Forestry Branch
Department of Northern Affairs and National Resources

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

Held in the Lecture Room, Forest Products Laboratory, Metcalfe and Isabella Streets, Ottawa, on March 8 and 9, 1955.

Attendance

Mr. A. Bickerstaff, Chairman
Dr. R. M. Belyea,
Dr. J. E. Bier,
Mr. A. J. Carmichael,
Dr. L. Chouinard,
Dr. W. H. Cram,
Dr. B. W. Dance,
Mr. A. R. Fenwick,
Mr. J. A. C. Grant,
Mr. J. M. Halpenny,
Mr. J. D. B. Harrison,
Mr. R. R. Hartig,
Dr. R. G. Hitt,
Mr. J. M. Holst,
Dr. A. W. S. Hunter,
Dr. R. J. Moore,
Mr. H. G. MacGillivray,
Dr. R. Pomerleau,
Mr. W. A. Porter,
Mr. J. W. B. Sisam,
Dr. E. C. Smith
Mr. C. R. Sullivan,
Mr. H. S. D. Swan,
Mr. C. W. Yeatman,
Dr. C. C. Heimburger, Secretary

40. Welcome

Mr. Bickerstaff welcomed the following guests and new members: Dr. R.G. Hitt and Mr. R.R. Hartig of the Lake States Forest Tree Improvement Committee, Dr. R.M. Belyea and Mr. C.R. Sullivan of the Forest Insects Laboratory at Sault Ste. Marie, and Mr. A.R. Fenwick of the Ontario Department of Lands and Forests, and new members: Dr. B.W. Dance, Mr. W.A. Porter, and Dr. R. Pomerleau of the Division of Forest Biology, Department of Agriculture, Mr. J.M. Halpenny of the Division of Reforestation, Ontario Department of Lands and Forests, Mr. H.S.D. Swan of the Pulp and Paper Research Institute of Canada, and Mr. C.W. Yeatman of the Forestry Branch, Department of Northern Affairs and National Resources.

41. Minutes of last meeting

Mr. Bickerstaff distributed copies of the minutes of the last meeting which had been mimeographed by the Forestry Branch and suggested the following corrections:

In Minute 38, Mr. A.L. Orr-Ewing was proposed as an active member. Since Mr. Orr-Ewing is an officer of the B.C. Forest Service, Dr. R.H. Spilsbury has been asked to become a sponsoring member. In the first copies of the minutes circulated "Adjournment" should be minute 39, not 38. Dr. Heimburger introduced a suggestion by Mr. McCallum to change "Division of Forest Biology" to "Division of Botany and Plant Pathology" in minute 28, page 5. Dr. Heimburger then made some comments on changes in the minutes of the last meeting made by the editor of the Forestry Branch, in deleting several paragraphs. These deletions are as follows: Minute 22, in the middle, "The C.P.P.A. has a Woodlands Section which has developed into a large body. It had a Silvicultural Research Committee which is now a Committee on Forestry. This Committee organized the present plantation survey. The Pulp and Paper Research Institute of Canada (P.P.R.I.C.) was established in 1950 and took over the Pulp and Paper Research Laboratory in Montreal. This is supported by McGill University and the Forestry Branch. Dr. L.L. Thiesmeyer, its president, is also a member of the directorate of Woodlands Research. Mr. A. Koroleff is Director of Woodlands Research, dealing with logging methods, hauling roads, wood transportation and similar studies." Minute 22, last paragraph: "Some of the latter are more interested in planting than others and are willing --etc."

In minute 23, in the middle: "In Canada, the governments are contributing about this share of the total cost if a comparison is made on a per capita basis and the cost reduced to about 1/3 of that in Sweden. Therefore, it is important to invite the participation of the industry in sponsoring forest tree breeding and allied activities." None of the members present voiced any objections to the wording or contents of these deletions and to their reinstatement.

Mr. Swan stated that the P.P.R.I.C. was reorganized, not established, in 1950. Dr. Cram moved a vote of thanks to the Forestry Branch for mimeographing the minutes of the last meeting.

42. Business arising from the minutes

Mr. Bickerstaff distributed copies of the Chairman's Report covering action taken on the items arising out of the 1953 and 1954 meetings of the Committee (see Appendix "A").

(a) Membership

Dr. L.P.V. Johnson (University of Alberta) did not reply to invitation for membership. Dr. H. Hills, the new chief of the Horticultural Division, was suggested as a sponsoring member. Mr. W.J. Le Clair, Secretary of the Canadian Lumbermen's Association, promised to appoint a member representing his organization "in the near future". Mr. W.A.E. Pepler wrote that he would be unable to attend the present meeting and suggested Mr. E.T. Owens as an alternate. He also suggested to invite

Dr. L.L. Thiesmeyer of the P.P.R.I.C. to become a sponsoring member. Dr. G.S. Allen (U.B.C.) has suggested that Dr. A.H. Hutchinson, formerly of the U.B.C., be invited to become an active member of this Committee. It was moved by Mr. Sisam and seconded by Mr. Porter that this suggestion be followed. This was accepted.

Mr. Bickerstaff read a letter received from Dr. N.H. Grace, Research Council of Alberta, extending greetings and good wishes to the Committee.

(b) Financial position

Mr. Bickerstaff read and distributed copies of a memorandum from the Director, Forestry Branch, covering among other questions, the functions of this Committee, its membership and availability of funds. (See Appendix "B").

Mr. Harrison outlined the functions of the National Research Council in initiating and sponsoring the Associate Committee on Forestry and its Sub-Committee on Forest Tree Breeding, and the subsequent development of the present Committee. The outline is similar to that given in minute 3 (1953). He stated that the Canada Forestry Act was promulgated in December, 1949. At present funds are available for agreements with the Provinces for the support of 2 kinds of activities of the Provinces: (1) forest inventories, and (2) reforestation of vacant Crown Lands.

Dr. Heimburger inquired about the kind of sponsorship carried out by the Forestry Branch. Mr. Harrison replied that the sponsorship at present consists of a certain amount of clerical work, arrangement for a place of meeting and the other activities outlined in the memorandum (Appendix "B").

(c) Lectures on tree breeding

Dr. Chouinard (Laval U.) stated that a few special lectures on this subject will be welcome at Laval University.

Mr. Sisam (U. of T.) wrote the following about this to Mr. Bickerstaff: "The matter of lectures on tree breeding has been discussed at some length with members of the Faculty. While the importance of forest tree breeding, and the need to have our forestry graduates well informed on this subject are fully realized, it is felt that the giving of three or four lectures on the subject by a visiting lecturer would not be particularly desirable. Such lectures would presumably not be a required part of the curriculum, might not fit in easily with the courses being given in related subjects, and would not be subject to examinations. Furthermore, if the subject Forest Genetics is treated in this way, how many more aspects of the biological, economic, operational, mensurational and so on, branches of forestry should also be given such special attention? As I mentioned to you in a previous letter, I am in favour of doing something more in this Faculty with regard to Forest Genetics, but it seems to me it will probably have to be developed within the framework of Silvics or Silviculture." Mr. Sisam stated further at the meeting that funds are available in the Graduate School of the University of Toronto for travelling lecturers. The lectures are given in the evenings and are also available to undergraduate students.

Mr. Bickerstaff mentioned that Dr. D.A. Macdonald met Dr. C. Syrach Larsen in India during the recent World Forestry Congress. Dr. Syrach Larsen is preparing a set of lectures on forest tree breeding. These lectures are to be translated into English by Dr. M.L. Anderson of Edinburgh.

Dr. G.S. Allen (U.B.C.) wrote as follows to Mr. Bickerstaff: "Although we require a course in Second Year which we call Principles of Forest Genetics, we would welcome visiting lecturers who might deal specifically with some phase of the work or who might outline the work of the organization represented. If we have sufficient advance notice we might be able to find funds to help defray expenses of a lecturer coming from another part of the country. At the same time, we would be pleased to contribute in some way to the program elsewhere, provided that we are qualified to deal with the subject desired."

Mr. J.M. Gibson (U.N.B.) wrote as follows: "We will be particularly interested in this and will be very glad to pay any necessary travelling expenses for a visiting lecturer to visit our University and talk to our students concerning forest genetics and tree breeding. At the present time, however, we have no funds available as an honorarium for such work. I have talked this over with our staff members and they feel it would be a most useful opportunity for our students to become acquainted with the present developments in this field and would definitely broaden the work already given by our regular staff members."

Mr. Harrison suggested the establishment of a regular program of lectures in forest genetics and forest tree breeding at the forestry schools having shown an interest in this. Dr. Heimburger mentioned a film, in sound and colour, on some phases of forest tree breeding prepared by the Mississippi State Forestry Commission which could be made available in this connection. Mr. Halpenny suggested that active members of this Committee could serve as lecturers. Mr. Harrison suggested that any university who sees fit to ask, should be considered in this respect. Dr. E.C. Smith expressed the view that such lectures should not be restricted to forestry schools and may be extended to other universities. Dr. Cram pointed out that forest tree breeding in North America is just as advanced as it is in Europe, and perhaps even more advanced along certain lines. Mr. Sisam stressed the point that a lecturer should be an outstanding geneticist. Mr. Bickerstaff emphasized the necessity of having definite funds allocated for such lectures. Dr. Cram would like the lectures to be an introduction to forest tree breeding rather than to cover special phases of this field. Mr. Carmichael recommended that the Mississippi film be rented or purchased as a first step in this direction. Dr. Heimburger promised to look into the matter of renting or acquisition of this film.

(d) <u>Preservation of superior stands</u>

Mr. Holst recommended an informal basis for arrangements with wood using industries for the preservation of superior stands. Mr. Carmichael believed that holding stands is a very difficult undertaking. A seed orchard program is preferable. Seed orchards of superior white pine are being planned in Ontario. Red pine seed orchards are being developed for northern seed production. The utilization of Holst's results with spruce in seed orchards was recommended. Dr. Bier was impressed with Corsican pine in England -- there was excellent growth and it seeded in naturally in openings. Mycorrhiza was established in natural regeneration and in temporary nurseries. Dr. Heimburger explained that our work in the preservation of superior stands can only be an attempt at present because of the large forested areas involved, in relation to available personnel for this task. Mr. Holst suggested two steps in this procedure: (1) increasing seed production in stands, and (2) mapping seed collection zones, and within the zones the collection of seeds from "good" stands.

Dr. Hitt said that in the Lake States there is a committee looking after the selection of desirable stands and trees, the subdivision of the forested area into seed zones and the selection of stands within such zones. Mr. Harrison drew attention to W.E.D. Halliday's forest classification for Canada as a suitable basis for the selection of areas deserving attention in this respect. Dr. Heimburger pointed out that the preservation of superior stands and trees is part of forest conservation and that the Canadian Forestry Association ought to be interested in this and support such activities. He drew attention to the statements of the late Dr. E.S. Babcock at the Lake States Forest Genetics Conference in 1953. These are as follows:

"1. The preservation of the better and elimination of the poorer hereditary stocks in each important timber tree species must be recognized as a basic principle in forest conservation.

2. The utilization of the best available hereditary traits or features of each important species, i.e. conservation of superior genes, in the creation of ideal types of timber trees by means of applied genetics must be recognized as a basic principle of forest conservation.

3. Since the utilization of superior genetic stocks of timber trees in growing our future forests can be accomplished only by qualified scientists, working intensively, continuously, and cooperatively for many years, the adequate financial support of research in forest genetics and allied disciplines is of basic importance in forest conservation."

Mr. Swan asked Mr. Holst about the cooperation of the wood using industries in this. Mr. Holst mentioned his questionnaire to the industries and his report on suitable stands of seed sources and outstanding single trees of white spruce. Most replies came from the boreal forest. Quebec is too far away from the Petawawa Forest Experiment Station for this. Twenty odd trees were selected that are suitable; a report on this to the C.P.P.A. has been prepared. Mr. Holst would like to extend this work and concentrate it to an area close to the Petawawa Forest Experiment Station. Mr. Swan believed that professional men were the most suitable for this kind of work. Mr. Bickerstaff mentioned that a revised edition of Halliday's forest classification for Canada will be put out next year as part of an Atlas of Canada in connection with this problem.

Mr. W.G.E. Brown has made a breakdown of Halliday's classification into physiographic divisions, based on comparable climate, land forms, etc. These are similar to the site districts of G.A. Hills. Mr. Harrison believed it would be of help for the selection of superior stands to reduce the country into more manageable areas. Mr. Holst said that this statement was included in his report and referred to areas of highest productivity. The map of Mr. Brown's is in support of his case. Mr. Bickerstaff recommended the extension of tree breeding activities into the north, starting with the selection of superior stands and trees.

(e) Participation of plant physiologists in flowering studies

Dr. Senn was asked for suggestions as to available plant physiologists (see Appendix "A"). There has so far been no reply from Dr. Senn. Dr. Moore stated that Dr. Senn had nothing further to say about this.

Mr. Sisam cited the work of Dr. G.H. Duff of the Department of Botany, U. of T., in flower induction in red pine. Dr. Heimburger also cited Dr. Duff's work in thinning, studies of flower bud initiation in red pine and treatment with growth hormones to induce flowering. Mr. Holst stated the problem consisted in forcing young trees to flower, especially seedlings of pine and spruce. Promising results have been obtained by long-day treatments. Dr. Hunter believed that such investigations also were important to fruit growers and cited the work of Dr. K. Sax at the Arnold Arboretum. Mr. Holst described his finding of young cones on seedlings of Scotch pine in the nursery and the preservation of such materials for further studies. Mr. Carmichael also found some potted red pine with flower buds. The pines had been potted during last spring and probably initiated flower buds as a result of heavy root damage during potting. They began to flower when forced in the greenhouse this year.

(f) Tree breeding sub-stations

Mr. Carmichael recommended that areas for this purpose be adjacent to research areas and should include black spruce swamps. Mr. Harrison recommended that a report on the requirements for tree breeding areas be submitted to the forthcoming meeting in April of the joint advisory committee on silvicultural research of the Forestry Branch and the Ontario Department of Lands and Forests. Dr. Cram moved that such a report be prepared before adjournment of the meeting of this Committee, Dr. Heimburger and Mr. Holst to submit a final report to the Committee in the afternoon. (Appendix M)

(g) Wood density studies

Mr. Bickerstaff cited an excerpt of a letter by Mr. Holst on this, stating that wood density varies with site, age of tree, with climatic cycles. He mentioned the work under way in Texas with loblolly pine. Some studies on slow-grown wood have also been undertaken at McGill University. Mr. Swan cited the studies of Mitchell on wood density in the southern States. Mr. Carmichael suggested that this may be a problem for graduate students. Dr. Heimburger stated that in his experience with pulp companies, the woods end and the mill end often did not have the same requirements as regards wood density and that we still know very little about the variation of this factor in the forest. Mr. Harrison suggested obtaining all available information about this from the Forest Products Laboratories and the Pulp and Paper Research Institute of Canada. Mr. Carmichael suggested that a member to this Committee be invited from the Forest Products

Laboratories, to study wood density, fiber length, and cellulose content of selected tree materials. Mr. Bickerstaff recommended that this matter be looked further into during next year.

