.P.A. has a Committee on Forestry which organized the present plantation survey.

At a meeting of the Committee held in Montreal on February 25th, 1954, a request was made by the Forestry Branch for co-operation in provenance studies of spruce and for help in the location of superior stands of spruce as an aid to breeding work. Mr. Holst stated that the member Companies of the C.P.P.A. can be divided into two groups. Some are wholly depending on natural regeneration for the perpetuation of their wood supplies and are not immediately interested in planting. Others are planting to obtain adequate supplies of wood close to their mills. Some of the latter are willing to expend relatively large efforts in this direction.

23. Financial Aid

Mr. Holst mentioned the recommendation of the last meeting (see minute 13) that the Committee should promote and sponsor forest tree breeding and should set up a fund for lectures on the subject. Dr. Heimburger inquired if the Canada Forestry Act could be implemented to render financial aid for this purpose. Mr. Harrison stated that there were no funds available at present. Under the Canada Forestry Act, the Forestry Branch renders aid for research in the form of services and personnel but not by means of direct cash grants. Two kinds of federal-provincial agreements are now in force (1) assistance in forest inventories where the Government of Canada carries 50% of the cost and (2) aid in reforestation of vacant Crown lands.

Dr. Heimburger then briefly outlined the main sources of financial aid to forest tree breeding in Sweden. Forest tree breeding costs Sweden annually about $250,000 of which only 17.5% is contributed by the State; the rest is obtained from private industries and from foundations and grants that are primarily set up by private industry. In Canada, the governments

are contributing almost all of the total cost and for any increase in tree breeding and allied activities; it is important to invite the participation of the industry.

Mr. Heaney was of the opinion that a direct appeal to the industry for funds is not warranted at present, but as a first step, it would be desirable to have the industry represented on this Committee. Mr. Holst stated that those of the paper companies most interested in forest planting would be the most likely to contribute funds in the near future. He also recommended studies in wood density, sponsored by the industry, as an important contribution to forest tree breeding, in evaluating tree materials from a qualitative standpoint.

Mr. Farrar again mentioned the desirability of lectures in forest genetics and tree breeding to forestry students as a first step in making the industry aware of the aims of this Committee. This will also require financial aid, as will the invitation to an outstanding geneticist from the United States to attend our meetings (see minute 13).

24. Dr. Heimburger's Report (See Appendix "B")

Working conditions in 1953 have been favourable. In white pine the acquisition of new breeding materials, hybridization and inoculation with blister rust have continued. Some of the older grafts have been moved from the inoculation beds to dwarfing boxes, to induce early and abundant flowering, if possible. All the strain test plantations established in 1951 have been tallied. In poplar, acquisition of new materials was greatly increased and included several new forms from southeastern Europe. Bench grafting has given promising results in the propagation of materials that root poorly from cuttings. Grafting of cottonwood on a basket willow induced formation of flower buds during the second year after grafting. A good method of mass-producing seedlings was found. "Rejuvenation" of some poplar materials was started. In 2-needled pines hybridization was continued and seeds harvested from crosses made in 1952. The girdling experiment in Vivian Forest was tallied and the data assembled for a report. The arboretum was again protected against mice. A poplar plantation was supplemented with new plants from the nursery.

In the discussion Mr. McCallum inquired about the resistance to blister rust of the white pine from Pointe Platon and Dr. Heimburger stated that the grafts from there have thus far not been infected after 4 years of inoculation and the material is presumed to be resistant. Mr. Watson remarked on the resistance of Pinus Thunbergii to the European pine shoot moth, which was confirmed by recent observations on Long Island by Holst and Heimburger.

Dr. Senn inquired about the physiological aspects of flower induction in forest trees and suggested the participation of plant physiologists in this phase of tree breeding. Mr. Holst stated that in his work on flower induction in red pine, trees with abundant flowering had lower osmotic pressure of the cell sap during the winter than trees with scarce flowering.

25. Mr. Holst's Report (See Appendix "C")

Mr. Holst also reported a favourable year for his work. The work in spruce was favoured by good flowering. Several crosses of Norway spruce with white spruce were not successful. Sitka x white spruce hybrids were obtained from Denmark. Seeds of red spruce have been assembled for a provenance test. Contact has been made with the C.P.P.A. for the selection of superior phenotypes and co-operation in provenance tests with spruce on the limits of member Companies. Work on induction of flowering in red pine was continued. Good results were obtained after the application of ammonium nitrate. Suppressed trees were easier to bring into flowering than large-crowned trees.

In the discussion, Dr. Heimburger mentioned a probable white spruce x Norway spruce seedling produced by L.P.V. Johnson and at one time growing at the Petawawa Station. Picea ajanensis has been crossed with black spruce and white spruce in France and could possibly be used as an intermediate if it were desirable to transfer genes between these two species. Early fall potting of white pine has made it possible to use the plants for grafting during the following spring.

Dr. Senn inquired about the supposed red spruce x black spruce hybrids in Haliburton County of Ontario and was told by Mr. Holst that such hybrids undoubtedly existed there and that red spruce often was contaminated by black spruce in that area and elsewhere in Ontario and Quebec. Mr. MacGillivray stated that the number of cotyledons in seedlings of black spruce generally is lower than in red spruce seedlings in the same region. In the northern parts of their range seedlings of both species have fewer cotyledons than further south (see Appendix "G"). Dr. Senn inquired if any irregularities in the meiosis have been found in such hybrids and Dr. Heimburger stated that, to his knowledge, professor F.H. Montgomery of Guelph had found such at Dorset, Ontario, during last summer. Dr. Heimburger remarked that red spruce could be subdivided into 3 broad groups: (1) the material in the great Smoky Mts. is the most typical "red" red spruce, (2) the red spruce of the Appalachians and Adirondacks is already somewhat similar to black spruce, and (3) the red spruce of some parts of the Maritimes, Quebec and Ontario shows more such similarity. The case is parallel to the Engelmann spruce of the Rockies where the southernmost types are the "purest" while the form in Canada, called var. Columbiana, shows similarity to white spruce.

26. Dr. Hunter's Report

Dr. Hunter was not present at the meeting but, in correspondence, stated that he had no report on elm breeding this year since there was no progress to report. The only activity in connection with his side of this project during the past year was a visit in company with Dr. R. Pomerleau to Dr. R.U. Swingle at Columbus, Ohio where they discussed his work on Dutch elm disease and saw at first hand some of the ravages of the disease.

Black x red currant seedlings will be sent to Dr. Heimburger during this spring, for further observation and testing for susceptibility to white pine blister rust.

27. Dr. Chouinard's Report

Dr. Chouinard stated that he is not doing any work in forest genetics at present, only giving a few lectures. During this summer a survey is planned of the variation in black spruce and red spruce, as well as in jack pine. Co-operation is offered to other members of the Committee in any phase of his work that would be of interest. Mr. Heaney thanked Dr. Chouinard for his offer of co-operation.

28. Mr. McCallum's Report (See Appendix "D")

Mr. McCallum gave a short resume of the present status of the Dutch elm disease in Ontario and Quebec. The situation has not changed much since last year. The disease has been surveyed in the cities of Ottawa and Windsor, Ontario. It is now widely distributed in Quebec 15-20 miles north of the St. Lawrence River. Determination of questionable infections on elm is still being carried out by the Division of Forest Biology in Ottawa.