(h) Abstract of meeting for the Forestry Chronicle

Dr. Heimburger reported that arrangements have been made for a short article to appear in the March issue of the Forestry Chronicle. Mr. Harrison moved that this article be prepared immediately after this meeting. This was seconded by Mr. Swan.

(i) Consolidation of records

Mr. Bickerstaff outlined the present situation in this respect. A complete file of the minutes of the old Sub-committee is in the Forestry Branch library. Forestry Branch file 14-5-3 covers the activities from the first meeting of this Committee. Dr. Heimburger stated that he had some new data on file.

(j) Invitation to outstanding geneticists

Mr. Holst recommended that we invite visitors to attend the meeting of this Committee and give lectures on their current work in this connection.

(k) Exchange of observers with the Lake States Forest Tree Improvement Committee

Dr. Hitt and Mr. Hartig were attending this meeting as representatives of the above organization, following an invitation to attend by Mr. Bickerstaff.

(l) Seed exchange

In response to a letter of appreciation from Mr. Bickerstaff, Mr. Bayly wrote as follows: "I would suggest that you address any requests for seed for this purpose to this Division, stating species and quantities required. I believe that we can supply the small quantities of seed required for this work free of charge if we have it available." Dr. Heimburger stated that he had received a letter from Mr. R.W. Marquis, Director, Northeastern Forest Experiment Station, with a request for seedlings of white pine of known origin and believed this Committee should reciprocate.

43. New Business

Mr. Bickerstaff suggested that the Committee deal with administrative matters first.

(a) Type of future meeting

In the past there has been a business meeting followed by reports of the members. At present, a two-day meeting is indicated, consisting of a business meeting, as brief as possible, and a longer meeting open to a wider group. Mr. Fenwick extended an invitation from Mr. R.N. Johnston, Chief, Division of Research, Ontario Department of Lands and Forests, to hold the next meeting at Maple, Ontario. Mr. Swan supported this move. Mr. Bickerstaff reported a suggestion received from Mr. A.L. Orr-Ewing, Forest Service, Victoria, B.C., that annual meetings should be held at different places, in order to give the most distant members a chance to attend from time to time. Mr. Holst suggested that progress reports by active members be submitted before the meetings, so that the members could have time to peruse and discuss them at the meetings. Dr. Heimburger suggested that the meetings be held in different parts of Canada, perhaps in connection with the Canadian Institute of Forestry annual meetings. Dr. Hitt stated that the meetings of the Lake States Committee on Forest Tree Improvement are held at different places in Wisconsin and consist of annual meetings of the executive council followed by field meetings. Mr. Carmichael stated that the time of year of the present meeting is suitable, also for the sponsoring members. Mr. Harrison was not in favour of having meetings in connection with the C.I.F. annual meetings because the time of the sponsoring members is usually fully taken up with other matters then. He supported Mr. Holst's suggestion about the presentation of reports prior to the meetings. Mr. Bickerstaff suggested that the meeting next year be held at this time. Mr. Harrison stated that summer meetings would be difficult to attend by the sponsoring members. Dr. Cram suggested this type of meeting and a field day at the Southern Research Station. Mr. Fenwick forwarded the suggestion of Mr. R.N. Johnston that the meetings be rotated among the member organizations and the reports be distributed at the meetings.

(b) Procedure for election of officers

Mr. Fenwick favoured a rotation of officers. Mr. Harrison suggested that the Chairman be a sponsoring member. Dr. Cram suggested that either the Secretary or Chairman rotate in relation to the locality of the meeting. Dr. Heimburger suggested that a moderator be elected for each specific meeting, who could act as chairman. Dr. Hitt mentioned that the meetings of the committee he represented were small and consisted of representatives from State, Federal and industrial organizations, and from universities. Mr. Holst favoured a rather flexible system in respect to appointment of both Chairman and Secretary. Dr. Bier suggested a relatively continuing Secretary and rotating Chairman. The Secretary should preferably be a member of the Forestry Branch and retain this office, and the rotating Chairman should be elected from another organization. Mr. Bickerstaff then appointed a nominating committee of three, consisting of Dr. Bier, Dr. Cram, and Mr. Carmichael, to nominate a new Chairman and Secretary for the next year.

(c) Other new business

Dr. Cram inquired about the availability of white spruce seeds and seedlings for testing under Prairie conditions. Eastern origins of white spruce were not suitable for the Prairies. Mr. Holst suggested white spruce from Yoho Canyon in British Columbia, and from Montana. Mr. Carmichael inquired about vegetative propagation of yellow birch. Dr. Heimburger replied that he had been able to root greenwood cuttings of yellow birch, with hormone application, in open propagation frames at the Petawawa Forest Experiment Station during his earlier work there.

The question of restriction of publication of the Proceedings of the meetings of this Committee then came up for discussion. It was suggested that the minutes be marked "Confidential" as were the minutes of the old Sub-committee. The Proceedings are not for publication. It was suggested that the incoming executive prepare a distribution list for the Proceedings of future meetings of this Committee.

Dr. Chouinard announced the recent formation of the Genetics Society of Canada, of which he is the Eastern Director at present. Meetings will be held in two parts of Canada and this information should be of interest to the new Secretary. The membership of this Society is open to all persons interested in any field of genetics. This would include many members of this Committee.

Dr. Cram suggested that progress reports be sent in advance of the meetings of this Committee. Mr. Fenwick stated that it should be the responsibility of the Secretary to get these out, and to advise members in advance accordingly. Dr. Heimburger stated that he had difficulties during the past year in the identification of pathogens causing a certain kind of canker on white pine at Maple, Ont., and at the Connaught Ranges, of mites on white pine at the Connaught Ranges and of certain aphids attacking poplars in his tests. Dr. Bier stated that the Advisory Committee on Forest Entomology and Pathology had not received a request for this type of work. Dr. Belyea recommended that a definite proposal be made in this respect. Dr. Cram then described the functions of the Forest Pathology Laboratory in Saskatoon. Specific requests about identification of pathogens and other matters of cooperation are made well in advance to the Division of Forest Biology. In Ontario, this could be made through the Advisory Committee.

44. Shoot Moth Resistance in Hard Pines

Mr. Holst had observed great damage to hard pines by the European pine shoot moth in Ontario and the United States and had prepared a paper on this, to appear in the Forestry Chronicle in the near future. He suggested that arrangements for cooperation be made between the Department of Agriculture, the Ontario Department of Lands and Forests and the Forestry Branch for conducting trials of exotic hard pines and their hybrids in southern Ontario for the evaluation of their resistance to shoot moth. The Department of Agriculture had this year conducted some studies of the behaviour of this insect and of its control, and plans to continue these studies for another couple of years. Dr. Belyea stated that he had visited the Petawawa Forest Experiment Station in this connection and that investigations were carried out in southern Ontario. Mr. Holst suggested that if the investigations are to be continued, our materials be added to these. Dr. Belyea stated that an active research program in this field is under way, especially to find out what causes resistance. Mr. Carmichael stated that he had established a test plantation in southern Ontario where native red pine is being compared with *Pinus nigra* var. *cebennensis* from central France in blocks. Dr. Belyea believed that many young pine carried different degrees of infestation by the shoot moth when they were planted. Mr. Holst believed that degree of infestation depended also on the adaptation of the plants to site. Dr. Belyea thought that winter climate was important in determining the degree of infestation.

45. Availability of Seeds from British Columbia

Dr. Heimburger described the difficulties found at present in obtaining small seed portions of definite origin of western tree species required for experimental purposes. Seed collection is at present carried out by large private companies on a wholesale basis. It is almost impossible to obtain small lots of definite origin from these sources. Mr. Porter gave the names of the following organizations in the Northwest from where seeds for experimental purposes possibly could be obtained:

Oregon State Forest Service;
Douglas Fir Seed Improvement Organization, sponsored by the Pacific Northwest Forest Experiment Station in Portland, Oregon;
Association of West Coast Nurserymen;
Forest Genetics Foundation, Berkely, California.

The above organizations are especially interested in Douglas fir seed of known origin.

46. Dr. Heimburger's Report

Dr. Heimburger presented a summary of his work during the past year, which is now given in extenso in Appendix "C". Mr. Carmichael inquired about the period of time annual reports should cover. Mr. Holst suggested the reports cover the calendar year, from January to December.

47. Decision of the Nominating Committee

The above committee nominated Mr. A.P. Leslie as Chairman for the year 1956 and Mr. C.W. Yeatman as Secretary.

48. Mr. Carmichael's Report (see Appendix "D")

Mr. Carmichael presented a report on his activities in establishment of provenance test plantations, seed plantations, seed orchards and graftings. In the discussion, Mr. Holst suggested the use of local strains in border row, in test plantations. To save space in greenhouse grafting, he recommended the use of long and narrow pots. Mr. Porter suggested tin cans. Mr. Holst suggested turning the roots of the rootstocks when setting them in the narrpw pots. Mr. Yeatman had seen potting tubes that could be suitable for greenhouse grafting. The methods currently used in fall grafting at the Petawawa Forest Experiment Station were then discussed.

49. Mr. Grant's Report (see Appendix "E")

Mr. Grant reported on his work at Glendon Hall on photoperiodism during the past year. Besides photoperiod, other factors of the environment such as temperature, moisture and light, were investigated. Mr. Holst made some remarks on chilling requirements of several conifer species, necessary to initiate new growth after a period of dormancy.

50. Dr. Chouinard's Report (see Appendix "L")

Dr. Chouinard reported briefly on his work in air-layering according to the method of Dr. F. Mergen (How to root and graft slash pine, Southeastern Forest Experiment Station, Station paper No. 46, 1954) in June-July of young trees 10-15 years of age. The species tried were red oak, red maple, sugar maple, silver maple, white birch, trembling aspen, silver poplar, balsam fir, red pine, white pine, white spruce, and larch. He was not successful in rooting trembling aspen in this manner, although abundant callus formation on the air layers were observed. Some of the other species rooted quite well.

51. Dr. Hunter's Report (see Appendix "F")

The report deals with further progress of the Dutch elm disease investigations. It has been possible to root greenwood cuttings of white elm. Irradiation of elm seeds is proposed for 1955.

52. Dr. Moore's Report (see Appendix "G")

Further cytogenetic work in Caragana is presented. Colchicine-induced tetraploidy in *C. arborescens* has been obtained.

53. Dr. Cram's Report (see Appendix "H")

The work on spruce, Caragana and damping-off diseases was reviewed. In the discussion, Dr. Heimburger criticised the use of S1 seedlings of Caragana in further breeding work.

54. Mr. Porter's Report (see Appendix "I")

Mr. Porter spends about 6 weeks per year on forest tree breeding. The testing of western white pine for resistance to blister rust was continued. Work with *Keithia thujina* on western red cedar has been started. Mr. Porter announced the regrets of Mr. Orr-Ewing for being unable to attend this meeting. He then briefly outlined Mr. Orr-Ewing's working program. It consists of the production of improved seed for reforestation with the B.C. Forest Service. Seed orchards of Douglas fir are being established. The distinguishing features of superior trees are still imperfectly understood. There is incompatibility and self-sterility in Douglas fir. Individual tree selection in Douglas fir has been started. The B.C. Forest Service collects seeds of all species. It was suggested that Mr. Bickerstaff or the incoming executive ask Dr. Spilsbury of the B.C. Forest Service about the possibilities of obtaining small quantities of forest tree seed of specific origin (see minute 45).

55. Mr. Holst's Report (see Appendix "J")

Mr. Holst presented his report on work at the Petawawa Forest Experiment Station. In the discussion, Dr. Heimburger pointed out that Mr. A. Gordon, of the Ontario Department of Lands and Forests, has located some very good red spruce in the area to the southeast of Algonquin Park which should be of importance to the work of Mr. Holst. Ways and means of obtaining breeding materials from the U.S.S.R. were then discussed, without arriving at a satisfactory conclusion, however.

56. Mr. MacGillivray's Report (see Appendix "K")

Mr. MacGillivray reported on further progress in his work at the Acadia Forest Experiment Station. In the discussion, Dr. Belyea made further inquiry about budworm resistance in balsam fir and weevil resistance in white pine. Mr. MacGillivray thought that frost pockets would be suitable for hardiness tests of breeding materials. Mr. Holst remarked that frost pockets would be of value chiefly for the evaluation of resistance to late spring frosts. Dr. Cram cited the work of Dr. Wellner at Indian Head in testing for hardiness by means of freezing chambers. Detached tree branches are used and their moisture content during the resting period is determined. A search for criteria for testing hardiness in *Malus* is in progress.

57. Additional Business

Mr. Bickerstaff mentioned the possibility of preparing a resume on forest tree breeding in Canada. Dr. Heimburger and Mr. Holst submitted their memorandum on tree breeding sub-stations. It was moved by Dr. Heimburger and seconded by Mr. Yeatman that it be adopted.

Mr. Bickerstaff then inquired about the status of the Secretary. It was decided to have Dr. Heimburger prepare the proceedings of this meeting and Mr. Yeatman take over the duties of assembling and preparing materials for the next meeting.

Dr. Dance briefly outlined the work at the Forest Pathology Laboratory at Maple, Ontario, in relation to forest tree breeding. The pathogenicity of several fungi attacking forest trees and Septoria canker on Russian poplar in the Prairies are being studied. The rooting of red pine needle bundles has been successful in the greenhouse and its application to the vegetative propagation of this species is under investigation. Dr. Cram requested that invitations to attend the meetings of this Committee be made at least one month in advance of the date of the meeting, to allow distant members time for making necessary travel arrangements. Dr. Belyea believed the first part of the terms of reference a) (see Appendix "B") need re-writing. Mr. Bickerstaff thanked the members of the meeting for their contributions. Mr. Porter thanked the Chairman and Secretary for their work on behalf of the meeting.

58. Adjournment

The meeting adjourned at about noon on March 9, 1955.

List of Appendices

to

Proceedings of the Third Meeting

of

Committee on Forest Tree Breeding

MEMBERSHIP -- 1955

COMMITTEE ON FOREST TREE BREEDING

Name	Class of Membership	Organization	Locality
J.D.B. Harrison	Sponsoring	Forestry Branch	Ottawa
A. Bickerstaff	Sponsoring	" "	"
J. L. Farrar	Active	" "	"
M. J. Holst	Active	" "	Petawawa F.E.S.
H.G. MacGillivray	Active	" "	Fredericton
C.W. Yeatman	Active	" "	Petawawa F.E.S.
		Dept. Agriculture	
Dr. M.L. Prebble	Sponsoring	Div. Forest Biology	Ottawa
Dr. J.E. Bier	Sponsoring	" " "	"
B.W. Dance	Active	" " "	Maple, Ont.
W.A. Porter	Active	" " "	Victoria, B.C.
Dr. R. Pomerleau	Active	" " "	Quebec, P.Q.
The Chief	Sponsoring	Horticultural Div.	Ottawa
Dr. W.H. Cram	Active	Exp. Farms Service	Indian Head, Sask.
Dr. A.W.S. Hunter	Active	" " "	Ottawa
Dr. H.A. Senn	Sponsoring	Div. Botany and Plant Pathology	Ottawa
Dr. R.J. Moore	Active	" " "	"
		Dept. Lands and Forests	
J.M. Halpenny	Sponsoring	Div. Feforestation	Toronto, Ont.
A.J. Carmichael	Active	" "	"
A.P. Leslie	Sponsoring	Div. of Research	"
Dr. C.C. Heimburger	Active	" " "	"
		Dept. Lands and Forests	
Dr. R.H. Spilsbury	Sponsoring	Research Division	Victoria, B.C.
A.L. Orr-Ewing	Active	" "	"
Dr. N.H. Grace	Corresponding	Res. Council of Alta.	Edmonton
Dr. W, Kirkconnell	Sponsoring	Acadia Univ.,	Wolfville, N.S.
Dr. E.C. Smith	Active	" "	"
L.Z. Rousseau	Sponsoring	Laval University	Quebec, P.Q.
Dr. Andre Lafond	Alternate	Laval University	"
Dr. L. Chouinard	Active	" "	"
J.W.B. Sisam	Sponsoring	Univ. of Toronto	Toronto, Ont.
J.A.C. Grant	Active	" "	"
Dr. G.S. Allen	Sponsoring	Univ. of B.C.	Vancouver, B.C.
H.S.D. Swan	Active	P. P. R. I. C.	Montreal, P.Q.
To be appointed		C. P. P. A.	"
To be appointed		C. L. A.	Ottawa

Ottawa, 10 February, 1955.

Appendix "B"

Ottawa, Ontario, 28 May, 1954.

MEMORANDUM FOR MR. A. BICKERSTAFF, CHAIRMAN,
FOREST TREE BREEDING COMMITTEE

The two meetings of the Tree Breeding Committee which have been held since the Forestry Branch took over sponsorship of the Committee from the National Research Council have resulted in certain recommendations which require clarification on future policy. Questions relating to functions of the Committee, its membership, and the availability of funds are of particular importance.

2. The functions of the Committee are defined in a general way by its terms of reference, which are as follows:

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

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

It is apparent that the principal functions of the Committee are those of arranging for interchange of information among organizations interested in forest genetics and tree breeding, and making recommendations to organizations which are active in these fields. It is clear from the terms of the reference that the Committee is not expected to initiate new programs for undertaking independent research under its own direction.

3. During the period before the second World War, when the Committee was sponsored by the National Research Council, certain funds were made available by the Council for preliminary work in forest genetics. This program came to an end before the war started, and since that time no funds have been available to the Committee other than those necessary to defray expenses of members attending meetings. Payment of attendance costs was discontinued when the Forestry Branch took over the Committee because it was felt that the participating organizations were in a position to assume these costs. Whether or not Forestry Branch funds should be appropriated for activities recommended by the Committee in addition to its already considerable expenditures relating to tree breeding, will depend upon the specific nature of recommendations which may be forthcoming. It is not possible to provide a blanket amount from Government funds to be spent as the Committee sees fit. It is probable that the same attitude would be taken by other participating organizations. It may be pointed out here that, up to the present, Parliament has not appropriated any monies under the Canada Forestry Act that could be made available to this Committee.

4. Since the Committee is sponsored by the Forestry Branch, it is considered that invitations to organizations or individuals participating in the work of the Committee should emanate from the Director of the Branch. Arrangements will be made to issue invitations to organizations or persons recommended by the Committee.

5. Recommendations involving action by the Forestry Branch, by the Ontario Department of Lands and Forests, or by other organizations, can best be transmitted in the form of resolutions appearing in the reports of meetings. It will be in order for the Chairman of the Committee to draw relevant items to the attention of the organization concerned by letter or otherwise. If joint action by more than one organization is involved, the Forestry Branch would be prepared to initiate consultation if the objects in view appeared to warrant so doing.

6. The submission of brief accounts of the discussions at Committee meetings to the Forestry Chronicle for publication is desirable as a means of informing the forestry profession regarding progress. Similarly, it would appear to be in order to supply copies of the terms of reference of the Committee to any organizations who may be interested.

7. With regard to lectures at universities on forest genetics and tree breeding, these will depend in the first instance on requests from the universities themselves. The Forestry Branch will always be glad to make the necessary arrangements, if such requests from universities are received.

8. The Forestry Branch is prepared to assume responsibility for reproducing and distributing the reports of the Committee.

9. In general, it is desired that the Committee should be enabled to make the maximum contribution to progress within its terms of reference. Extension of its influence will have to be achieved gradually, but I am satisfied that it can play a valuable part in promoting interest in the subjects under its consideration.

(Sgd.) D. A. Macdonald

Director,
Forestry Branch.

Appendix "C"

FOREST TREE BREEDING, 1954

C. C. Heimburger

WORKING CONDITIONS

Working conditions continued to show a steady improvement during the year under review as compared with former years, in respect to availability of labour and technical staff and in respect to co-operation rendered by the maintenance staff of the Station. The construction of some cement frames in between the greenhouses was delayed some two months during the fall of 1954 and this caused a curtailment of white pine grafting during the following winter. Instead of the usual 2000 grafts, only some 800 white pine could be grafted. However, the loss was more than made up by a large number of additional white pine grafts made at the Seed Extraction Plant at Angus.

Breeding work with white pine, aspen poplars and two-needled pines continued to be the main projects.

WHITE PINE

The object of the work with white pine was, as in former years, selection for resistance to blister rust, adaptation to climate, and good growth form and growth rate, as well as possible resistance to weevil attack. The main phase of the work is gradually shifting from acquisition of breeding materials to their testing and evaluation.

Provenance Tests

The test plantations established in 1950 and 1951 with different geographic strains of white pine from Ontario, have been tallied in 1953. In 1954, the tallies have been partly analysed. According to origin, the white pine materials can be subdivided into two broad groups, one from central and northern Ontario, growing on acid soils of granitic origin, and one from southern Ontario, growing largely on calcareous soils. The strains within each group are rather similar in respect to survival and rate of growth in the nursery and in test plantations. Strains of the northern group are subject to excessive damping-off and show slow growth when raised on the calcareous soils of southern Ontario. The southern strains show poor survival and growth form when set out in northern plantations. This indicates that the white pine native to Ontario is segregated into relatively few geographic strains, so that planting stock can be moved for considerable distances without ill effects within each broad geographic area. Thus, resistance to blister rust and other important characteristics need to be incorporated into a few strains only which then can be used within a relatively wide range of climatic conditions.

Acquisition of New Materials

Scions were collected from six selected plus trees in a plantation at St. Williams and of one early-flowering tree discovered in a plantation near Thessalon. One Japanese white pine from Vineland and two Himalayan white pines from a park in Toronto were also incorporated into the collection of breeding materials in this manner. Seeds of 11 populations of western white pine, including one hybrid population resulting from the cross: resistant western x resistant eastern white pine, were received from the Blister Rust Control Unit of the U. S. Forest Service in Spokane, Washington. Four seedling populations of southern white pine, raised at the Petawawa Forest Experiment Station, were received in the fall and stored over winter in a coldframe, for further testing here. One seed lot of white pine from Wisconsin was received for our strain tests.

Propagation

Five clones of apparently resistant white pine were propagated for the establishment of seed orchards at Angus. Twenty clones of slender white pine from Midhurst and one promising -- apparently resistant -- clone from Denmark were propagated for further testing.

Induction of Early Flowering

Scions of five clones of the hybrid _P. strobus_ x _parviflora_ (_P. Hunnewellii_) and of one clone of _P. peuce_ x _parviflora_ were grafted on to low side branches of old trees for pollen production. Old white pine usually produce female flowers at or near their tops, while male flowers are borne on the lower side branches. Pine seedlings grafted on to low side branches of old trees at Placerville, Calif., started producing male flowers a few years after grafting. The scions of the hybrids mentioned above were collected from young trees just starting to flower and their pollen is desirable for backcrossing with native white pine.

Scions from selected early-flowering Scotch pine and Japanese red pine were successfully grafted on to white pine seedlings. These materials will later be top grafted with scions from selected white pine so that double grafts will result. These double grafts are expected to start flowering very early, possibly because of the influence of the intermediate piece consisting of early flowering materials. A large number of the older grafts were set out in the dwarfing-boxes, designed by I. Lucas of Markdale, Ontario, to induce early flowering of dwarf fruit trees. Some of these grafts were already in a flowering condition.

Grafting on Pinus Thunbergii

In Japan, _Pinus parviflora_ and _P. koraiensis_ are usually propagated by grafting on stock of _P. Thunbergii_ (Japanese black pine). As seedlings of this species reach grafting size one year earlier than seedlings of white pine, the possibility was explored of using _P. Thunbergii_ as stock for the other white pines. Scions of one clone each of _P. strobus_, _monticola_, _Peuce_, and _Griffithii_ were grafted on _P. Thunbergii_ in the greenhouse in the usual manner. This resulted in good take and survival of the _P. Peuce_ and _Griffithii_ scions and no survival of the _P. strobus_ and _monticola_ scions. Although results with one clone of each species are far from conclusive, the test indicates that _P. Peuce_ and _Griffithii_ may be grafted on _P. Thunbergii_ with some success.

Fall Grafting

The experiment in fall outside grafting of white pine undertaken in

1953 was largely unsuccessful because of excessive winter mortality of the grafted scions. This experiment was repeated in 1954 but started about a month earlier, to allow the grafts more time to knit before the onset of winter. The grafting was done in late September, soon after the break in the hot weather of the Indian summer, usual at that time of year. The usual side grafting was used. The grafts were covered with nine different combinations of inner and outer bags. Arrangements were made to have our entire annual white pine grafting stock requirement potted in the spring at Angus. This will enable us to start grafting earlier in the winter, and perhaps also to do some fall grafting on potted stock in the greenhouse.

Some plastic containers for fall potting of grafting stock were obtained but not used this year, because of the delay in the construction of the cement frames.

Hybridization

Of the crosses made in 1953 the following yielded seeds in 1954:

Strobus x Hunnewellii	4 cones	7 seeds
Strobus x Griffithii	7 "	265 "
Peuce x Griffithii	52 "	828 "
Griffithii x Peuce	3 "	9 "

Seeds of the last two crosses were grown on grafts.

Many of the older grafts had abundant female flowers this year which were used in crosses. The following crosses were made:

	Number of clones pollinated	Bags or tubes	
Strobus x pentaphylla	40	189 bags	141 tubes
Strobus x flexilis	2	6 "	
Parviflora x flexilis	4	15 "	6 "
Peuce x flexilis	3	22 "	
Monticola x Peuce	6	108 "	2 "
(Griffithii x Strobus) x pentaphylla	1	3 "	
(Peuce x Strobus) x flexilis	1	1 "	
Griffithii x pentaphylla	1	29 "	

The tubes used were plastic tubes cut into short lengths and stoppered with cotton at one end while the other end was inserted over the female flower. This kind of tubes are currently being used in pine pollination in Sweden.

Blister Rust

Weather conditions were excellent for infection in the fall of 1954. With more abundant currant materials available this year, shoots with green leaves carrying abundant telial columns were stuck into the soil close to the pine grafts in the inoculation beds and the soil was thoroughly watered. The beds were covered with lath screens and burlap that was being kept wet by means of plastic soakers. In this manner it was possible to maintain the leaves in a fresh condition during several days, which has not been possible previously by using detached currant leaves as inoculum. This is essentially the method currently used in Spokane, Wash., for white pine inoculation with blister rust. One thousand and eighty-six grafts belonging to 64 clones and 5385 seedlings and 129 grafts belonging to 43 populations were inoculated this year. There was abundant infection on grafts and seedlings inoculated during former years and much material was culled because of susceptibility to blister rust. There was also abundant natural infection in the co-operative testing plot of western white pine, but thus far none of the supposedly resistant grafts have shown any infection.

The white pine plantation at Connaught Rifle Ranges near Ottawa, established in 1947 and 1948 by the Forestry Branch to test older white pine materials for resistance to blister rust, was again visited this year. Two hundred of the most promising young trees completely free from blister rust under condition of very severe infection were selected during the summer and used for scion collection later in the year. It is planned to use the scions at this Station for further testing and propagation. A new--as yet unidentified--stem disease and a needle injury apparently caused by mites, were found in this plantation during the visit in the summer. Materials were collected for identification by the pathologists. Severe injury to the stems and side branches by a moth larva were observed at the Connaught Ranges and at Maple in the summer of 1954. Closer investigation revealed that the larvae mainly attacked stems and branches that had shown the aecial stage of blister rust earlier in the spring and were thus weakened. This moth was later identified as Dioryctria Zimmermannii.

POPLARS

The object of poplar breeding was, as in former years, the production of aspen-like hybrids with rapid growth, good growth form, resistance to several important diseases and capability of producing high yields in forest plantations in southern Ontario. Propagability from stem cuttings is also one of the long-range objectives.

The main phase of the work is at present the production of new hybrids and their evaluation, with the abundant flowering materials at hand and pollens available from other poplar breeders in the U. S. and in Europe.

Acquisition of New Materials

The following new poplar materials were obtained during the year under review:

P. nigra from near East	3 clones
P. alba, mainly from Hungary and Wisconsin	7 "
P. alba x tremuloides, natural hybrids from Ontario	3 "
P. canescens, Hungary	4 "
P. tremuloides, Colorado	1 "
P. tremula, Europe	7 "
P. tremuloides x alba, Wisconsin hybrids	5 "
P. canescens x alba, Hungarian hybrids	2 "
P. tremula x alba, Hungarian hybrid	1 "
P. tomentosa x adenopoda, natural hybrid from Rochester, N.Y.	1 "
P. grandidentata x deltoides, Wisconsin hybrids	2 "

P. alba, seeds from Europe	4	populations
P. grandidentata, Ontario origins	5	"
P. tremuloides, Ontario origins	5	"

The acquisitions from Hungary have proved to be of great promise. In 1952 and 1953 seeds of wild poplar species were first obtained from Hungary and these produced seedlings of excellent growth form, resistance to disease and hardiness. In 1954, some of the Hungarian hybrids were first obtained and their performance thus far has been exceptionally good. They are superior to poplar materials from western Europe in adaptation to our more continental climate, tolerance of summer drought and excellent growth form. Their breeding value in crosses with our native aspen species would be most important to evaluate as soon as they will start flowering with us. Of the populations raised in former years the following outstanding clones have been selected in 1954:

P. alba	13	clones
P. alba x tremula	2	"
P. grandidentata x alba	11	"

Rooting Capacity

In former years tests for rooting capacity from stem cuttings have been conducted regularly by counting the cuttings planted in the fall in the nursery and again counting the plants produced during the following summer. With the steadily rising number of clones and populations being tested this procedure gradually became very cumbersone. The results of tests with the same clones during several years varied greatly with the winter climate, so that a single test in any one year was not a reliable measure of the rooting capacity of a clone. A laboratory test has been devised in 1954 that seems a useful short-cut. In the laboratory, the conditions are sufficiently uniform from year to year to give uniform results, and thus the rooting capacity of a poplar can be determined with reasonable accuracy by means of simple beaker tests. During the winter of 1954-55, a great number of such beaker tests were made and their results correspond fairly well with the average results of previous rooting capacity tests in the nursery of the same clones during several years. In this manner, several new clones were tested and compared with old standard clones, from which several years' rooting results were available. Populations were tested by a method of mass selection, that also shows good promise. Instead of breaking up a seedling population into a great number of single clones, and then testing these separately, much tedious work can be avoided by mass selection. All the tops of a group of seedlings comprising a population are cut off and made into cuttings, which are planted in the regular manner in the nursery. The surviving plants from such an operation must have some rooting capacity. By repeating this process during 2-3 years, the best rooters within a population are selected automatically. These are then tested further for growth rate, growth form, resistance to disease, etc. Such tests were started in 1954 with some hybrid seedling populations.