29. Dr. Cram's Report (See Appendix "E")

Dr. Cram presented his report on shelterbelt tree breeding. The work was much reduced because of shortage of available labour during the planting season. The work in pine was confined to nursery observations of one-parent progenies of Scotch pine. In spruce, work was done to find means of controlling damping-off in Colorado spruce. Seed treatments with several fungicides carried out during the winter showed some to be non-toxic to the spruce seeds. In Caragana studies were continued in vegetative propagation, selfing and cross-compatibility within the species C. arborescens. Self-incompatibility and cross-compatibility appear to be governed by incompatibility(s) genes in agreement with the oppositional theory of incompatibility, as in many other plants. Variation in rooting capacity between clones and after application of bottom heat, fungicides and hormones, as well as with date of collection was observed.

In the discussion, Dr. Heimburger warned against too much reliance on antibiotics and other means of preventing damping-off as resistance to damping-off may be inherent and if so desirable from a breeding standpoint. This should not prevent the raising of valuable hybrid and other materials with all due precautions, however. Dr. White remarked that resistance to damping-off may be very complicated as several causal fungi are involved, each having its own host and environmental preferences. The use of antibiotics in this connection has given promising results. Mr. Holst stated that soil sterilization with heat kills everything and then the soil is quickly reinvaded by bacteria which, in turn, may produce antibiotics. With chemicals, some poison effects may persist for a long time. Mr. MacGillivray mentioned some good results in the use of spruce-hardwood duff to prevent damping-off in a nursery in New Brunswick.

30. Dr. Moore's report (See Appendix "F")

Dr. Moore reported on his work with Caragana. The collection of plants in the arboretum was maintained and there was still no evidence of successful interspecific crosses. The technique of pollen storage was described, as well as results of colchicine treatments. Dr. Cram mentioned that he had observed symptoms of polyploidy within his Caragana materials,

similar to those induced by Dr. Moore. Dr. Heimburger recommended Caragana pollen storage at slightly higher humidities, as used for poplar pollen, to retain viability for longer periods.

31. Mr. MacGillivray's Report (See Appendix "G")

Mr. MacGillivray presented his report on initiating a program in forest genetics and forest tree breeding in New Brunswick. This involves a search for superior stands and individuals of spruce and balsam fir, establishment of genetic arboreta and provenance experiments. The number of cotyledons in seedlings of balsam fir and white spruce was higher in southern provenances of these species than in northern. The same tendency was observed in seedlings of black spruce and red spruce. As a rule, red spruce seedlings had more cotyledons than black spruce from the same general localities. The discovery of a balsam fir that apparently is resistant to the spruce budworm, is noteworthy. Mr. Watson inquired further about this. Mr. MacGillivray stated that the tree in question had retained 70% of its foliage in a heavily defoliated stand since 1951. A detailed comparison of the status of its foliage with that of trees of similar age classes and growing on similar sites was recommended.

32. Mr. Carmichael's Report

Mr. Carmichael stated that he is conducting provenance tests with white pine, red pine, jack pine, Scotch pine and Corsican pine. These tests cover only the Province of Ontario. Usually about a dozen provenances are included in each test, covering the entire Province. The tests are tied in with the main 3 site regions of Hills. A plantation of red pine in the Swastika area is being supplemented with a provenance test of this species. Five trees selected in each of 3 localities in northern Ontario are supplying the seed. Mr. Lewis conveyed the greetings of Mr. Carman to the meeting.

33. Mr. Porter's Report

There was no report from Mr. Porter and the Secretary was instructed to ask Mr. Porter if a report would be available.

34. Mr. Grant's Report

Mr. Grant described briefly his present studies of length of day in relation to growth of tree seedlings. Length of day is of considerable importance and may also be a critical factor in the distribution of biotypes and tree species. Mr. Grant's work is carried out at Glendon Hall, near Toronto, with one greenhouse and about 100 acres of land. There are working facilities for graduate students in forestry. His work is supported by the Research Council of Ontario. The University of Toronto supplies the plant and equipment. In the discussion, Dr. Cram inquired about the light sources in Mr. Grant's experiments. Mr. Grant stated that at first he used plain incandescent light to extend natural daylight, but has recently used fluorescent light.

35. Provenance Studies and Acquisition of Materials

Mr. Holst described the recently established co-operation between the C.P.P.A. (Canadian Pulp and Paper Association) in provenance tests of

spruce, (see also minute 22). He further stressed the increasing need for experimental areas with a milder climate than at the Petawawa Forest Experiment Station, for the growing of exotic species and southern strains of native species. An experimental area in a northern location was also needed for the proper testing and evaluation of provenances.

Dr. Heimburger mentioned his proposed establishment of substations, one in southern Ontario, and one in the border zone between the Boreal Forest Region and the Great Lakes-St. Lawrence Forest Region, in a 10-year plan of work recently drawn up. Possibly these two kinds of requirements could be combined into some kind of co-operative arrangement.

Mr. Carmichael recommended that the Committee make a statement of the value of seed exchange to forest tree breeding. At the present time there is no clearcut policy in respect to seed distribution to outside agencies by the Reforestation Division of the Ontario Department of Lands and Forests. He was of the opinion that seeds should be available free of charge if a request comes from a member of this Committee or from this Committee, and recommended an expression of appreciation by the Committee, of the value of seed exchange to current work in forest tree breeding. Mr. Heaney thought that straight buying of seed would be more feasible.

Mr. Farrar moved that the Committee contact the proper authorities of the Ontario Department of Lands and Forests and explain the value of seed exchange through this Committee to the Province and the Dominion. An expression of appreciation that the seeds are available should be included. This was seconded by Mr. Carmichael and was APPROVED. It was suggested that a letter from the Chairman would accomplish this.

36. Functions of the Committee

Mr. Heaney stated that the officers of this Committee should take action on the items recommended in minute 13. Mr. Holst pointed out Mr. Farrar's proposals of the last meeting, namely (1) lectures in forest tree breeding (see minute 13a) at the forestry schools, and (2) preservation of superior stands or single trees.

Mr. Heaney recommended that the Committee investigate the possibilities of lectures (see minute 13b) in forestry schools and the availability of funds for this purpose through the Canada Forestry Act or through the Provincial Research Councils. Mr. Farrar inquired from Dr. Chouinard about his lectures. Dr. Chouinard replied that he gives lectures to forestry students in their fourth year. Mr. Farrar thought that a visiting lecturer might also be desirable. The suggestion of Dr. Bier at the last meeting (see minute 13f), to invite an outstanding geneticist from the United States to attend our meetings, was again mentioned in this connection.

37. Disease Garden at Connaught Ranges

Mr. Holst stated that he had visited the area during last spring with Mr. Eggertson and helped in locating the various strains of white pine. The grass is now very tall and falls over the lower branches of the planted white pine. This causes locally favourable conditions for infection with blister rust. Dr. White read parts of the report prepared by Mr. Eggertson

on his inspection of the plantation and tally of the infected trees during last spring. Mr. Heaney pointed out that the report recommended a re-examination of the area in 1954. Dr. White assumed the responsibility for having this done.

In a letter, Dr. Hunter advised on the maintenance of the area as follows: "The maintenance of this plot is included in the regular maintenance of the land occupied by the Experimental Farm at Connaught Ranges. The plots are regularly mowed and I think are kept in a satisfactory condition. Dr. Bier, Mr. McCallum and I visited them last spring and they were in good condition then. I will undertake to see that they will be looked after again this year."

Mr. Holst mentioned the files pertaining to the disease garden which originally were kept by the Forestry Branch, the National Research Council and the Department of Agriculture. Dr. White moved that the records be kept at Maple in Dr. Heimburger's care, as it is one of his work projects. This was seconded by Mr. Holst and was APPROVED.