Hybridization

As mentioned in the progress report for 1953, the poplar breeding project has been subdivided into the following three main phases:

1. Mass production of the most promising hybrids for industrial use;

2. Breeding of early-flowering materials to serve as stock for grafting to induce early, frequent, and abundant flowering in important breeding materials, and

3. Continuation of the long-term work of the incorporation of good rooting capacity from stem cuttings and other desirable properties of silver poplar into aspen hybrids.

Breeding for Industrial Use

The growing demands of the wood-using industries for aspen hybrids for immediate use in plantations have prompted the production of the following crosses, many of which can be expected to yield hybrid populations of immediate value and also serve as raw material for future selection of superior individuals of direct forest value or for further breeding work:

P. alba x tremula	1 population
P. alba x tremuloides	1 "
P. alba x grandidentata	3 "
P. alba x davidiana	1 "
P. grandidentata x (alba x grandidentata)	1 "
P. tremuloides x adenopoda	1 "
P. tremuloides x davidiana	1 "
P. tremuloides x (alba x tremuloides)	1 "
P. tremula x (alba x grandidentata)	1 "
P. tremula x grandidentata	3 "
P. tremula x tremuloides and reciprocal	4 "
P. tremula x (alba x tremuloides)	6 "

The pollen of P. tremula was to a great extent obtained from grafts growing at this Station and now beginning to flower abundantly. Pollen of P. davidiana was obtained by air mail from Sweden where it, in turn, was sent by air mail from Japan. It has thus travelled more than halfway around the world before it arrived here and, nevertheless, produced a large number of hybrid seedlings. The crosses involving P. tremula as female parent were largely made in Sweden and Germany and the hybrid seeds sent here, in exchange for pollens supplied for poplar breeding there. Pollen of our native P. tremuloides, particularly of straight-growing northern types, is much in demand in Europe for the production of hybrid aspens. A trip was made to Caramat, Ont., to the limits of the Marathon Paper Mills of Canada, Ltd., to collect aspen branches with male flower buds. These were then forced in the greenhouse for pollen production. Several of the crosses listed above are back-crosses of silver poplar-aspen hybrids to aspens. These, more or less three-quarter aspens, are of promise for direct industrial use and for future breeding work.

Breeding for Early Flowering (Precocious) Materials

Precocious forms of the native P. tremuloides are found in southern Ontario and have been used with good success in previous years as stocks for grafting, to induce early flowering in some late flowering breeding materials. This prompted the breeding of still more precocious types, using the native precocious materials for this purpose. During the year under review a precocious form of P. grandidentata was discovered on the shore of the St. Lawrence River near Maitland, Ontario. Another, very precocious natural hybrid, P. tomentosa x adenopoda, was discovered in a park in Rochester, N.Y. These two discoveries were utilized at once and the following crosses were made:

P. tremuloides precocious x tremula	4 populations
P. tremuloides precocious x (tomentosa x adenopoda)	1 population
P. tremuloides precocious x (alba x grandidentata)	1 "
P. tremuloides precocious x grandidentata	1 "
P. grandidentata precocious x tremula	1 "
P. grandidentata precocious x alba	1 "

The breeding of precocious aspen materials can be used for still another purpose. Because of the short breeding cycles involved, it should be possible to incorporate the valuable properties of silver poplar into precocious aspens within a relatively short time. As this still is largely an empirical process with many unavoidable mistakes and errors, these can be detected relatively soon and the efforts directed towards the most promising crosses. The most promising crosses can then be repeated with normal, late flowering materials, thus avoiding many mistakes. The same process should also be possible in breeding for disease resistance in poplars. Any unpromising precocious materials obtained in this way could be utilized as stocks for grafting and are thus not completely wasted. It should also be possible to determine the genetic basis of precocious flowering in aspens relatively soon and, perhaps, to use it in a general speeding up of the aspen breeding program.

Breeding for Rooting Capacity

In order to incorporate good rooting capacity from stem cuttings of other poplar species into aspens it is necessary to use good rooters of the other species in crosses with aspens and aspen hybrids. Several clones of P. alba with good rooting capacity have been found and thoroughly tested in former years. These have now been used in the following crosses:

P. alba x (alba x tremuloides)	2 populations
P. alba x (alba x grandidentata)	3 "
P. alba x trichocarpa	1 population
P. euramericana cl.virginiana x nigra pyramidalis	1 "
P. angualata x wind	1 "

The cross P. alba x trichocarpa was made in Germany and the hybrid seeds were received here in exchange for aspen pollens. It is expected that P. trichocarpa is carrying genes for rooting capacity that differ from those found in P. alba and thus can increase the possibility of obtaining new hybrids with good rooting capacity. The cross P. euramericana cl. virginiana x nigra pyramidalis was made in Spain and the seeds were also received in exchange for aspen pollens. The resulting seedlings are very vigorous and of good growth form. It is possible that many of these can be used directly in plantations besides serving as new sources of rooting capacity genes. The cross P. angulata x wind is a natural cross which took place in the poplar arboretum at this Station. Many of the resulting seedlings are obviously hybrids with the native balsam poplar, while others are hybrids with the other cottonwood types found in the arboretum. These latter are very variable and it is possible that some will be of direct value besides being of breeding value.

Propagation

The production of aspen seedlings has until recently been a very slow and circumstantial process requiring much work and resulting in relatively low numbers of seedlings from each cross. In 1954 the production of seedlings by direct sowing in a seed bed in the nursery was first tried on a large scale. The soil in the seed beds was improved in structure by heavy applications of krilium followed by sterilization with methyl bromide. The aspen seeds were mixed with fine sifted sand before sowing, to obtain uniform stocking in the beds. The seedlings were watered by means of plastic hose sprinklers. During the summer they received several applications of liquid fertilizer. This resulted in very good stands of seedlings in the beds at the end of the summer, never obtained before. The seedlings were then lined out in the nursery during the fall and hilled for the winter. The experiments with bench grafting of aspen poplars in late winter were continued, but the results obtained are still indifferent. Although progress has been made and good results were obtained in the propagation of some hybrid aspen clones by using this method, other aspen materials did not respond in a satisfactory manner and indicated that further improvements in the method are necessary.

Test Plantations

The Ontario Paper Company sent their nursery foreman from Gore Bay to work in the nursery at this station during the fall to obtain first-hand experience in poplar propagation. In returning to Gore Bay, he was given some aspen hybrid seedlings and poplar cuttings, to continue the work with these at the Gore Bay nursery. These materials are to be used in establishing poplar plantations. Another poplar plantation was established near the Bonnechere River in Algonquin Park by Pembroke Shook Mills, Ltd., using some of the most promising hybrid poplar materials from this Station. The co-operation with Howard Smith Paper Mills Ltd. in Cornwall, Ont., and with the Canadian International Paper Company at Harrington, P.Q., continued, in supplying these organizations with new poplar materials for testing in the field. Knechtels Limited in Hanover, Ont., acquired a new property near Markdale and established a small poplar nursery on this. Poplar materials were supplied for propagation in this nursery besides being obtained as cuttings from their own poplar plantation near Hanover.

Poplar Arboretum

The poplar breeding arboretum was expanded considerably by taking in an old field which was fallowed and freed from rocks during the summer and then planted with poplar materials in the fall. Some old trees were cut during the early winter to prepare other areas for further poplar planting.

Cytology

The giant type of *P. grandidentata* found growing at this Station was investigated cytologically during the latter part of the winter when assistance for this became available. The usual fixing and staining procedures, to count poplar chromosomes, were found inadequate and a new fixing and staining procedure was developed. It was found that the giant *P. grandidentata* of this Station was diploid, and the large cell size thus depends on genetic factors rather than on polyploidy. The new fixing and staining procedure is of value to further work in poplar cytology. Grafts of the triploid P. tremula obtained from Sweden, growing at this Station, flowered abundantly in 1954 and were used for pollen production. The pollen was used in several crosses and sent to the Institute of Paper Chemistry, Appleton, Wisconsin, where breeding work with polyploid poplars is in progress.

Wood Tests

At the request of Knechtels Limited of Hanover, Ont., wood samples of the more commonly grown hybrid poplars were obtained from Europe, and of some natural aspen hybrids in Ontario. They were then sent to Knechtels Limited to be assessed for their suitability for veneer. The Company classified the poplar woods in the following decreasing order of suitability for veneer:

1) P. alba x tremuloides
2) P. euramericana cl. marilandica
   " " serotina
3) P. alba x grandidentata
4) P. grandidentata
   P. euramericana cl. gelrica

Unfortunately, wood samples of P. tremuloides were not available at that time. This classification will undoubtedly influence poplar breeding here to some extent in the future.

Poplar Rejuvenation

Many aspens and their hybrids have been obtained from abroad in the form of scionwood collected from old, flowering trees. These scions produce grafts with an adult type of foliage and branching habit. Thus some root very poorly from stem cuttings even if vigorous new growth is available from young grafts. Others show a pendulous and crooked growth habit, depending on the place in the crown of the original trees where they were collected. To determine the rooting capacity and growth habit of the corresponding juvenile phase of the respective clones, these are being rejuvenated. This is done by producing low grafts, preferably bench grafts, and by planting them deeply, with the place of grafting well below the surface of the ground in the nursery. The grafts are then made to produce roots above the place of grafting and these roots are made into root cuttings. The top growth produced by the root cuttings is juvenile growth originating from meristematic tissue in the core of the roots. This new top growth has a juvenile type of foliage and is believed capable of producing a juvenile type of growth with better growth form and rooting capacity. The cuttings of this type of growth are directly comparable with cuttings of other poplar varieties currently being tested for rooting capacity and growth form. Such rejuvenation has been started with some promising clones to improve their evaluation and use in forest plantations.

TWO-NEEDLED PINES

The aim of this project is to incorporate the resistance to European shoot moth found in Japanese black pine and other Asiatic pine species into the more commonly grown two-needled pines in southern Ontario. To this end, breeding materials of the resistant Asiatic pine species are acquired and crosses made between these and red pine and Scotch pine. The new pine strains to be obtained should possess the hardiness, growth form and other valuable properties of the native red pine and the best strains of Scotch pine with the added resistance to shoot moth of the Asiatic pines.

Acquisitions

The following new materials of this kind were obtained in 1954:

P. densiflora, Midhurst	20 clones
P. densiflora, Rochester, N.Y.	3 "
P. Thunbergii, Rochester, N.Y.	1 "
P. resinosa, Petawawa F.E.S.	1 "
P. Thunbergii, Kemptville, Ont.	1 population
P. nigra cebennensis, Angus, Ont.	1 "

In addition, the following materials were received from the Petawawa Forest Experiment Station, for growing in the milder climate of this Station:

P. nigra caramanica, Nancy, France	1 clone
P. nigra cebennensis, Nancy, France	2 "
P. nigra Poiretiana, Nancy, France	1 "
P. nigra Poiretiana x austriaca, Placerville, Calif.	1 "
P. Thunbergii, Montauk Point, Long Island	1 population

Hybridization

The following crosses made in 1952 have yielded seedlings in 1954:

P. densiflora x resinosa	2 crosses
P. nigra austriaca x Thunbergii	1 "

Of the crosses made in 1953 the following yielded seemingly viable seeds:

P. densiflora x silvestris	1 cross	2 seeds
P. densiflora x ponderosa	1 "	4 "
P. densiflora x nigra	2 "	302 "
		308 seeds

The success of the cross P. densiflora x ponderosa is remarkable and is worth following up in the future.

The following crosses were made in 1954:

P. silvestris x resinosa, Rochester, N.Y.	2 crosses	66 bags
P. silvestris x densiflora, Midhurst	3 "	158 "

P. densiflora x nigra Poiretiana, Rochester, N.Y.	1 cross	65 bags
P. densiflora x silvestris, Sweden	11 crosses	57 "
P. densiflora x resinosa, Rochester, N.Y.	1 cross	36 "

Test Plantation

A test plantation of two-needled pines was established at this Station, in a locality where heavy infection by the shoot moth is usual. The following materials were set out in this plantation:

P. densiflora	5 populations	362 plants
P. Thunbergii	2 "	145 "
P. silvestris	2 "	38 "
P. nigra cebennensis	1 "	846 "
P. mugo uncinata	1 "	25 "
P. Hwangshanensis	1 "	2 "

The partial girdling experiment of planted red pine in Vivian Forest was again tallied in 1954 and the tallies show continued superiority of the girdled trees in cone production as compared with the untreated controls.

OTHER WORK

Other phases of work done in 1954 may be briefly mentioned:

Grafts of some spruce hybrids and southern pine seedlings were received from the Petawawa Forest Experiment Station for growing in the milder climate here. Seeds of curly birch were received from Finland, in exchange for aspen pollen, and produced a large number of promising plants. A visit was made to RC-17 in the fall of 1954 and a talk on the tree breeding work here given to the meeting at Heron Bay at that time. An industrial hybrid poplar committee, utilizing the products of the current poplar breeding efforts at this Station, was established during the summer of 1954. In connection with the establishment of this Committee, an inspection trip to all existing poplar hybrid plantations in Ontario and to those at Harrington, P.Q., was made. A tulip poplar with curly wood was discovered in the Aylmer area by the District Forester there and scions from it were obtained after it was felled by the farmer who owned it. The scions were unsuccessfully used in grafting on to tulip poplar seedlings at this Station, but some were sent to the T.V.A. and successfully grafted there. Cuttings of a South American willow, Salix Humboldtiana were obtained from Brazil and Argentine and successfully established in the greenhouse. A large collection of poplar cuttings was sent to the Government of Chile in the fall of 1954.

Appendix "D"

REPORT TO COMMITTEE ON FOREST TREE BREEDING, MARCH 8, 1955.

A. J. Carmichael, Ontario Tree Seed Plant, Angus, Ontario.

TEST PLANTING 1954.

A. Introduction

The sample size which is required for the measurement of a stand should be as small as possible. The problem becomes one of establishing about 80 trees in each sample of a strain or provenance test at the age of about 60 years. The minimum number of trees acceptable in each sample would be 40 trees at 60 years of age.

B. Planting Procedure

Plant all trees at 6' x 6' spacing.

Plant 400 trees in each sample and repeat each sample four times on the area. This requires 1600 trees for each strain or provenance, and takes an area of 1.32 acres. The location of each sample within the test area is determined by the random method.

The allocation of provenances is recorded on a map before going into the field. The base map is retained in the office and photo copies are used at the planting site. This method enables each person responsible for a portion of the ploughing or planting to be aware of the exact location for each provenance. The system allows for survival counts to be placed on the field copies and for these records to be made permanent later by placing inserts over the base map, and taking a photo copy. Eventually, this method can be used to record any information pertaining to a sample, for example, average height, diameter, basal area, etc.

The method of planting is controlled often, by the nature of the site to be used. Whenever possible it has been felt desirable to hand plant with the wedge or slit method in ploughed furrows. Machine planting, using a Lowther planter, will be tried in 1955. This method may increase the difficulty of uniform planting depth and the uniform spacing of trees. This is particularly true when planting stock of the same age, is of several size classes. Machine planting may be more uniform in rough areas where it is difficult to make a furrow with clean cut edges. The use of a machine should reduce the variation due to different planters, since only three men will be involved in placing trees. When using a planting machine, a single run down the length of the field will pass through several provenances. It will be difficult to insure proper allocation of the stock to the planter and to be certain each provenance is retained within its own sample block.

During the 1954 season all planting was carried out by hand using either the wedge or slit method in ploughed furrows. The wedge method is favoured because it gives greater uniformity of planting, the slit method was used for Scotch pine, to save time and because it was felt that this species could survive with less attention. Greater uniformity may have been obtained using the wedge method, however the rough furrowing on some sites would not have allowed a wedge to be made.

The following points were observed in the layout of an area for planting.

A. The equipment to be used for planting, namely the tractor and driver, and plow, should be brought to the site. The use of local farm equipment delays the operation due to breakdown or inaccurate adjustments. The single furrow 12" bottom plow, which is required, can seldom be obtained locally. It is not possible to make a proper furrow without the co-ordination of a good driver, tractor and plow.

B. Straight furrows simplify planting and assist in keeping a uniform spacing between rows. It has been found helpful to lay out the first furrow using one sighting picket at the far end of the field for distances up to 800 feet. For distances greater than this a centre picket is desirable. Hilly terrain would require more frequent pickets. The sighted furrow can then be used as a guide line and the tractor wheel kept a uniform distance from it.

Appendix "A"

COMMITTEE ON FOREST TREE BREEDING

Chairman's Report

1954 - 1955

The action taken during the past year by your Chairman and Secretary on the items arising out of the 1953 and 1954 meetings of the Committee, is summarized below so as to expedite discussion at the Third Meeting to be held the 8 March, 1955.

(a) Membership (Minute 38): The Director, Forestry Branch, sent invitations to men and organizations recommended for membership at the 1954 meeting. Their names, addresses, and classes of membership are shown on the attached list.

(b) Financial Position (Minute 13 et al): The Committee has no funds specifically allocated to its operation. A memorandum from the Director, Forestry Branch, (28 May, 1954) reads in part. "Payment of attendance costs was discontinued when the Forestry Branch took over the Committee because it was felt that the participating organizations were in a position to assume these costs. Whether or not Forestry Branch funds should be appropriated for activities recommended by the Committee in addition to its already considerable expenditures relating to tree breeding, will depend upon the specific nature of recommendations which may be forthcoming. It is not possible to provide a blanket amount from Government funds to be spent as the Committee sees fit. It is probable that the same attitude would be taken by other participating organizations. It may be pointed out here that, up to the present, Parliament has not appropriated any monies under the Canada Forestry Act that could be made available to this Committee."

(c) Lectures on Tree Breeding at Forestry Schools (Minutes 13 and 23): The Deans of the four Canadian Forestry Schools were asked for their views through correspondence with the Chairman. Action on this matter is to be discussed.

(d) Preservation of Genetically Superior Stands and Species (Minutes 13 and 23): The Forestry Branch and the Ontario Department of Lands and Forests have a program of visiting superior stands suggested by companies and others to assess their tree breeding value. Material is preserved by vegetative propagation, or seed is collected.

(e) Participation of Plant Physiologists in Flower Induction Studies (Minute 24): Dr. Senn was asked for suggestions as to available plant physiologists, and the Forestry Branch is also considering the possibility of physiological work in this field.

(f) Tree Breeding Substations (Minute 35): Arrangements were made for Dr. Heimburger and Mr. Holst to prepare a joint submission of requirements for consideration by the Ontario Department of Lands and Forests and the Federal Forestry Branch.

(g) Wood Density (Minute 23): Mr. Holst advised that the variation in wood density attributable to genetic make-up would be a useful field of investigation if a suitable man was available, but the matter is not urgent.

(h) Abstract of Meetings for Forestry Chronicle (Minute 13): A resume was submitted to the Forestry Chronicle the 28th of July, 1954.

(i) Consolidation of Records (Minute 21): File of correspondence (14-5-3), Forestry Branch, Ottawa, covers activities from the first meeting of the new committee in 1953. A complete set of minutes for the old subcommittee is in the Forestry Branch Library, Ottawa.

(j) Invitation to Outstanding Geneticist (Minute 23): No funds are available from the Forestry Branch for this purpose.

(k) Exchange of Observers with Lake States Tree Improvement Committee (Minute 38): An invitation was sent by the Secretary.

(l) Seed Exchange (Minute 35): Letter of appreciation was sent by the Chairman to G.H. Bayly, Chief, Reforestation Division, Department of Lands and Forests, Toronto.

A. Bickerstaff
Chairman,
Committee on Forest Tree Breeding.

Ottawa,
10 February,
1 9 5 5

C. The procedure for laying out a test area is as follows:

1. Mark a base line with pickets and plough a furrow along this line. (5/8" birch dowels, painted in red and white sections, have been useful as pickets.)

2. Determine the position of the two front corners of the test area.

3. Using a right-angle prism lay out the side boundaries from the two front corners.

4. Plow a furrow down each side boundary.

5. Measure the distance required for each sample block along the two side boundaries, and place a picket at each division point.

6. Plough a furrow across the field between each pair of boundary markers.

7. Plough furrows at 6' spacing, perpendicular to the base line. When a wide bottom plough is used the furrow slice obstructs the tractor wheels if adjacent furrows are ploughed consecutively. It would be better to begin ploughing at the right side of the field for the first furrow, turn left at the end of the field and travel to the first furrow of the second row of sample areas. When this furrow is ploughed turn left and travel to the second furrow of the first sample area. In this way the furrow slice will not interfere with the tractor wheels.

8. Embossed zinc tags bearing the name of the provenance are rivetted to 18" lengths of 3/4" aluminum angle and are placed as markers in the furrow at the two front corners of each sample block.

9. Trees are removed from the boxes and heeled in along the front of the test area and marked with identifying stakes.

10. A sufficient number of bundles of trees to plant one provenance, in one sample area, are taken in a pail and heeled in adjacent to a named stake in one of the front corners of the sample block.

11. No planting is done until all trees are heeled in the proper sample block.

12. In a sample block of 400 trees (20 rows, 20 trees per row) it was found better to have two crews of two men each to plant, beginning at opposite sides of the block. The method made more moves for the men and seemed to stimulate the planting.

    No definite opinion was reached as to the value of moving each pair of crews to a new block as soon as they finished or to move all crews at the same time. A slow crew can hold up the entire program if you move everyone at once. However, moving each crew as they finish, soon separates the crews and entails a great deal of walking in order to check the planting.

13. The most frequent error in planting was found in the slit method where tramping of the soil is so important. The wedge method would produce a satisfactorily planted tree when tramping was omitted. A continuous check was necessary by pulling on the tree to see if it was firmly held in place.

14. A check on pacing for 6' spacing was always necessary in order to get the required 20 trees in the allotted space. Once a row is completed correctly, the man carrying the pail of trees, walks on the land side of the furrow and determines the location of the next tree to be planted, by observing the adjacent planted row, and placing his foot at the location in the row being planted. The man with the shovel can thus concentrate on tramping the soil and moving ahead, without wasting time looking for his next tree location.

15. The time taken to plant 1000 trees varied from 10 to 16 man-hours and averaged 13 man-hours at a cost of $11.57. Furrowing would average $1\frac{1}{2}$ hours per 1000 trees at a cost of $ 2.85.

C. <u>1954 Planting Program</u>

<u>1. Red Pine Provenance Test.</u>

A preliminary test planting was carried out in 1954 to determine what difficulties might be expected in the larger planting in 1956. The planting took place in Hills' Site Region 3 at German township and in Site Region 5 at Rose township in the Kirkwood Forest Management Unit.

Three sources of seed were used representing areas from which pickers brought cones to be sold at collection centres. These sources were Algoma, Douglas and Sturgeon Falls, all of which are within site Region 5.

A total of 4800 trees were planted in each Site Region on an area of 4 acres. Survival counts made on August 17, 1954, in Site Region 3 showed a mortality of 4% for all provenances. Survival counts made on August 20, 1954 in Site Region 5 showed a mortality of 1% for each provenance. The difference between these results could be traced to ploughing which was too deep in Site Region 5, and subsequent burial of the trees due to erosion from the sides. A replacement planting will not be made for dead or missing trees.

2. <u>Scotch Pine Provenance Test.</u>

The chief purpose for this provenance test is to determine the effect of provenance on certain desirable characteristics for Christmas tree production. The trees will be examined for fall foliage colour, rate of growth, form, needle length, retention of needles, density of needles, branch angle and the number of branches per whorl.

Plantations were established at German township in Site Region 3, at Rose township in the Kirkwood Forest Management Unit in Site Region 5, and at Marlborough township in Larose Forest in Site Region 6. Since these trees are to be grown until they can be examined for Christmas tree stock, Eleven sources of seed are represented, extending from Finland to Southern France and being equally divided between Northern and Southern sources. A total of 9400 trees was planted in each Site Region. Survival counts showed that Northern stock had a greater mortality than Southern stock of the same age. This was probably due to the smaller size of the Northern stock, which made it susceptible to burial whenever furrows were ploughed too deeply. It was found that large stock survived better than small stock regardless of whether it was of Northern or Southern origin.

3. Mugho Pine Christmas Tree Test.

The excellent foliage colour of mugho pine, its dense foliage and compact form could make a useful Christmas tree if a single-stemmed habit of growth was found. Varieties which were thought to be single-stemmed were grown to compare with the commonly used dwarf variety, P.M. Mughus.

The P.M. Mughus used came from the Alps and the Lowlands of France. The other varieties tested were P.M. rostrata from the French Alps and Switzerland, and P.M. pumilio and P. montana gallica of unknown origin. The P.m. gallica died out in the nursery and was not represented in field trials. None of the other varieties has shown a common tendency toward a single-stemmed habit although individuals in all varieties do show some tendency in this direction. The greatest number of single-stemmed types at 4 years of age are in the dwarf variety P.M. Mughus.

The appearance of the stock in the nursery caused a change in plans and resulted in the establishment of only one test plantation. This test plantation was at Rose township in the Kirkwood Forest Management Unit in Site Region 5.

The sample size used was 100 trees and the spacing used was 5' x 5'. Five varieties totalling 2000 trees were planted.

4. Pine Shoot Moth Test.

A comparison of Pinus nigra cebennensis from Cevennes, France was made with red pine of Douglas origin in Site Region 5, on two areas where shoot moth attack was prevalent.

The area in Site Region 7 supported a 15-year-old Scotch pine plantation which had been severely attacked by shoot moth. The plantation was bulldozed into windrows, leaving cleared strips approximately 100' in width. The clearing was done during the summer previous to planting.

The area in Site Region 6 supported a 10-year-old red pine plantation adjacent to an older Scotch pine plantation. Almost 100% of the red pine shoots had been attacked by the shoot moth, the year previous to the thinning in preparation for planting. Growth on the trees was abnormal and the stand appeared unfit for culture. Blocks were cleared in this area leaving a band of infected trees surrounding each replication of the experiment. The trees which were removed were piled and burned away from the planting site.

Corsican pine stock was examined by the Forest Insect Laboratory Staff, before planting, for evidence of shoot moth damage. The tally for 1600 trees to be used in site Region 6 showed, 10 hollowed buds, 5 dead larvae and 3 living larvae. The tally for 400 trees to be used in Site Region 7 showed that there was no infestation. The red pine stock was not inspected prior to planting.

The planted stock in Site Region 6 was given a 100% check on July 8, 1954, by the Forest Insect Ranger staff. The following observations have been made from their tally. (1) The Corsican pine were more heavily attacked by shoot moth than the red pine. The red pine were more heavily attacked with other shoot insects than the Corsican pine. (2) The attack of shoot insects of all kinds was five times greater in Region 6 than in Region 7. (3) Only 3% of all trees, Corsican and red, were attacked by some shoot insect.

The planted stock in Site Region 7 was given a 100% check on July 19, 1954, by the Forest Insect Ranger staff. The following observations have been made from their tally. (1) Corsican pine and red pine were both attacked by shoot moth to the same degree and both species were free from attack by other shoot insects. (2) The attack of shoot insects of all kinds was far less than in Site Region 6. (3) Only 1% of all trees, Corsican and red, were attacked by some shoot insect.

Inspection of these plantations will be carried out each year to determine the course of injury. Other varieties of two-needled pine will be tested also to determine their resistance to attack.

SEED PRODUCTION

A. Seed Plantations.

1. Red Pine Seed Plantation at Nairn.

General

The Red Pine plantation at Nairn was planted in 1929 at a 6 foot by 6 foot spacing, on Lot 4 and 5 Concession 4, Nairn Township. The area lies adjacent to the Spanish River on a ridge about 30 feet above the river level. The soil is a medium to coarse sand laid at depths varying from one to six feet over coarse gravel.

The reason for selecting this area was partially to utilize in a useful manner, red pine trees which had been planted on too poor a site for good timber production. The object of thinning was to open up the stand giving the remaining trees full sunlight on all sides. Due to the nature of the soil it was felt necessary to remove only every other row and to allow the remaining trees to become windfirm before removing every other tree in the row. The area will serve as a test plot where various treatments will be used to induce flowering and fruiting.

In the area thinned the planting consisted of three rows of red pine alternating with one row of white pine. The white pine rows were largely absent, in a few cases trees reached a height of 10 feet and a DBH of 2 inches.

The area thinned was 8 acres, which would contain 9,680 trees at the time of planting. The number of trees removed was approximately 5,800. This allows for a 25 per cent reduction for white pine rows and a 15 per cent reduction for blank spaces in the red pine rows. No account has been made for the natural jack pine found on the area, which could have amounted to as much as 200 trees. The average red pine removed would have a height of 15 feet and a stump diameter of 5 inches.

Cost of Operation

Labour	$388.13
Board and lodging	159.55
Transportation	50.80
Total cost	$598.48
Cost of thinning per acre	$ 74.81
Cost per tree	.10

Time to cut and trim one tree including travel to the area 3.6 minutes.

Time to cut and trim one tree excluding travel to the area 2.4 minutes.

2. Red Pine Seed Plantation at Lynn Tract Drury Forest.

General

A block of red pine in the Lynn tract of Drury Forest in Simcoe County was planted in 1945 at a 6 foot by 6 foot spacing. The area lies on a hill which is one of a series of knobby ridges found commonly in this vicinity. The soil is a medium to fine sand lying over roughly stratified gravel. This area was selected for a test seed plantation because of the naturally early fruiting of red pine trees growing on the site. The relatively rich but dry soil forms an excellent site for work dealing with seed production. Four acres have been thinned by the removal of alternate rows and will have the alternate trees in the row removed next year. Various treatments such as fertilizing, partial girdling, and strangulation will be applied in order to induce and maintain flowering and fruiting.

This plantation is of importance because it represents a stand having the earliest fruiting age which we have. It most closely represents the type of tree we expect to obtain by grafting mature scions and growing them in seed orchards. The results obtained in increased cone production will be utilized in the grafted seed orchards.