38. Membership and Officers

The membership sub-committee set up during the last meeting (see minute 16) proposed that three classes of membership be recognized:

(a) Active Members - those actually conducting work in tree breeding or closely allied fields

(b) Sponsoring Members - official representatives of organizations engaged in tree breeding work

(c) Corresponding Members - occasional visitors or those with a general interest in tree breeding who wish to keep informed of the Committee's work.

This was agreeable to the meeting, and it was recommended that the Forestry Branch consider the following names for membership, and extend appropriate invitations.

Dr. W.H. Cram and Dr. A.W.S. Hunter as active members and ask Dr. E.S. Hopkins to appoint sponsoring members.
Mr. B.W. Dance, Mr. W.A. Porter and Dr. R. Pomerleau as active members and ask Dr. K.W. Neatby to appoint sponsoring members.
Dr. R.J. Moore as active member and ask Dr. H.A. Senn to be or to appoint sponsoring members.
Mr. M.J. Holst, Mr. H.G. MacGillivray, and Mr. J.L. Farrar as active members and ask Dr. D.A. Macdonald to appoint sponsoring members.
Dr. C.C. Heimburger as active member and ask Mr. R.N. Johnston to be or to appoint sponsoring members.
Mr. A.J. Carmichael as active member and ask Mr. G.H.U. Bayly to be or to appoint sponsoring members.
Mr. J.A.C. Grant as active member and ask Mr. J.W.B. Sisam to be or to appoint sponsoring members.
Mr. A.L. Orr Ewing as active member and ask Dr. G.S. Allen to be or to

appoint sponsoring members.
Dr. E.C. Smith as active member and ask Dr. W. Kirkconnell to be or to appoint sponsoring members.
Dr. L. Chouinard as active member and ask Dr. L.Z. Rousseau to be or to appoint sponsoring members.
Dr. N.H. Grace and Dr. L.P.V. Johnson as corresponding members.

Mr. A.W. McCallum did not wish to continue his membership.

Mr. Farrar nominated Mr. Bickerstaff as chairman, as Mr. Heaney did not wish to continue in this capacity. Dr. Cram moved that nominations close; this was seconded by Mr. McCallum and was APPROVED. Dr. Heimburger was retained as secretary.

Dr. Heimburger expressed the desirability of an exchange of observers with the Lake States Forest Tree Improvement Committee, as its aims and methods are very similar to ours and we have many problems in common. This was approved and it was decided to extend an invitation to the Lake States Forest Tree Improvement Committee to send an observer to our Committee meetings.

It was, likewise, decided to have industrial representatives attend our meetings (see minute 23), and it was recommended that the Forestry Branch ask Mr. W.A.E. Pepler, Manager of the Woodlands Section, C.P.P.A., and Mr. W.J. LeClair, Secretary-Manager of the Canadian Lumbermen's Association, to nominate representatives to attend our Committee meetings.

39 Adjournment

The meeting adjourned at 4.30 P.M.

Appendix "A"

Terms of reference of the Committee on Forest Tree Breeding

The Committee on Forest Tree Breeding, Forestry Branch, Canada Department of Northern Affairs and National Resources, hereby adopts the following terms of reference:

1. To advise, assist and when necessary make recommendations to the Forestry Branch and to other participating organizations, with regard to matters referred to it by organizations concerned with forestry and with regard to matters that may appear expedient for the progress of research in forest genetics and forest tree breeding.

2. To serve in a liaison capacity between the various organizations concerned, for the investigation and review of facilities for, progress in an requirements of research in forest genetics and forest tree breeding in Canada.

Appendix "B"

Report on Forest Tree Breeding in 1953

C.C. Heimburger

Working conditions

The lack of adequate assistance which seriously hampered the progress of the work from 1948 to 1952 was largely overcome in 1953. The assistance rendered by the staff of the Station was sufficient during the spring. In the fall, other assistance became available. This resulted in favourable working conditions throughout the year. The weather was also favourable for spring work and during the exceptionally long and mild fall. More than usually successful grafts in the spring and more and better work in the fall could thus be accomplished than during any previous year. The work could again be subdivided into 4 main projects (1) white pine, (2) poplar, (3) 2-needled pines and (4) arboretum.

White Pine

The object of white pine breeding continued to be the production of new strains suitable for reforestation in southern Ontario and satisfactory in respect to resistance to blister rust, reaction to weevil injury, and growth rate and growth form. Necessary adaptation to climate and soil is a further requirement in respect to survival and performance in plantations. Native white pine is the main species concerned while valuable characteristics from other, related species are being introduced after their evaluation. The acquisition of breeding materials and their testing and evaluation still constitute the main phases of the work.

During a trip to the southern United States in January scions were collected from 3 outstanding trees and from 8 populations. This material represents some of the southernmost native white pine of good form and very rapid growth rate. In contrast to this, some material from the northernmost part of the range was obtained in the form of scions of 7 trees in northern Ontario and Quebec. Additional scions were collected from 33 selected "plus" trees at St. Williams. Other acquisitions comprise scions of exotic white pines collected in several arboreta near Philadelphia, near Asheville, N.C. and in an experimental plantation on Mt. Mitchell in North Carolina. Fairly large seed samples of native white pine were obtained in Georgia, North Carolina and West Virginia and seedlings from these are being raised at the Petawawa Forest Experiment Station, for future testing at Maple. In the fall, scions were collected from some Pinus flexilis of flowering age in the Rockies and sent to this Station for grafting during the winter following.

Of the crosses made in 1951, the following populations were raised from seeds harvested in 1952:

Strobus x Peuce	163	seedlings
Strobus x pentaphylla	37	"
Peuce x pentaphylla	4	"
Griffithii x wind	269	"

The use of canvas bags treated with wettable DDT protected the young cones during their second year quite effectively against attacks by insects and squirrels. No seeds were harvested from the extensive crosses made in 1952 because of total damage to the young cones during their first year. This damage was probably caused by insects and indicates that the young cones should also be protected immediately after pollination. Similar experience has been obtained in white pine pollination work in Philadelphia.

Hybrid seeds of the cross P. monticola x Strobus, with both parents probably resistant to blister rust, were received from Idaho. Pollen from a supposedly blister-rust resistant P. Strobus was sent there in 1952 and was used in this cross.

The following crosses were effected in 1953:

koraiensis, Orono x Griffithii, Rochester, N.Y.	6 bags
Strobus, Maple x Hunnewellii (Strobus x parviflora), Mass.	23 "
Strobus, Maple x Peuce, Rochester, N.Y.	25 "
Strobus, Maple x Griffithii, Rochester, N.Y.	24 "
Strobus, Maple x Peuce, Ottawa, Ont.	13 "
Peuce, Ottawa x Griffithii, Rochester, N.Y. (2 crosses)	66 flowers
Griffithii, Toronto x Peuce, Rochester, N.Y.	3 "

The last 3 crosses were made on young grafted trees at Maple, without using isolation bags but by applying pollen directly to the newly opened female flowers with a camel-hair brush. This resulted in an excellent crop of young cones. A similar method has recently been put in use for spruce pollination in Philadelphia.

Weather conditions were quite favourable for infection with blister rust. Black currant bushes grown in the lath house supplied most of the leaves used to inoculate 1540 grafts belonging to 145 clones and 4285 seedlings and grafts belonging to 58 populations this year. The lath house was enlarged considerably and should in the future produce enough black currant leaves for all current inoculation work. Seeds of Ribes curvatum, a species of possible use in blister rust inoculation, were obtained from Tennessee. Ribes Gordonnianum, obtained previously from England, seems to retain its leaves better under outdoor conditions than black currant and is being propagated for possible supply of inoculum without the use of the lath house. The Ribes diacanthum material obtained at about the same time from Manitoba was discarded because of insufficient susceptibility to white-pine blister rust. Grafts of 4 clones of white pine were found to be so heavily infected with blister rust in the spring that it was possible to eliminate them as not being resistant to blister rust. Two clones of P. Griffithii, originally obtained from Placerville, Calif. were eliminated from the tests because of repeated lack of winter hardiness under our conditions. Much hardier materials of this species are now at hand.