The number of trees removed was approximately 2,520 and the average tree was 9 feet in height and had a stump diameter of 4 inches. The County Forest removed 920 trees for sale as Christmas trees and airport runway markers. The remaining 1,600 trees were felled by the Seed Plant Staff.

Cost of Operation

County Forest - Sale of Trees			337.85
- Labour . . .	145.00		
- Trucks . . .	30.00		
	$175.00	. . .	175.00
- Net Earnings			$162.85
Tree Seed Plant - Labour . .	71.39		
- Trucks . .	10.96		
	$82.35	. . .	$ 82.35
- Operational Profit		. . .	$ 80.50

B. Seed Orchard Production

1. White Pine.

This project is meant to utilize the material, which has been tested by Dr. Heimburger, to produce seed on a production basis for Ontario nurseries. The 1953-54 season was largely exploratory in order to develop techniques in grafting and care of stock.

In September 1954, white pine scions were collected from natural trees growing at Angus, and grafted to develop a technique for fall grafting. Scions were collected from young trees, 5' - 12' in height and from old trees 60' in height. The scions from the old trees were collected separately from the top and basal branches. The stock plants used were white pine which had been spring or fall potted and fall potted Scotch pine. The grafting was done in the greenhouse and after 2 months plants were moved to coldframes for the winter. Coldframes were of ½" mesh screen to allow snow to filter among the trees and prevent drying of the stock.

During the present season 1954-55, 651 scions from untested or partially tested trees at Pointe Platon, Quebec, have been grafted to assist Dr. Heimburger in his testing program. This group represents the scions collected from the tops of the trees. Further assistance will be given by potting 5000 white pine in spring 1955 for use in the 1955-56 season. The attention which has been given to the mycorrhizal condition of the tree roots by selecting proper potting soils has resulted in greatly improved grafting stock.

The grafting procedure followed is to side graft and tie with a rubber budding band. The graft is made when the roots of the stock show definite activity. After grafting the scion and stock are either enclosed in a polythene bag which is left open at the base, or the plant is placed in a polythene humidity chamber, for a period of six weeks. At the end of this time the bag or chamber is removed. After an additional three weeks the stock plant is completely cut back in one operation.

2. Red Pine.

The interest in red pine for orchard production lies chiefly in maintaining a more regular supply of seed. The northern regions are of particular importance since their cone production is low even in a good seed year.

Scions were collected in February 1954 from five trees at Cochrane and Timmons in Site Region 3, and from Englehart in Site Region 4. These were stored in Polythene bags at 40°F. after treatment with a fungicide. The majority of scions were in too poor condition to consider grafting by the spring. The better scions were grafted in the nursery on 6-year-old Scotch pine and 6-year-old red pine. Twenty-three of the 25 grafts on Scotch pine survived and 21 of the 36 grafts on red pine survived. Scions from this group were grafted also by Mr. Holst at Petawawa.

Scions were collected in January 1955 from 10 trees at German township in Site Region 3. These were generally too large for the available potting stock and the majority have been stored in snow at 0°F. They will be grafted at Kirkwood Forest on 6-year-old Scotch pine. Thirty-five grafts have been made in the greenhouse on red pine stock, and 27 on Mugho pine stock.

Two hundred and five scions from the 1955 collection were sent to Dr. R.G. Hitt, College of Agriculture, University of Wisconsin.

3. Scotch Pine.

(a) Timber Types.

Ten trees have have been selected from a group of trees growing along the Ontario Northland Railway at Nellie Lake, 30 miles south of Cochrane. The provenance of these trees is unknown. They came from Luke Bros. Nursery Co. Ltd., Como, Quebec and were planted in the spring of 1919. The seed was purchased from St. Williams Provincial Forest Station in 1915, but nursery records do not indicate the origin.

These trees were 37 years of age from seed in 1954 and had an average height of 40' and D.B.H. of 8". Trees of a similar size in the adjacent jack pine stand were about 60 years of age. Tests are planned to have each of the clones tested for their various strength properties following the method described in the Journal of Forestry Vol. 53, February 1955.

Scion collections have been made to establish a seed orchard in Southern Ontario, to produce seed to provide trees for use on the sand plains of the Swastika area. When sufficient seed is available, a test planting will be made to compare various Scotch pine provenances with native jack pine, as to their growth characteristics and their production value.

Three hundred and fifty scions were collected from 10 trees in September 1954. These were grafted in the greenhouse on spring and fall potted Scotch pine, and were placed in coldframes 2 months after grafting.

Two hundred and forty-two scions from the same 10 trees were grafted in the greenhouse in February 1955. The stock plants used were Scotch pine, Mugho pine and red pine.

(b) Christmas Tree Types.

Scions from five trees in a Christmas tree plantation at Thessalon were grafted in 1954 for future testing. Twenty-eight grafts were made on 6-year-old Scotch pine established in the nursery. In July, 1954, 27 grafts were living.

4. Yellow Birch.

This project is designed to preserve some of the better trees as they are cut in logging operations. The selection of trees is carried out by Mr. Burton of the Research Division. He prefers felled trees in order to be certain of the extent of rot within the tree. A seed orchard will be developed from which seed will be used to restock desirable sites within the Algonquin Highlands.

Scions were collected in January 1954 from trees felled in logging during the winter months. These were stored in snow until they were grafted in February and March. Both yellow and white birch stock plants were used and observations made show that white birch is not compatible with yellow birch. No detailed record is available at present to support these observations.

There were 51 grafts living from the 604 grafts which were made, at the time the stock was removed from the greenhouse on June 15, 1954. The living trees were taken to Algonquin Park and planted in a clearing on the lower part of a North slope, beneath a birch cover. This was done to allow the scions to become established in a humid atmosphere.

The present plan is to clear a 2-acre block in a pure Hemlock stand and use this area for the orchard site. Location of the area will be carried out during 1955.

5. Grafting Summary.

<u>1953-54 Season</u>

A. Greenhouse Grafting

Species	No. Grafted	No. Living	% Living
Pw on Pw	77	76	99 (on removal from greenhouse)
PSc on PSc	87	61	70 " "
By on By By on Bw	405) 199)	51	8 " "

B. Field Grafting

PSc on PSc	125	107	86 (on July 26, 1954)
Pr on PSc	25	23	92 " "
Pr on Pr	36	21	58 " "

1954-55 Season

A. Greenhouse Grafting

Species	No. Grafted	No. Living	%Living
Pw on Pw	651	628	96 (on Feb. 28, 1955)
PSc on PSc	7		
PSc on PM	132		
PSc on Pr	103		
PSc on *PJr	70		
Pr on Pr	35		
Pr on PM	27		
By on By	279		
By on Bw	13		
By on Bg**	10		

Species

*Pinus densiflora -
Japanese red pine

**Betula glandulosa -

Appendix "E"

REPORT TO COMMITTEE ON FOREST TREE BREEDING, 1955

UNIVERSITY OF TORONTO, GLENDON HALL

by

J. A. C. Grant

The work at Glendon Hall has its initial, though not necessarily its continuing emphasis on the field of photoperiodism. Work has begun on such other factors of environment as temperature, moisture, and light. During the past year Dr. Heimburger asked us if we could determine the best combination of environmental factors for the growth of white pine grafting material from seed. In addition to practical aims of this sort, we would hope to contribute to an understanding of the basic physiology and ecology of our more important tree species. Following is a summary of the more important indications that have issued from our work during the past year. All tree material used was in the first year of its life, hence the results do not necessarily apply to older material.

1. There is strong evidence that the growth response of jack pine to a particular photoperiod is independent of the latitude of the seed source. This is based on material from eight different sources ranging from Bruce Peninsula, Ont. (Lat. 45°) to Doré Lake, Manitoba (Lat. 54½°).

2. The optimum photoperiod for growth of root and stem of jack pine appears to lie somewhere between 16 and 24 hours. Seedlings growing under a photoperiod of 20 hours showed noticeably better growth than those under photoperiods of 16 or 24 hours.

3. The optimum photoperiod for stem growth in trembling aspen also appears to lie between 16 and 24 hours. However, growth under a 20-hour photoperiod was not markedly greater than under 16 hours.

4. In white spruce the response of the breaking of dormancy to the photoperiod seems to bear a strong correlation with the latitude of the seed source. Seven strains of white spruce that had been grown for 50 days under natural daylength in the greenhouse were placed in the photoperiod compartments on August 5th. Within about two weeks all the seedlings had formed a terminal bud, but before the end of September many specimens had begun to sprout a new whorl of leaves from the bud. Under natural photoperiod there was no breaking of dormancy. Under 16-hour photoperiod a single specimen from Denbigh in Southern Ontario emerged from dormancy. Under 20-hour photoperiod all seed sources except the two northernmost (Doré Lake, Manitoba and Peace River) showed some specimens with renewed growth. Under 24-hour photoperiod the two northernmost strains remained totally dormant while the other five strains showed increased breaking of bud. Under the two longer photoperiods the fraction of seedlings breaking dormancy was strongly correlated with the latitude of the seed source. This suggests a high degree of latitudinal differentiation in white spruce with respect to photoperiodic response.

5. An experiment with various moisture regimes indicated a similarity in behaviour of white pine and Scotch pine, but, as would be expected,

Scotch pine survived on a lower ration of water than white pine. Just beyond the threshold of survival growth of the root increased with increasing moisture. Root growth reached a peak at a regime not much beyond the threshold of survival and then fell off rather rapidly with increasing moisture. Stem growth continued to increase to a point somewhat moister than the peak for root growth and then appeared to maintain itself right to the point of saturation.

6. An experiment with three light regimes: 100%, 85%, and 70% was conducted using white pine, jack pine, and white spruce. Jack pine showed a linear retardation in growth with decreasing illumination. With 70% illumination white pine showed poorer growth than with the two higher intensities, but there was little to choose between the growth under 100% and 85% illumination. White spruce showed little if any reduction in growth with the shading treatments used. Although the white pine seed, alone of the three species used, came from a single tree, nevertheless the variation between individuals was much greater with white pine than with jack pine or white spruce.

Work at Glendon Hall during the coming year will depend on the support received. Projects to be undertaken if funds are available include the following:

1. Continued investigation of photoperiodic responses to find optimum photoperiods, dormancy behaviour, possible latitudinal adaptations to photoperiod, the importance of the intensity of light used to lengthen the photoperiod, interaction of photoperiod with other factors of environment. A new set of five photoperiod compartments working on the principle of the exclusion of light, and designed for outdoor use is almost ready for operation.

2. Repetition and extension of experiments on light, moisture, and temperature using more refined techniques.

3. Experiments on the nutritive requirements of tree seedlings and the ability of various types of soil and parent material to supply these needs. This work will be conducted in large measure by K.A. Armson on his return from Oxford University in September.

Appendix "F"

DUTCH ELM DISEASE INVESTIGATIONS

By: A.W.S. Hunter,
Horticulture Division,
Central Experimental Farm,
Ottawa, Ontario, and,
C.E. Ouellet,
Experimental Station,
L'Assomption, Quebec.

The search for American elms (Ulmus americana) that are resistant to Dutch elm disease (Ophiostoma ulmi) is conducted at the Canada Department of Agriculture Experimental Station, L'Assomption, Quebec. The work on the development of resistant hybrid elms of suitable type is located at the Horticulture Division, Central Experimental Farm, Ottawa. Little progress has been made in the latter phase of the study beyond that reported in previous years, i.e., the securing of a single hybrid between U. americana and U. pumila and the production of several tetraploid seedlings of U. pumila by colchicine treatment.

However, the first stage of the studies at L'Assomption has been brought to a successful conclusion. A reliable method of propagating American elms vegetatively has been developed. This involves the use of softwood cuttings, 3½ to 4½ inches long and bearing two leaves. These are treated with a 50 ppm. solution of indolebutyric acid for 24 hours and rooted in sand under heavy shade and high humidity. The best results are secured from cuttings taken during the period from mid June to the end of July. Age of tree has an effect on rooting, cuttings taken from young trees three to eight years old rooting more readily than those taken from older trees. The Christine Buisman elm, a resistant variety of U. carpinifolia from Holland was successfully rooted by this method, although it has been reported to be very difficult to propagate.

The second phase of the project at L'Assomption involves the testing of trees which appear to have remained uninfected although surrounded by infected trees in areas of high Dutch elm disease incidence in southeastern Quebec. It is not known whether these trees are resistant, or merely have escaped infection. Cuttings were rooted from a number of such trees and 125 clones were tested for resistance by inoculation in the field. In addition, 7,000 open-pollinated seedlings of these trees were inoculated.

The testing of elms for their resistance to Dutch elm disease is complicated by the fact that many susceptible seedlings escape infection unless they are inoculated during the period of maximum susceptibility for the particular plant. Therefore, it is necessary to reinoculate in several successive years before one can have any assurance that a plant is resistant. Among all the plants inoculated at L'Assomption to date, one seedling has been found which shows a certain degree of resistance after four inoculations, and eight after two inoculations.

The results are not extensive enough to prove that a useful degree of resistance to Dutch elm disease will not be discovered in U. ameri-

cana. However, when coupled with the more extensive series of tests by Swingle in the United States, it does seem probable that no appreciable resistance exists in this species and that uninfected exposed trees are merely escapes. Indeed, it is apparent that resistant trees within the genus Ulmus are not truely resistant but only tolerant. This is true even of the Siberian elm, _U_. _pumila_, which is considered to be the most resistant species.

In view of the lack of true resistance, the possibility of inducing mutations for disease resistance by radiation is being investigated. Preliminary studies were conducted in 1954 to determine suitable x-ray dosages for elm seeds. Large quantities of seeds will be irradiated in 1955. Mutations are likely to be chimeral in nature so that the usual method of inoculation will not be applicable. It is probable that resistance mutations, if they occur, will be associated with other changes, some of which will be recognizable visually. Therefore, it is proposed to propagate by cuttings all branches that show any sign of mutation and to test these branches separately for disease resistance.

Appendix "G"

CYTOGENETIC STUDIES IN *CARAGANA*, 1954

by

R. J. Moore

The plantings of *Caragana* have been maintained during the past year and representative plants of the various species are being transferred from the nursery to the permanent collection in the Dominion Arboretum as the plants reach a suitable size.

Material of two new species has been obtained and the chromosome numbers determined, as follows:

Caragana brevifolia Kom. 2*n* = 16.

Caragana sinica (Buc'hoz) Rehder 2*n* = 24.

The triploid number found in *C. sinica* is the first departure from the diploid or tetraploid numbers found in the genus. The plants were received as cuttings and have not yet flowered, so the degree of fertility is unknown. It seems probable that other chromosome numbers occur in this species and it would be desirable to obtain plants from other sources, preferably wild collections. It seems that all known sources of the species in North America originated from one nursery in Holland.

About 35 crosses, mainly interspecific, were attempted with the negative results previously reported. One bush of *C. densa* flowered for the first time. The cross *C. densa* x *C. maximowicziana* was attempted without success. The bush of *C. densa* was self-sterile.

It appears that one potentially successful colchicine-induced tetraploid of *C. arborescens* has been obtained. The tetraploid chromosome number was observed in all divisions in squashes of leaf tissue. The root was immersed in .2% aqueous colchicine for 24 hours when the plant was a 2-inch seedling. The stem is now thicker than normal and somewhat twisted and the leaflets are slightly irregular in outline and unusually pubescent. The plant has made slow growth since treatment (18 months) but all new leaves appear alike and to show colchicine symptoms. Plants previously treated have readily produced polyploid tissue which, however, did not long survive competition with the normal tissue.