Several of the older grafted clones, subjected to repeated inoculations with blister rust without showing signs of infection are, at least for the time being, presumed to be sufficiently resistant to warrant their propagation for the establishment of seed orchards. In the spring, scions were collected from 13 such clones of Pointe Platon and Wisconsin origin and 77 grafted outside on established nursery stock. An additional 100 such grafts

were made at Angus, Ont. In the fall, 456 further grafts of this kind were made, belonging to 10 clones. Ninety eight of the more valuable older grafts, of 13 clones, were removed from the inoculation beds and set out in dwarfing boxes, designed by I.B. Lucas, of Markdale, Ont., to encourage early flowering, for use in breeding work.

All the strain test plantations established in 1951 were tallied during the summer and preliminary information is now available on relative performance of different strains in the localities where the plantations are reasonably successful. In the course of this tally a couple of early-flowering white pine were discovered. These could possibly be used as dwarfing stock, to induce early flowering in the grafts. Another such early-flowering white pine was discovered at Little Rapids, near Thessalon, and scions of it were obtained for further study at Maple.

The first phase of the white pine breeding project, namely acquisition of breeding materials, is now gradually being completed and other phases will become increasingly important in the future. These will deal mostly with the evaluation of the materials assembled, such as determination of resistance to blister rust and weevil, already under way but still subject to considerable improvement. A detailed study of weevil resistance and its relationship to leader thickness will need the co-operation of entomologists; further studies of resistance to blister rust will, likewise, need assistance from plant pathologists assigned to this work. Better methods of pollination and of protecting the young cones, improved methods of seed germination and of growing the young seedlings, to shorten the breeding cycle, are the more immediate problems in the breeding phase of this project. As some of the grafts begin to flower, their combining ability in various crosses will be one of the first characters to study. To this end research into the induction of early flowering is gradually growing in importance.

Poplar

The chief aim of the poplar breeding project continues to be the production of aspen-like hybrids with rapid growth, resistance to several important diseases, capability of growing in forest plantations in southern Ontario and easy propagability from stem cuttings. As in former years, this is being achieved through hybridization of various aspen species with silver poplar. The acquisition of aspens and silver poplars for this purpose was continued and comprised the following materials:

P. alba	17	clones
P. alba x grandidentata	5	"
P. alba x tremuloides	1	"
P. canescens	5	"
P. Davidiana x tremuloides	1	"
P. grandidentata	3	"
P. grandidentata x tremuloides	10	"
P. tremula	1	"
P. tremula x alba	1	"
P. tremuloides	1	"
P. nigra	5	"
	50	"

P. alba	2	seedling	popul.
P. tremula	3	"	"
P. Bachofenii	2	"	"
P. grandidentata	1	"	"
P. tremuloides	2	"	"
	10	"	"

In addition, the following clones have been selected from older populations for propagation and further testing:

P. alba	7 clones
P. alba x (alba x grandidentata)	1 "
P. alba x alba	6 "
P. alba x tremula	2 "
P. grandidentata x alba	11 "
	27 "

Again this year, all new P. alba materials and their hybrids were subjected to rooting capacity tests as soon as sufficient numbers of cuttings became available. None have thus far proved superior in this respect to some P. alba planted in southern Ontario, although many recently acquired clones and seedling populations still await testing. One clone of P. alba from near Brampton, Ont. showed great superiority in rooting capacity and is currently being used for breeding. Several seedling populations of P. alba and its hybrids with aspens were subjected to mass selection for rooting capacity. As soon as the seedlings reached suitable size they were cut off at the ground and the tops prepared into cuttings and planted. Of the planted cuttings only those with rooting capacity survive and are retained for further propagation and breeding. The roots of the original seedlings are used in test plantations.

Poplar hybridization was not very successful this year because of a late start and consequent lack of space in the greenhouse. Of 11 crosses attempted only 3 yielded sufficient seeds to make the raising of seedlings worth while. These are:

P. alba x tremula triploid, 2 populations
P. canescens x tremula triploid, 1 population.

Two hybrid populations of the parentage P. tremula x (alba x tremuloides) were raised from seeds produced in Denmark and Germany where these crosses were made using pollen supplied from here, in exchange for pollen of P. tremuloides for their own use. Two additional hybrid populations were raised from open-pollinated seeds of grafted P. tremula. The grafts flowered at about the same time as the native P. tremuloides and the resulting seedlings also indicate that this species is the pollen parent. Several lots of aspen and silver poplar seeds were received from Austria, Czechoslovakia and Hungary. Most of the seeds were sown in a seed bed where the soil had been treated with krilium to improve its structure. This was highly successful. Seeds of two early-flowering P. tremuloides were sown also because the resulting seedlings might later prove useful when used as stocks for grafting, to induce early flowering in the grafts. Pollen of native P. tremuloides was again produced in fairly large quantities and sent to various European countries for the production of hybrid aspens there. Pollen of P. grandidentata was also produced and sent, mostly to southeastern and southern Europe where there is a growing interest in this species for breeding work. A trip was made to Longlac, Ont., to collect branches with flower buds of native P. tremuloides for pollen production because recent outbreaks of the forest tent caterpillar had prevented the formation of flower buds in more easily accessible localities.

A series of experiments in bench grafting of aspens on rootstocks of P. alba was carried out during the winter and one method gave very encouraging results as shown by high survival of the grafts when set out in the nursery and good growth of the resulting plants. This method is at present being put to use for the propagation of valuable aspen materials that are difficult or not possible to root from cuttings. An experiment in evaluating the rooting capacity of cuttings taken from different parts of the shoot was laid out in the nursery in the fall, with randomization, replication and statistical advice of Mr. L.M. Morrison.

The poplar plantation at Knechtels' Limited in Hanover, Ont. was pruned and tallied. The results indicate the suitability of some clones for large-scale use in the production of core stock for veneer in that region. Some Italian hybrid poplars were distributed to 4 zone foresters in Ontario, to test their performance under different climatic and soil conditions. About 200 rooted cuttings of the hybrid P. alba x grandidentata were given to the Ontario Paper Company for testing in plantations on Manitoulin Island.

Some grafts of Chinese and Czechoslovakian aspens were set out in the same kind of dwarfing boxes as the white pine grafts, to encourage early flowering. A clone of female cottonwood, grafted on willow 2 years ago and set out in dwarfing boxes this year has started to produce flower buds. The grafts are at present about 18 inches tall while rooted cuttings of the same age are about 9 feet tall. All the grafts of aspens and silver poplar on willow reported previously have died or are moribund, indicating a high degree of incompatibility of these materials with the basket willow (Salix purpurea) in question.

Since many poplar materials are being received from abroad in the form of scions collected from mature trees, their grafts often do not show the normal growth habit of the clone in question nor is their rooting capacity directly comparable with the rooting capacity of cuttings prepared from juvenile growth of other materials tested. A beginning was made this year in the "rejuvenation" of such clones, by deep planting of the grafts and forcing them to produce their own roots above the place of grafting. These roots are then being used as cuttings and the resulting plants have the juvenile habit of growth and will, presumably, have a higher rooting capacity.

The poplar breeding project is rapidly gaining in importance because of the growing interest of the wood-using industries in the new strains and clones produced. This interest is also quite pronounced abroad, as indicated by the rapidly growing exchange of pollen, scions and seeds of native aspen species and the most promising hybrids. A subdivision of this project into the following 3 main phases is indicated in the near future; (1) mass production of the most promising hybrids from seeds to satisfy the growing demands of the wood using industries for planting stock and our requirements for test plantations under different climatic and soil conditions, (2) breeding of early-flowering clones and populations, to serve as stocks for grafting, to induce early flowering in promising breeding materials, i.e. the production of better tools for future breeding work and (3) continuation of the long-term project of incorporating rooting capacity and other desirable characters of silver poplar into aspen hybrids, based on experience gained from phase (1).

2-needled pines

This project was initiated in 1952 with the aim of finding resistance to the European shoot moth within the group of 2-needled pines and then to breed resistant strains of red pine and Scotch pine. Induction of flowering in red pine, to produce more and better seeds for the needs of reforestation also comes within the scope of this project.

A fairly large collection of scions of different species was obtained in Philadelphia, on Long Island and in Rochester, N.Y. and grafted on Scotch pine outside. Most of the scions were kept in a frozen condition in a deep-freeze before grafting and probably because of this, the grafts were generally unsuccessful. A few grafts of Pitch pine and table mountain pine succeeded, however. During the collecting trip some observations on resistance to the shoot moth were made on Long Island. Other accessions comprised the following lots of seedlings:

P. nigra var. Poiretiana	1/1	1000	from Petawawa F.E.S.
P. montana uncinata	2/1	200	" Angus, Ontario.
P. montana pumila	2/1	200	" " "

Hybridization was again carried out on a fairly large scale, using the materials of planted Scotch pine at this Station and the plantation of Jap. red pine at Midhurst for this. Pollen of several species was again collected in Rochester, N.Y. and some of it was sent to the Petawawa Forest Experiment Station, to be used on native red pine there.

The crosses made in 1952 yielded the following seeds:

P. nigra austriaca x Thunbergii	50	cones	2052	seeds
P. Mugo x nigra austriaca	0	"	0	"
P. silvestris x nigra austriaca	85	"	588	"
P. densiflora x resinosa	106	"	910	"
P. nigra austriaca x wind	2	"	143	"
	243	"	3693	"

The following crosses were made in 1953:

P. densiflora x Mugo	2	crosses	23	bags
P. densiflora x silvestris	6	"	30	"
P. densiflora x Banksiana	6	"	32	"
P. densiflora x ponderosa	6	"	29	"
P. densiflora x nigra austriaca	2	"	38	"
P. densiflora x resinosa	2	"	7	"
P. silvestris x (densiflora x Thumb.)	2	"	42	"
P. silvestris x nigra austriaca	4	"	27	"
	30	"	228	"

These are mostly exploratory crosses made with the aim of determining cross-compatibilities of the main 2-needled pine species.

Seedling populations, 3 of P. densiflora and one of P. Thunbergii, raised from seeds sown in the spring of 1950 and transplanted in 1952, were subjected to intensive selection for stem form and adaptation to climate in the fall of 1953. The selected seedlings ranged from 6% to 19% of the available numbers and will be used for further testing and breeding work in test plots. Most of the culls were potted in the fall and later used as stock for grafting. P. Thunbergii is successfully used as stock for P. parviflora and P. koraiensis in Japan and could possibly also be used for other white pines. P. densiflora is well known for its precocious flowering and can possibly be used as dwarfing stock for grafts, to induce early flowering in other species of this group. The girdling experiment in Vivian Forest, to induce early flowering in planted red pine, was continued and a tally was made of all the girdled trees and controls. The tallies have been worked up and material is at hand for a report. The results are quite encouraging and indicate that it has been possible to bring about early and abundant flowering and cone production in planted red pine by means of repeated partial girdling and thinning.

Arboretum

No further work was done in the development of the arboretum after a survey of the possibilities in 1952. The poplar and pine plantations have been maintained and protected against damage by mice by wire netting sleeves around the most important trees used for grafting and for breeding. All the dead and damaged plants in the poplar plantation have been removed and replaced with young healthy plants from the nursery. A new area was selected for an extension of the poplar plantation and ploughed in the fall. Some trees were cut down near the poplar grafts, to give space for the continued growth of the grafts.

Other work

Scions of Pinus rigida (pitch pine) were collected near Gananoque and grafted on white and Scotch pine with good results and on Jack pine and red pine with poor results, as a preliminary investigation of grafting possibilities of this species. The first Lake States Forest Genetics Conference was attended in the spring and a paper given, describing our work. The work of the Wisconsin group was seen during a visit to Madison in September to attend the meetings of the American Institute of Biological Sciences, and a useful exchange of ideas and experiences in white pine and poplar work took place. Seeds of Betula fontinalis were collected in the Rockies in Alberta in the fall and sown in the nursery. This species can possibly be used as stock in grafting of other birch species and may be useful as a tool in breeding work with the yellow and the white birch groups in the future. The breeding work at this Station was visited by Mr. K. Shea and Dr. P. Joranson from Wisconsin who are interested in poplar breeding. Seeds were collected from a couple of outstanding sugar maple trees at this Station and sent to Mr. H. Kriebel of Wooster, Ohio, who is starting some selection and breeding work there with this species. Mr. M. Holst and his associates from the Petawawa Forest Experiment Station visited this Station in the fall, to obtain some new information on methods and procedures in forest tree breeding.

Appendix "C"

Report of the Tree Breeding Activities

at Petawawa Forest Experiment Station

1953

M. Holst

Working conditions for tree breeding work have been quite satisfactory at the Petawawa Forest Experiment Station this year.

The staff has been enlarged with a full time nursery man and propagator. The conifers flowered abundantly but a late spring frost killed many of the female flowers in hard pine.

Spruce

The provenance experiment in white spruce was followed by measurements of leader and diameter growth. Similar measurements for comparison were made on black, red and Norway spruce.

Our efforts to get a provenance experiment in red spruce established was quite successful. With the help of various Canadian and American forest organizations it was possible to collect cones in representative areas from North Carolina to the Province of Quebec. Fourteen provenances were obtained and the material is to be sown in the nurseries at Acadia, Valcartier and Petawawa.

Thirty-three races of white spruce were sampled in an area covering Southampton in the south, Cochrane in the north, Kapuskasing to the west and St. Maurice River to the east. Forty-six single tree collections in white spruce were made in the area covered by the above provenance collection. Extreme broad and extreme slender types were sampled to investigate wood productivity of broad and slender types respectively. The seed from these collections were sown in the fall.

The flowering in white spruce was quite abundant and the following crosses were made.

Norway Spruce x Eastern White Spruce / Petawawa White Spruce / Western White Spruce

(8 crosses and 276 bags)

White Spruce x Norway Spruce

(4 crosses and 201 bags)

White Spruce x selfed

(15 crosses and 148 bags)

It looks like Norway spruce and White spruce cannot be crossed successfully. We therefore have to look for other ways in trying to transfer the weevil resistance of white spruce to Norway spruce. It is quite possible that a crossing bridge can be established between these two species by the help of Sitka spruce.

Our study of weevil resistance in Norway spruce was continued.

Help was given to Miss Doreen Laird in her study of the red spruce black spruce problem.

The C.P.P.A. was contacted for co-operation in provenance studies and selection of superior phenotypes in the Great Lakes-St.Lawrence Forest Region.