Appendix "H"

SHELTERBELT TREE BREEDING

Forest Nursery Station
Indian Head, Sask.

by

W. H. Cram

Technical phases of the tree breeding work were limited in 1954 for three reasons: namely, by the death of the only experienced assistant, by the adverse weather and by the demands of a scale planting program. Progress in 1955 seems assured by promises of a doubling of the staff (additions of a student assistant and a technical assistant) and of a new adequate greenhouse.

As previously reported the work at Indian Head in 1954 involved ramifications of three main projects in 1) Spruce; 2) Caragana and 3) Damping-off diseases. The project with pine was suspended in 1954 due to the above circumstances. In addition, preliminary studies of seed maturity-viability were initiated for spruce and caragana, with the objective of ensuring maximum seedling production from controlled pollination seed.

SPRUCE

Flowers and cones were produced in abundance by Colorado and white spruce for the first year since 1948. Regrettably pollination of white spruce was reduced by wet weather and together with a serious infestation (31%) of seedworm resulted in a small seedcrop. Bloom of Colorado spruce coincided with a short period of sunny weather, while the infestation of seedworm was light so that a fair to good seedcrop was obtained.

Needle coloration of the 5-year-old open-pollination progenies of 35 Colorado spruce selections was investigated. The percentage of blue seedlings varied from 0 to 55%. Seedtrees, which were selected for blue needle coloration (in addition to other characteristics), produced a greater proportion of blue seedlings than did green selections. One 'deep' blue selection, which was isolated from other Colorado spruce and produced only three seeds per cone, gave 27% blue seedlings. Thus it would appear that the blue character of this tree was apparently due to a single recessive gene. However, gradations for blue coloration were exhibited by other Colorado selections and suggest the reaction of two or more factors for this character.

Cone-seed maturity was investigated for two adjacent selections of Colorado spruce in 1954. Samples of four weekly intervals. Specific gravity and moisture content was determined for the cones at harvest time, as well as for the extracted seed one month later. The results are listed in Table 1. This exploratory study suggests that specific gravity of Colorado spruce cones decreases to .67 and moisture content to 35% just prior to seed shed. On the other hand, specific gravity of the seed increased to 1.13 and moisture content of the seed decreased to 6.2% with maturity. The results of germination tests now in progress with stratified and non-stratified seed of this study may clarify the value of the above cone and seed characteristics. Finally with regard to spruce, self- and cross-compatibility determinations in Colorado spruce are scheduled for 1955.

CARAGANA

Spring plantings of caragana included 78 Inbred progenies, 33 hybrid combinations, 32 accessions and 51 clones. Some 2700 S_1 seedlings, from the 1952 and 1953 self-compatibility determinations were added to the Inbred Progeny plots. Approximately 1000 hybrid seedlings from the preliminary cross-compatibility determinations of 1953 were planted into field performance plots. Over 1000 seedlings and cuttings were placed in the Caragana Accession Orchard, which now contains 67 accessions of 18 species. The genetic diversity of future breeding stocks is assured as 41 of the accessions represent seed collections of C. arborescens from foreign sources. The Clonal Observation Nursery was extended by the plantings of some 400 rooted cuttings from 51 local selections.

In addition, 12 self-incompatible selections and 15 accessions of C. arborescens were grafted, in triplicate, on potted seedlings for future greenhouse breeding work. Grafted material has proven superior to rooted cuttings for survival and have demonstrated earlier floral development.

Maturity-viability of the 1952 and 1953 Caragana seed was investigated. Seed was harvested from four trees at 8 successive dates prior to natural pod dehiscence in 1952 and 1953. Moisture content of the seed was determined at the time of harvest and again in 1954 prior to the viability test. The viability of stratified and non-stratified seed was evaluated in terms of germination capacity and rate by a greenhouse test in 1954. The results from one seedtree are listed in Table 2. Conclusions from the above Caragana seed maturity-viability study were briefly as follows: 1) The rate at which Caragana seed developed and matured differed by some 18 days in 1952 and 1953. 2) Moisture content of caragana seed fell below 40% some 5 days prior to natural dehiscence of the pods, and decreased from over 72% to less than 30% with approaching maturity. 3) Dormancy of caragana seed increased, not only with approaching maturity but also with age of the seed, and was most pronounced for seed which had a moisture content of 40% at the time of harvest. 4) Stratification for 15 days at 41°F. induced rapid and almost complete germination of all caragana seed, which had a moisture content of less than 70% at the time of harvest or if harvested from 1 to 17 days prior to natural dehiscence of the pods.

Seedbed germination of S_1 caragana seed revealed a possible association between small seed size and albino seedlings. The inbred seed, from the 1952 and 1953 self-compatibility determinations of 38 caragana selections, was stratified and sown outdoors in 1954. Germination results for the S_1 seed of only one seedtree, which proved heterozygous (Yy) for the chlorophyll-producing factor, have been summarized in Table 3 as an example. The following conclusions were apparent from the complete study: 1) Field germination was almost identical for seed of the two years. 2) Germination was consistently higher for the smaller two-year-old seed than for the larger, and vice versa for the one-year-old seed. 3) The bulked progeny of each seedtree gave a fair to good fit to a 3 : 1 ratio of green : albino seedlings. 4) The proportion of albino seedlings decreased with increasing size of the seed.

Vigor of progenies from open-pollination seed of 17 caragana selections was investigated in 1954. Height of 3-year-old seedlings bore no relationship to: density of the branches, height of the one-year-old seedlings, or self-compatibility of the parental trees.

Pollen germination tests were made to determine the reliability of aceto-carmine stain for evaluating the viability of caragana pollen. The relative germination of pollen in water, agar and various concentrations of four sugars was compared with the percentage of pollen stained by aceto-carmine for five selections. Pollen from only one tree germinated (72%) in distilled water, while pollen from the same and from another tree germminated (77 + 87%) in a 1.5% aqueous solution of agar. Solutions of sucrose and dextrose proved superior germination media to water and agar, as well as to maltose and lactose sugars. Germination of pollen in 15% sucrose and 5 to 10% dextrose solutions approached the percentage of stained pollen very closely for two trees. However, the average germination of pollen from the five trees was only 78% in 15% sucrose, while 97% of the pollen stained with aceto-carmine. Further study is required to find a more congenial germination medium for caragana pollen.

Self-compatibility determinations were performed in the field for 62 selections which had previously been found to be relatively self-incompatible. Twelve of these selections proved completely self-incompatible, 15 were slightly (1-10%) self-compatible, while the remainder were definitely classified as self-compatible (10-50%). The selections found to be slightly self-fertile have been classified as psuedo-self-compatible, in that they set seed with their own pollen only with manual and careful manipulation. The value of such plants in a breeding program remains to be determined.

Cross-compatibility determinations were made in the field for 21 self-compatible and self-incompatible selections using the pollen from 4 to 15 tester selections. The results for 18 selections with six testers have been summarized in Table 4. These cross-compatibility data seem to segregate the 9 self-incompatible selections into three fertility groups, the 4 pseudo-compatible selections into two groups and the 5 self-compatible selections into three groups. Thus, it would appear that compatibilities within *C. arborescens* are controlled by 8 or more combinations of 3 or more factors. Until such time as information is available for reciprocal combinations and for F_1 progenies, no precise classification of the compatibility genotypes is possible.

It is hoped to verify the results to date and some reciprocal combinations with grafted material in the new greenhouse. An estimate of the relative hybrid vigor of present combinations may be obtained from the seedlings secured from the 1954 F_1 seed. It would seem logical to now establish isolated crossing blocks for the mass production of hybrid seed for A1 X B2-5A, and A1 X B4-2. These crosses would then be in production by the time the hybrid combinations have been evaluated and could be utilized or discarded depending on the relative vigor of the F_1 seedlings.

The Pathogenicity of five damping-off isolates was evaluated in terms of seed germination and seedling losses of white spruce, Colorado spruce, Scotch pine and caragana. This is one of three projects initiated in co-operation with the Forest Biology Division because of the seriousness of the damping-off problem. Results of the 1953-54 greenhouse study carried out with inoculated seedbed soil in the greenhouse were briefly as follows:

1) *Rhizoctonia solani* proved to be the most virulent pathogen causing both pre- and post-emergent losses in all four tree species. It reduced emergence of caragana from 95 to 50%, that of Scotch pine from 99 to 73%, but had little influence upon emergence of spruce seed. Post-emergent losses due to Rhizoctonia were 68% for caragana, 64% for Scotch pine, and 34% for spruce.

2) *Pythium* spp. were of secondary importance as pathogens of the four tree species under greenhouse conditions. Pre-emergence losses due to Pythium were insignificant except for spruce species. Post-emergence losses due to Pythium were insignificant for caragana, but varied from 14% for Scotch pine to 43% for white spruce.

3) The pathogenicity of Fusarium, Alternaria and/or Nematodes, was not established. However, numerous isolates of Fusaria spp. were obtained from both diseased and apparently healthy seedlings.

4) Seedtrees within both species of spruce demonstrated a differential susceptibility to some diseases causing damping-off.

5) Two applications of Tersan reduced post-emergence losses due to Pythium from 21 to 7%.

Table 1. Specific Gravity and Moisture Content of Cones and Seed as Harvested from Two Trees of Colorado Spruce at 5 Weekly Intervals in 1954

Tree	Date of* harvest	Specific gravity cones[1]	Specific gravity seed[2]	Moisture content cones[3] (%)	Moisture content seed[2] (%)
42-3	Sept. 2	1.010	.937	58.3	9.22
	Sept. 8	1.066	.953	57.7	7.88
	Sept. 15	.992	.953	58.2	7.73
	Sept. 22	.909	.938	52.7	6.14
	Sept. 29	.669	1.130	35.6	6.20
C-1E	Sept. 2	1.022	.877	57.2	7.86
	Sept. 8	1.071	.833	57.2	8.49
	Sept. 15	1.027	.862	57.0	7.47
	Sept. 22	.954	.966	52.2	7.44
	Sept. 29	.714	1.135	35.6	6.09

[1]average for 6 samples of 4 cones each

[2]average for 10 samples of 10 seeds each

[3]average of 3 samples of 2 cones each

*seed shed started on Sept. 30 for 42-3 and on Oct. 3rd for C-1E

Table 2. Characteristics of the Seed as Harvested from One Tree (V-7) of *Caragana arborescens* on Five Successive Dates in 1952 and 1953

Year	Date of harvest	Moisture content harvest[1]	Moisture content germin[2]	1954 Germination Capacity[3] non	1954 Germination Capacity[3] strat	1954 Germination rate[4] non	1954 Germination rate[4] strat
		(%)	(%)	(%)	(%)	(ind)	(ind)
1952	July 11	71	8.6	80	75	.47	.75
	July 18	66	9.4	62	88	.36	.86
	July 25	58	6.9	58	98	.23	.94
	July 30	43	6.9	55	95	.21	.93
	Aug. 4	33	6.4	68	98	.23	.94
	Means	54	7.6	65	91	.30	.88
1953	July 29	73	9.2	83	78	.44	.91
	Aug. 5	65	7.5	80	95	.42	.92
	Aug. 12	59	6.6	65	88	.27	.95
	Aug. 19	45	7.6	57	93	.26	.92
	Aug. 22	24	7.0	65	95	.25	.97
	Means	53	7.6	70	90	.33	.93

[1]average of seed from 2 samples of 20 pods at time of harvest (% wet wt.)
[2]average of 2 samples of 20 seed in 1954 prior to germination test
[3]apparent germination in 50 days for stratified and non-stratified seed
[4]rate of germination index, the larger the value the earlier emergence

Table 3. Germination Capacity (%) and Rate (index) for the 1952 and 1953 S_1 Seed of One Caragana Tree with the Proportion of Albino Seedlings Produced

Seed-year	Size & No. of seed 3.0	3.5	4.0 mm.[1]	Germination cap.	Germination rate[2]	Seedlings green	Seedlings yellow	X^2 [3]
				(%)	(ind.)	(No)	(No)	
1952	-	118	-	83	.74	76	22	0.34
	15	-	72	75	.71	61	5	10.67*
			bulked	80	.73	137	27	0.64
1953	40	-	-	65	.66	8	18	27.13*
	-	297	-	84	.73	200	50	3.33
	-	-	104	86	.74	87	3	22.53*
			bulked	83	.73	295	71	6.12

[1]diameter of seed in mm. prior to stratification
[2]rate of germination index
[3]chi-square value for fit to 3:1 ratio (*poor fit)

Table 4. Cross-compatibility of 18 Selections of *Caragana arborescens* with Pollen of Six Tester Selections in the Field in 1954

Seedtree	Self-compat.	Set with pollen of V-16	A-1	V-2	B2-4	21-16	N-19
B6-2	-	-	-	-	?	?	$+^2$
B2-4B	-	-	-	-	?	?	?
V-16	-	-	-	+	-	-	+
A-1	-	-	-	$+^2$	-	-	+
B2-4	-	-	-	+	-	-	$+^2$
15-2	-	-	-	+	?	-	$+^2$
21-16	-	-	-	$+^2$	-	-	+
B2-5A	-	-	+	$+^2$	?	-	+
B4-2	-	-	+	$+^2$	?	?	+
B2-7	$+^2$	-	$+^2$	-	?	?	+
21-21	$+^1$	$+^1$	-	?	?	-	+
B5-5	$+^1$	$+^1$	-	$+^2$	-	-	+
B5-1A	$+^1$	$+^1$	-	+	?	-	+
V-2	+	$+^1$	-	+	$+^2$	$+^1$	+
B3-5	$+^1$	$+^1$	$+^1$	+	$+^1$	$+^1$	+
21-28	$+^2$	+	+	$+^2$	$+^1$	?	+
B1-1A	+	+	+	$+^2$	+	+	+
B1-5	+	+	+	+	?	?	+
N-19	+	+	+	+	+	+	+

? no data available
+ cross-compatible, $+^1$ very low set (1-5%); $+^2$ low set (6-15%)
- cross-incompatible

Projects:

P-137 Breeding of weevil resistant and frost hardy Norway spruces for eastern Ontario and elsewhere.

P-138 Investigation of flower inducing techniques for spruces.

Reports:

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

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

3. Phenology of rootstocks and grafts in a timing experiment with fall grafting and winter grafting of Norway and white spruce. Intended for publication as "Technical Notes". M.J. Holst, 16 pages.

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

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

3. Problem 2: Selection, Breeding and Genetics of Hard Pines

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

We also measured the red and jack pine nursery provenance experiments. The measurements showed variation in vigour that was correlated with summer temperature index.

No cones were obtained from the rather extensive hard pine crosses done in 1953. The Scots pine and Mugho pine flowers were killed by a late spring frost, and the red pine cones heavily attacked by the red pine cone beetle, (Conophtorus resinosae). Although we sprayed the trees in the spring and bagged the cones with cotton bags dipped in DDT, it was obvious that beetle damage had ruined the cones in their first growing season. It is therefore necessary to drench the trees or protect the conelets or cones both in first and second growing season. We have as yet not found a satisfactory technique for protection of red pine cones from beetle damage.