Red Pine

The study of how to control flowering in red pine was continued. In the 20 year old plantation the controls did not flower. Of the mechanical treatments, girdling near the ground was the most successful, while girdling in the middle of the crown and two strangulation treatments were less effective. Ammonium-Nitrate was highly effective as it both increased flowering and decreased growth. Twenty per cent Superphosphate and a 4-12-6 commercial fertilizer gave only few flowers. On old trees flowering could be increased about 25% by application of Ammonium Nitrate and 4-12-6 fertilizer. Apparently, ringing of old trees was not effective.

Several new races of red pine were obtained and a few of these go into the large provenance experiment. This experiment now includes the following races:

Raco, Michigan, U.S.A.
Cass Lake, Minnesota, U.S.A.
Trout Lake, Wisconsin, U.S.A.
Stanley, Nova Scotia.
Grand Lake, New Brunswick.
Upper Jay, New York, U.S.A.
Sorel, Quebec.
Mattawin River, Quebec.
Kenogami, Quebec.
St. Charles, Quebec.
Thessalon, Ontario.
Pointe aux Pins, Ontario.
Sturgeon Falls, Ontario.
Regina Bay, Ontario.
Lake Huron, Ontario.
Petawawa, Ontario.

Only a few cones were secured from the pollinating made in 1952. We still have to improve on our breeding technique in red pine. In this respect, to make control easier, we have started to graft population samples. Material of about 2000 scions representing important red pine races is at the moment ready for spring propagation.

The following crosses in red pine and other hard pines were made this spring.

		densiflora
		densiflora x Thunbergii
P. resinosa	x	nigra var austriaca
		mugo x sylvestris
		resinosa
P. sylvestris	x	rigida
		densiflora
		rigida
P. mugo x sylvestris	x	resinosa
		densiflora

(10 crosses and 210 bags)

Although flowering was abundant, late spring frost injured many of the pollinated flowers.

Jack Pine

Only few cones were obtained from the pollination made in 1952. We cannot account for these losses.

No pollination work was made this spring due to other more pressing work.

Plantation Work

A test plantation was established with various races of spruce, hard pine and larch, and a 7 acre plantation area made ready for planting of red pine and jack pine provenance material.

Vegetative Propagation

A total of 904 spruce grafts and 375 pine grafts were made in the greenhouse. Following is a summary of % of success of spring grafting in the greenhouse.

	1951		1952		1953	
	May	Oct.	May	Oct.	May	Oct.
Spruce	40	9	61	13	92	80
Pine	60	8	88	22	96	91

The low results in 1951 are explained by the fact that we only had fall potted rootstocks. In 1952 there was something wrong with handling of the grafts during the summer. We suspected the reason to be the fact that the plants were left in the pots and therefore liable to be potbound. In the

middle of June, 1953, the grafts were planted out and were well looked after by watering and shading. The difference in the May results of 1952 and 1953 is due to better handling of the greenhouse.

Three hundred and forty-six hard pine grafts were made in an experiment with outdoor grafting. A survival of 50% was secured. Grafting in the morning gave better results than grafting in the afternoon.

We have felt for a long time the need of a time saving technique for collection and propagation of white spruce scions. The normal procedure is to collect cones from August 25 to September 10 and scions from January till March. That means that the tree has to be visited twice for collection of the necessary breeding material. If cones and scions could be collected at the same time much would be gained. Scions were therefore collected from most of the old trees we collected cones from, stored in peat-moss over ice and usually grafted within a week. This technique gave a take of 50%. Old trees from Petawawa grafted within two days of collection, gave 80%, while young trees from Petawawa gave 90% survival.

Grafting of red pine in October gave 82% survival.

Nursery Work

Fifty-five thousand spruces (2-0) and 15,000 pine were transplanted this spring. About 28,000, 1-2 pine seedlings are ready for transplanting to test plantations.

Several lots of 2-0 spruce and pine were shipped to Maple and Harrington Forest Farm.

Other Work

Almost complete samples of our provenance seed collections in white spruce, (red spruce) and red pine were shipped to France, Germany, Denmark and Finland.

Pollen and scions of Populus tremuloides were sent to Sweden and Denmark and Pollen of Pinus resinosa to Maple and Sweden.

Appendix "E"

1953 Report on Shelterbelt Tree Breeding

W.H. Cram

Progress in the tree breeding work at Indian Head was drastically reduced due to the demands of nursery work in 1953. Lack of any labor force for a large transplanting program and a late spring limited the 1953 breeding to caragana. As previously reported the work at Indian Head involves three main projects: 1) Pine; 2) Spruce; 3) Caragana.

Pine

Work in this project was confined to nursery work in 1953. 2-0 progenies of 19 seed trees and 2-2 progenies of 44 seed trees of six geographic races of *Pinus sylvestris* were planted in field progeny tests. In all some 4500 seedlings were transplanted. Survival was high, averaging 95.2% for the 2-0 seedlings, and 99.3% for the 2-2 seedlings, due to the favourable conditions at time of planting. A more reliable picture of survival will be available in 1954.

The pine seed crop in 1953 was very light, with only 14% of the seed trees producing cones. Squirrels were partially responsible for the small crop. However, all seed crops since 1948 have been light.

Spruce

Pre- and post-emergence losses in the 1953 sowings of Colorado spruce (*Picea pungens*) were disastrous. Pre-emergence losses up to 68% occurred and less than 12% of the germination from seed of 48 seed trees survived. Post-germination losses due to 'damping-off' diseases have ranged from 1.4 to 56.0% for the 1948 to 1953 seed bed sowings. On the other hand losses due to climatic conditions, etc., following germination have averaged only 1.6%.

Previous studies have demonstrated that stratification of Colorado spruce seed for 30 days resulted in an average germination of over 90%. However, a plant breeding program cannot function with the losses cited above, because only a distorted picture could be portrayed by the surviving progenies.

Three projects were formulated with the specific objective of controlling spruce losses due to 'damping-off' diseases. They were: 1) Phytotoxicity of fungicides to tree seeds; 2) Pathogenicity of damping-off isolates; and 3) Control measures for damping-off. All three phases were designed on a co-operative basis with Dr. O. Vaartaja of the Forest Pathology Laboratory at Saskatoon. Results of a greenhouse test, which was conducted in the greenhouse during October and November 1953, to aid in the selection of non-toxic fungicides, appear in Table 1.

Table 1. Germination of Colorado Spruce Seed Following Application of Fungicides Before and After Stratification

Fungicide	Check	Before	After
	(%)	(%)	(%)
HgCl (0.5% soln.)	79	85	83
Captan	83	81	83
Arasan	73	78	80
Tersan	81	78	78
Nematicide	88	90	65
Manzate	74	79	25
Oxyquinolene	74	77	0
Ceresan	82	71	0

It would appear that Captan, Arasan and Tersan are not toxic to stratified seed of Colorado spruce. The efficiency of these fungicides in controlling 'damping-off' in Colorado spruce remains to be determined. The pathogenicity of four damping-off isolates has been under investigation. However, the results have not been completely processed to date.

The seed crop for spruce in 1953 was light, and this was further reduced by insects and squirrels. There has been only one good seed year since this project was initiated in 1947, and that was in 1948.

Caragana

Nursery work in the spring of 1953 involved the following planting: 1) a clonal observation nursery with rooted cuttings from 32 selections; 2) an accession orchard containing 1030 seedlings of 5 species and rooted cuttings from 5 sources; 3) extended the inbred plantation by 2620 S_1 seedlings of 49 seed trees; 4) polycross block with replications of rooted cuttings from 18 seed trees; 5) a vigor study with 1350 seedlings from 18 selections; 6) rooted cuttings of 15 selections were potted for greenhouse breeding work.

Self-compatibility determinations were carried out on 33 new vigorous selections and rechecked for 62 previous selections. Ten of the new selections appeared to be self-incompatible and the self-incompatibility of 15 of the rechecks was confirmed.

Cross-compatibility and pollen viability tests were made on a limited scale in 1953 to study the factors contributing to self-incompatibility. Pollen, from 47 seed trees with a self-compatibility range of 0 to 87%, revealed an abortion range of 0.1 to 24%. Two self-incompatible seed trees had 24 and 19% pollen abortion, while the average for 5 other self-incompatible trees was only 1.9%. It would appear that although pollen abortion may be a factor contributing to incompatibility, it was not considered responsible for complete self-incompatibility of these trees. The cross-compatibility results are summarized in Table 2.

Table 2. Self- and Cross-compatibility (% pods/flower) and Pollen Abortion (%) for Four Seed trees of Caragana arborescens

Seed tree	Set with pollen (♂) of A-1	V-16	V-2	N-19	Proposed genotype
♀	(%)	(%)	(%)	(%)	
A-1	0	0	11	55	S_1S_1
V-16	0	0	25	34	S_1S_1
V-2	0	0	0?	27	S_1S_2
N-19	0	0	25	42	S_1S_f
Pollen abortion	23.6	1.8	2.5	5.2	

The compatibility data in Table 2 appear to segregate the four seed trees into three fertility groups in agreement with the oppositional theory of incompatibility. By this theory, incompatible (S) factors operate to inhibit growth of pollen tubes when the pistil and the pollen possess a common S factor but pollen and pistils with no common S factor are compatible. The four seed trees have been assigned tentative S-factor genotypes which appear in the last column of Table 1. Self-incompatibility of A-1, V-16 (both S_1S_1) and V-2 (S_1S_2) was evidently due to common incompatibility factors. The self- and cross-compatibility of N-19 was most likely due to the presence of the fertility factor Sf. These results stress the importance of analyzing selections for pollen viability and compatibility prior to their inclusion in a breeding program.

<u>Vegetative propagation</u> tests were continued in 1953. Hardwood cuttings rooted poorly. Rooted cuttings were obtained for only 14 of the 37 trees tested even following hormone and fungicide treatments. Rooting of softwood cuttings, which were collected from four trees at four 14-day intervals, was increased by the application of bottom heat, fungicides and hormones.

Cuttings from the four trees varied in their reaction to treatments for the different collection dates. The following general responses were noted. Bottom heat increased rooting capacity for all four collection dates. Results averaged 27% compared with 7% for no heat. Application of Fermate doubled the rooting capacity with and without heat, while application of hormones (especially Rootone) tripled the rooting capacity with no heat. There was little to no difference in rooting capacity of cuttings collected on the first three dates. However, when the cuttings reached the stage of maturity with a moisture content of less than 60%, rooting was induced only by hormones plus bottom heat.

Appendix "D"

Dutch Elm Disease

A.W. McCallum

During 1953, there was probably very little change in the Dutch elm disease situation in Canada. However, there was no general survey for infected trees, those that were sampled being in or near towns or cities in Ontario and Quebec. In Ontario 57 trees were sampled and 37 were found to be infected. One of the latter was from Elgin County and this is the first known instance of the disease in that County. Four diseased trees were found in Ottawa in Carleton County and the remainder were from Essex and Kent Counties, mostly from Windsor and vicinity. In Quebec collections were made from 360 suspected trees and 181 were found to be positive. These were mainly from the cities of Drummondville, St. Hyacinthe, Sherbrooke, Victoriaville, and Montreal and environs.

Appendix "F"

Cytogenetic Studies in *Caragana*

1953

R.J. Moore

A small number of interspecific crosses were again attempted. The following crosses involving the less common species have been attempted over several years without success.

C. frutex - C. spinosa
C. aurantiaca - C. spinosa
C. aurantiaca - C. maximowicziana
C. spinosa - C. maximowicziana

Of the above species, *C. frutex* and *C. spinosa* are tetraploid; and *C. aurantiaca* and *C. maximowicziana* are diploid (2n=16).

Pollen Storage

Tests of the viability of stored pollen of *C. arborescens* and of *C. frutex* have been made in 4 different years. Mature anthers were folded in thin porous paper and stored in a vial containing calcium chloride. The vials were tightly corked and stored, some at room temperature and others at about 0°C. The pollen was tested for germination on slides on which 2% agar plus 1% sucrose had been spread. The slides were germinated in a moist chamber and after 6 hours the germinated pollen grains were counted. Considerable variation in the per cent of viable grains was noted in different years but it may be concluded in general that a sufficient number of pollen grains of both species retain their viability for 2 weeks to be useful for breeding purposes. After 3 weeks storage germination is very low, less than 1%. Storage at the lower temperature is beneficial, but not essential. The percentage of viable grains is increased by storage in frigidaire.

Colchicine Treatments

Over several years attempts have been made to induce polyploidy in *C. arborescens* and in *C. frutex* by the use of colchicine. The following methods have been used. Germinated seeds were soaked in .05% and .1% aqueous cochicine 6-24 hours. Solutions of .1% and .2% colchicine were applied to the terminal bud of actively growing seedlings. A drop of solution was placed on the bud daily for about 1 week or the bud was immersed in solution. Terminal buds were painted with .2% colchicine in 2% carbowax. Roots of seedlings were soaked in .2% solution for 24 hours.

In almost all cases some immediate effect was observed, indicating that the drug had entered the tissues and acted on the growth process. Swollen, stunted primary roots of seedlings were observed. Larger seedlings usually lost their foliage after treatment. The new leaves were often irregularly shaped, darker green in colour and more than normally pubescent. Unusually large leaf stomata were observed in some cases, indicating that polyploid cells had been produced.

In all cases to date the growth rate of the affected tissue was very slow. After several months the abnormal leaves were replaced by normal leaves. It is believed that sectors of polyploid tissue have been produced by the treatments but that the growth rate of this tissue is slower than that of diploid tissue and that the polyploid tissue is overgrown by diploid tissue before polyploid organs are formed.

Approximately 40 seedlings, branches of 50 arboretum plants and 20 seeds have been treated. Approximately 3/4 of these were C. arborescens. At present 4 seedlings treated almost a year ago are still showing colchicine effects. The treatment caused a dormancy of about 8 months.

Treatments similar to the above using Podophyllin produced no "colchicine effect".

Appendix "G"

Report on Forest Genetic Studies at Acadia

H G. MacGillivray

A programme in forest genetic studies was initiated at Acadia in 1953. This work is supervised by a committee of three, the writer acting as chairman, Mr. McLeod, who is in charge of the Acadia nursery, assisting in handling nursery material, and Mr. B.C. Wile advising in silvicultural problems and making field selections.

The main object of the programme is to develop or select superior strains of spruce and fir for use in the Maritimes. The initial part of the programme will therefore consist largely of assembling suitable tree breeding material. This will involve selection of superior stands and superior trees for the development of seed orchards. In the meantime work on provenance experiments has been initiated.

Plans are being made to establish genetic arboreta as a future source of tree breeding material. Plantations of suitable exotics, about two acres per species, will be established. These will be exposed to natural selection factors for about 20 years. The best surviving trees will then be selected as tree breeding material. In the meantime it is hoped that a map can be developed showing the location of present plantations of exotics and native species in the Maritimes.

Present Work

1. Provenance experiments: Material for provenance experiments in red, white and black spruce have been collected during 1952 and 1953. This work is to supplement rather than duplicate work done at Petawawa.

A provenance experiment in balsam fir was initiated by fall sowing in 1953. Cones of the bracted balsam fir (*Abies balsamea* var. *phanerolepis*) were observed in many cone collections, indicating that this variety is much more common in New Brunswick than was previously supposed.

Small samples of seed from white, red and black spruce and balsam fir provenance material were spring-sown in 1953. Some of the samples of white spruce and balsam fir produced few seedlings. There appeared to be an indication, however, that the more southerly the provenance, the higher tended to be the average number of cotyledons per seedling for both balsam fir and white spruce.

Larger numbers of seedlings were obtained from the red and black spruce seed samples. The more southerly the provenance the higher tended to be the average number of cotyledons per seedling. It was not clear whether there was a relationship between these averages and the overlapping of the ranges of red and black spruce. The average number of cotyledons per seedling for southeastern Prince Edward Island black spruce was very significantly smaller than that of black spruce from Nova Scotia. The averages for New Brunswick black spruce were intermediate between those from Prince Edward Island and Nova Scotia. No red spruce were observed growing in southeastern Prince Edward Island.

The average number of cotyledons per seedling for red spruce from West Virginia, beyond the range of black spruce, was very significantly greater than for any of the red spruce from the Maritimes. Some red spruce from northern New Brunswick near the fringe of the natural range of red spruce had very significantly fewer cotyledons than red spruce from Nova Scotia.

The differences between the average number of cotyledons per seedling for red spruce and black spruce remained fairly constant from one locality to another as the averages for both species changed in the same direction.

2. Selection of superior trees: Several individual spruce and fir trees were selected at Acadia Station. Seed collections were made for single tree progeny tests.

3. Selection of spruce budworm resistant host trees: Field selections were made on the Green River Watershed. Two white spruce and six balsam fir were selected for future investigations. One balsam fir was of particular interest because of its apparent resistance to spruce budworm attack.

4. Comparative study of red spruce, black spruce, and possible hybrids: It was considered important to have a clearer understanding of these two species before using them in any hybridization work. Key characteristics from several texts were used to classify about 80 trees along a transect leading from a black spruce stand into a red spruce stand. Seed collections from these individual trees as well as seed from other red spruce and black spruce stands will be used in an attempt to get a better understanding of heredity in these species and also the effects of site on these species.

Committee on Forest Tree Breeding

Report on the Lake States Forest Tree Improvement Conference

August 30-31, 1955

by

M. J. Holst

The proceedings of the Lake States Forest Tree Improvement Comference is published by the Lake States Forest Experiment Station as Miscellaneous Report No. 40, December 1955. 108 pp.

The Conference was opened with progress reports presented by the many workers in the Lake States; these were: The Lake States Forest Experiment Station, University of Minnesota, Quetico-Superior Wilderness Research Center, University of Wisconsin, University of Michigan, Michigan State University, The Institute of Paper Chemistry, Nekoosa-Edwards Paper Company, Marathon Co-operation, Kimberly-Clark, and Consolidated Water Power and Paper Company. These reports cannot possibly cover the variety of fields taken up for investigation but they show clearly how effectively the newly established Lake States Forest Tree Improvement Committee is working. There is hardly any duplication of the work. The large work consuming provenance experiments are handled on a co-operative basis and the ease with which the co-operation is organized makes it possible to start with complete coverage of the Lake States. Also the fact that so many private companies are actively involved in both practical silvicultural improvement work, in co-operative testing conducted by the Lake States Forest Experiment Station and the Lake States Universities and in their own selection programs, indicates how determined the foresters are to try their hand on genetical improvement work. I think the reason for this intensive activity is that the Lake State Foresters are planting so much and they reason that they might as well plant the best.

Thereafter followed progress reports on the work going on at the Southeastern, Southern and Northeastern Forest Experiment Stations, the Central States, and Canada. Again the activity seems to follow the planting programs. For instance, the Southeastern Forest Experiment Station has a very large breeding program (both practical and theoretical) and 185 million seedlings were planted within the Station territory in 1954. The timber cut still exceeds

growth in most areas, and the size of the average tree is decreasing.

Three panel discussions were held but limited time prevented extensive discussions.

The first discussion was on seed and pollen collection, storage, and exchange. Dr. Pauley gave a good outline of how to organize collections and Dr. Nienstaedt gave some interesting information on the forcing of Tsuga pollen in 20-hour light period. In this way the pollen may be gathered some 10 days earlier than by normal day. Dr. Shea discussed the dangers of pollen exchange without quarantine regulations. The shipment of pollen (and seed) is a somewhat calculated risk. So long as we use intelligence and ordinary precaution we probably are on the safe side. So far as possible, both pollen and seed should be collected and handled by trained scientific personnel.

The second discussion was on vegetative propagation. It was clearly indicated how the various workers were trying to overcome the difficulties of vegetative propagation and how intensive the research is on these problems. All tree breeders aim to find suitable techniques for large scale production and the preferred techniques seem to be as many as there are tree breeders and tree species. This is very fortunate and has lead to the discovery of many new techniques.

S. R. Gevorkiantz presented some interesting statistical methods for the selection of plus trees. The system is based on a so called space-competition index. Tree volume or growth is correlated with age and space-competition index and analysed by partial correlation analyses. The system seems good for uniform, evenly-aged stands which have not been suppressed, or, more specifically, for plantations of intolerant species. The system is not likely to work for the selection of plus trees in tolerant species where suppression is a normal occurrence.

The panel discussion on testing for resistance to disease and insects emphasized what we do not know rather than what we do know, and this is probably quite typical of the situation to-day. But of course intelligent questions may be half solved problems.

An interesting paper was presented by H. L. Mitchell dealing with breeding for high-quality wood. Wood-quality evaluations are based largely on three anatomical and physical features, namely: percentage of summer wood, fibril angle, and wood density. Correlated with these are such quality factors as mechanical strength, shrinkage, pulp yields, and other wood properties. The techniques for the rapid and accurate determination of wood characteristics from small samples of living trees are now available. The techniques mentioned were: Smith's maximum moisture method for determining specific gravity of single annual rings in increment cores and Mart's fluorescent microscopic technique for measuring fibril angles directly on cores from standard increment borings. Canadian tree breeders should keep in touch with this development and eventually apply these tedhniques for the rating of their selected trees. Beside growth and form selection, we should include a check on wood-quality.

Mr. Mitchell then discussed the effect of a 50 per cent increase in both growth rate and specific gravity, which in southern pines would increase kraft pulp yields per acre about 2 or 3 times. This is an enormous improvement, and should be taken with a grain of salt. It is not likely that the production of bone dry matter per any given acre can be increased more than perhaps 10 per cent, unless special silvicultural treatments (for instance fertilizing) are applied. The highest recorded volume improvement is from 20 to 50 per cent (German Norway spruce grown in southern Sweden). High volume production is most often correlated with low density wood. However, Mr. Mitchell is right in pointing out this quality aspect, although he could have been a bit more conservative in his estimates of what tree breeders can produce in terms of improvements.

The Lake States Forest Tree Improvement Committee also undertook active work projects which are dealt with by sub-committees. Four such sub-committees were active: (1) Seed collection zones, (2) tree and stand selections (3) bibliography and directory, and (4) projects for study.

A most interesting work project was the attempt to establish seed collection zones. The zones are based on summation of temperatures above 50°F. Intervals of 1,000 "degree-days" above 50°F and of 4°F in average January temperature provides some 26 zones in the Lake States. Within any one of the Lake States the "degree-day" would suffice and this would provide 6 zones for Minnesota, 5 for Michigan and 4 for Wisconsin.

The Conference terminated with a field trip of which the most interesting stop was Dr. Reikers old white pine blister rust test garden.