A few hard pine crosses were made in the spring of 1954 on rootstocks and grafts in the greenhouse. They were:

P. sylvestris x densiflora (Midhurst)
P. nigra (Hungaria) x densiflora (Midhurst)
P. nigra (Spain) x densiflora (Midhurst)
P. nigra (Algir) x densiflora (Midhurst)
P. nigra (Crimea) x densiflora (Midhurst)
P. nigra (Italy) x densiflora (Midhurst)

(9 crosses on open flowers)

The following crosses were made out of doors in the spring of 1954:

P. banksiana x virginiana
palustris
contorta latifolia

P. contorta latifolia x virginiana
palustris
banksiana

P. sylvestris (Riga) x Thunbergii (Rochester, N.Y.)
densiflora (Midhurst)
Thunbergii x densiflora (Morris Arb.)
densiflora x sylvestris (Morris Arb.)

(14 crosses and 613 bags)

The hard pine experiments planted in the spring of 1954 are shown in Table I.

Table I

Experiments planted in the spring of 1954

Exp. No.	Title	Experimental Plots	Observation Plots	Number Plants Exp.	Number Plants Shelter	Area	Location
38 P-142	Single tree progeny test of P.F.E.S. red pine	x	-	1960	632	.94 acres	P.A. 106 P.F.E.S.
39 P-139	Provenance experiment with Ontario red pine (10 provenances)	x	-	2700	700	1.20 acres	P.A. 106 P.F.E.S.
40 P-140	Provenance experiment with Ontario jack pine (12 provenances)	x	-	4800	1052	2.13 acres	P.A. 106 P.F.E.S.
41 P-140	Observation of Ontario jack pine provenances planted at the K.V.P. Co. limits	-	x	6000	-	4.9 acres	West Br. K.V.P.Co. Espanola, Ont.
42 P-140	Observation of Ontario jack pine provenances planted at Valcartier F.E.S., Quebec	-	x	6000	-	4.9 acres	Val-cartier F.E.S., Quebec
43 P-141	Comparison of Austrian, Corsican and Japanese red pine planted in middle Ontario	-	x	6000	-	-	Clare-mont, Ontario
74 P-139	Nursery provenance experiment with 26 races of red pine originated mainly in the middle and western distribution area	x	-	3900	-	-	Nursery 2 Petawawa F.E.S.

To establish a collection of red pine grafts with scions taken from the flowering part of the crown and therefore capable of flowering within a few years 1889 grafts were made in June 1954 and the following provenances were grafted:

Kings Co., N.S.
Wilmat - Annapolis Co., N.S.
Windsor, N.S.
Grand Lake, N.B.
Norfolk, Conn.
Cortland Co.,
St. Foy, P.Q.
Petawawa, Ontario
Massey, Ontario
Batchawana Bay, Ontario
Manitoulin Island, Ontario
Cochrane, Ontario
Engelhart, Ontario
Fort William, Ontario
Piney, Man.
Trout Lake, Wisc.
Star Lake, Wisc.

Although the collection is not complete yet it is intended to use this material for provenance hybridization. To have flowering trees of these different provenances assembled in one place is much easier than trying to make hybrids with pollen shipped in for this purpose, because pollen often spoils in shipping (too wet when collected). Climatic data for the various provenance experiments were assembled and filed away for use in future publications.

A similar grafting of population samples is planned for jack pine in the spring of 1955.

<u>Work Proposed for 1955-56</u>

1. Phenological observations in nursery provenance experiments of red pine and jack pine.

2. Planting of provenance experiment with Lake States jack pine.

3. Lay out of new experiments with flower inducing of young hard pine plants.

4. Grafting of jack pine population samples.

5. Publication on red and jack pine provenance experiments.

6. Various hybridization work.

Projects

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

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

P-141 Provenance experiment with exotic hard pines.

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

P-143 Finding, recording, testing and preserving for the future of superior phenotypes of jack pine.

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

P-145 Investigation of flower inducing techniques for hard pines.

P-146 Interspecific hybridization in the group Insignes.

P-147 Selection of the perfect Scots pine Christmas tree.

Reports

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

2. Spring grafting of population samples of red pine. M.J. Holst, File report, 15 pages.

3. Sections on (a) Strains and other genetic features, (b) Pertinent features of morphology, (c) Flowering and cone development, (d) Seed crop and seed dispersal, (e) Vegetative propagation in white pine--red pine monograph. M.J. Holst, 9 pages.

4. Problem 3: Selection, Breeding and Genetics of miscellaneous conifers

The work consisted mainly of increasing our collection of various conifers.

Planting of both hard pine and soft pine was done in P.A. 106.

Projects

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

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

P-150 Selection of suitable Douglas fir for eastern Ontario and elsewhere.

5. Problem 4: Selection, Breeding and Genetics of Miscellaneous Hardwoods.

Maintenance of previously established poplar plantations and minor collections, mainly of seed, was done during the year.

Project

P-151 Growth behaviour of exotic hardwoods.

Table II

Summary of Grafting during 1953-54-55

Fall 1953	No. Grafted	Survival	
24 broad and slender genotypes of white spruce	495	216	
Other spruces	45	34	
Red pine	50	28	
Experimental spruce grafting with and without chilling	380	336	88%
Winter 1953-54			
Selected Norway spruce provenances obtained from Humlebak, Denmark	377	292	
Sitka x white spruce hybrids obtained from Arboretum, Horsholm, Denmark	250	144	
Picea orientalis, Rochester, N.Y.	25	24	
Elite (slender) Norway spruce of German origin but grown in Sweden	145	99	
Population sample of white spruce from Alberta	100	99	
Pinus nigra from Italy, Spain, Algir, Hungaria and Crimea	264	227	
Lodgepole pine x banksiana hybrids from natural hybrid swarms in Alberta and controlled hybrids from Placerville	446	425	

Winter 1953-54(concl'd.)	No. Grafted	Survival
Pinus hybrids (Group Lariciones) from Rochester and Arnold Arboretum	74	74
Selected Christmas trees of Scots pine	300	289
Spring 1954		
Experimental grafting of population samples of red pine	1889	1054
Fall 1954		
23 elite white spruce from Ontario and Quebec	1340	-
Experimental fall grafting with local weevil resistant Norway spruce	400	-
Weevil resistant Norway spruce from CIP plantation near Grenville, P.Q.	200	-
Experimental fall grafting with Northern Ontario red pine	106	-
	6986	

6. Problem 5: Development of Techniques and the Maintenance of Facilities for Tree Breeding.

Vegetative Propagation

Much time was spent investigating fall grafting of spruce and pine, and June grafting of red pine. Reports have been prepared on these experiments and on our standard grafting techniques. (see below)

Spruce can be grafted safely during August and September and the grafts can most profitably be left out of doors for normal chilling.

Rootstocks of white spruce taken into the greenhouse in the fall and kept there over winter are sickly looking in the spring and summer, Norway spruce treated the same way appears quite healthy.

Slightly chilled rootstocks taken into the greenhouse on December 1st should be used for early winter grafting near the end of December and the beginning of January. For grafting during February, either the non-chilled rootstocks of October 1st or the partially chilled rootstocks taken in around the middle of January should be used.

Red pine can be grafted with good success in June, but deep-frozen scions are better than cold storage scions. The take can be boosted to approximately 90 per cent by protecting the graft with a polythene bag with an added kraft paper bag for shade.

6986 grafts were made of spruce and pine. (Table II)

It is now possible to do large scale grafting for establishment of seed orchards. The techniques are ready - but we would need additional trained personnel, both for grafting and for selecting elite trees.

Nursery Work

45,660 2/0 seedlings were transplanted. 58 per cent of these were pine, 38 per cent spruce and the rest a variety of cedar, hemlock and larch. 44,000 2/2 spruce are ready for transplanting to experimental plantations.

The nursery has been somewhat enlarged but the expansion does not cover the needs. The total area under cultivation is now 7.7 acres. Planned expansion west of the previously cultivated area (only partly cultivated) is 4.0 acres. Area of red pine stand to be cut south of nursery 3.9 acres. This makes a total of 15.6 acres. As the total area needed is approximately 26 acres, we still have a long way to go.

Plantation Work

The test plantations planted during 1954 are shown in Table I. Only pine was planted.

Plantation areas have been cleared and cultivated and are ready for the experiments to be planted in the spring of 1955. These are: (1) A provenance experiment with Lakes State jack pine (2) spruce experiments and (3) a pine-graft arboretum.

Other Work

The tree breeding files have been re-organized and indexes prepared for the experimental material.

343 letters were received during 1954 and 351 letters and memoranda were written.

Pollen and scions of Populus tremuloides were sent to Sweden, Denmark and France. White spruce and Sitka x white spruce hybrid seed were sent to Oregon and B.C. to investigate whether or not this material is resistant to the Sitka spruce weevil.

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

Other small requests for plant material were filled on request.

Work Proposed for 1955-56

Routine work in nursery, greenhouse and plantations. Preparation of papers about grafting techniques. Establish experiments as indicated above.

Projects

P-4	Acquisition and distribution of plant material
P-45	Arboretum
P-51	Nursery work
P-60	Technique in forest tree breeding
P-61	Establishment and maintenance of experimental plantations related to tree breeding.

Reports

1. Performance of rootstocks and grafts in a timing experiment with fall and winter grafting of Norway and white spruce. M.J. Holst, file report, 20 pages.

2. Grafting of population samples of red pine. File report, 15 pages.

3. Spring grafting of red pine, with two methods of storage of scions and four methods of protection of grafts. M.J. Holst, submitted for publication as "Technical Notes." 15 pages.

4. Greenhouse grafting of spruce and hard pine at Petawawa Forest Experiment Station. Submitted for publication as "Technical Notes." M.J. Holst, J.A. Santon and C.W. Yeatman, 31 pages.

5. Tree breeding in Canada to-day and in the future. M.J. Holst, speech delivered to the Deep River Science Association. Dec. 9, 1954.

6. Subject index for tree breeding experiments. M.J. Holst, File report, 340 pages.

7. Index by number of experiments dealing with forest tree breeding and genetics. M.J. Holst, File report, 15 pages.

8. Annual report. M.J. Holst, Committee on Forest Tree Breeding, 14 pages.

Appendix "K"

REPORT ON THE FOREST GENETICS ACTIVITIES AT ACADIA FOREST EXPERIMENT STATION - 1954

by

H.G. MacGillivray

Some progress was made in the forest genetics studies at Acadia Forest Experiment Station during 1954. This report will deal with the selection of spruce budworm resistant host trees; provenance studies; the relationship between white, red and black spruce; and air-layering experiments.

Field Selection of Host Trees Which Were Apparently Resistant to Spruce Budworm Attack

The unsprayed area of the Green River Watershed in northwestern New Brunswick was surveyed for apparently resistant white spruce and balsam fir trees in 1954. More time was spent on the survey in 1954 than in 1953. Generally the trees that did not appear to have been attacked were first spotted by scanning the valley bottoms and slopes, from good vantage points. Binoculars were used in spotting these trees. The green crowns of these trees were easily located amid the red or bare tops of the heavily defoliated trees. The green-topped trees were then visited and were either selected or rejected as breeding material following close inspection. The defoliation of the crowns of the selected trees was very light compared to the defoliation of crowns of trees of similar size, crown class and species within the same stand.

The trees selected in 1953 were re-examined. A few new apparently resistant trees were selected in 1954. Out of trees selected in 1953 and 1954 four balsam fir and one white spruce were considered worthy of further study. Attempts were made to propagate two of these firs this spring. The scions appeared to be rather weak and as a result it is doubtful whether or not they will survive.

Provenance Experiments

A few collections of red spruce seed were received from Nova Scotia in 1954 even though it appeared to be an exceptionally poor seed year in most parts of the Maritimes.

Cone measurements, current growth measurements, cotyledon counts and weight per 1000 seed were obtained for several Maritime spruce and fir seedlots as well as the weight per 1000 seed of red spruce seedlots supplied by Mark Holst. To date these data have not been thoroughly analysed. However, this will be done in the near future.

Relationship Between White, Red and Black Spruce

Very little field work was done on the morphological differences between red spruce, black spruce and their possible natural hybrids in 1954. However, some preliminary work was done using serum diagnosis to determine the relationship between white, red and black spruce.

The protein extract for each species used in this work was made from 5 gm. of pollen and 50 ml. normal saline solution. The extract was made by freezing the mixture at -20°F. for a period of several days. The mixture was stirred at intervals until freezing took place. The mixture, while it was thawing, was stirred in a Warring Blender for 5 minutes and then filtered and centrifuged.

Three rabbits were inoculated with pollen extract, each rabbit receiving inoculum of one tree species.

The following subcutaneous inoculations of pollen extract together with the lengths of time indicated, were sufficient for the rabbits to react to the protein in the solution in each case. No rabbits died from a violent reaction.

Inoculation:	1/4cc	1/2cc	1/2cc	1cc	2cc	2cc
No. of days between inoculations:	5d	6d	6d	8d	13d	

The rabbits were bled 16 days following the last inoculation. The serum was separated from the clotted material the following day and later centrifuged.

After several unsuccessful attempts it was found that a slight cloudiness in the pollen extract was masking the reactions between the serums and pollen extracts. However, further centrifuging cleared the extract. Finally good reactions were obtained between the serum and protein of each species, indicating that the inoculation treatment of the rabbits had been successful.

As had been anticipated the pollen extracts of red spruce reacted strongly with red and black spruce serums and the pollen extract of black spruce reacted strongly with white spruce and red spruce serums, indicating common components in all three pollens. This will be investigated further in 1955. By using different dilutions of these serums and cross absorption it is hoped that the degrees of relationship between these three species will be indicated.

Air-layering Experiments

Air layering techniques were employed in an effort to vegetatively reproduce white, red, and black spruce; balsam fir; white, red, and jack pine. Air-layering was attempted on both suppressed and dominant branches of mature and immature trees. These studies were started in May and June.

Green sphagnum moss was used as the rooting medium. It was held snugly against the branch by polyethylene film. The film was sealed on the branch with Scotch Electric Tape. An eight-pound kraft paper bag was hung over the air layer on each branch to help keep the sphagnum moss cool.

Three air-layering techniques were employed on black spruce.

(1) The sphagnum moss was placed around the branch as described earlier.

(2) The twig was girdled and treated as described above.

(3) The twig was girdled, treated with a commercial rooting hormone mixture (Stim-root) plus the above treatment. In the fall the layers were inspected. Binoculars were used in some cases. Those having roots showing beneath the polyethylene film were removed from the tree and potted.

Suppressed branches of young black spruce and red spruce trees were the only ones which had successfully rooted in the fall. Twenty per cent of the suppressed branches of black spruce rooted. Of this one-half had received hormone treatment, one-quarter girdling treatment and one-quarter sphagnum moss treatment. The branches which had not rooted in the fall will be examined this spring.

Appendix "L"

REPORT TO THE COMMITTEE ON FOREST TREE BREEDING (1955 MEETING).

by

Lévi Chouinard

Faculty of Forestry, Laval University

Quebec

An attempt has been made to propagate vegetatively through air-layering some of our hardwoods and conifers. The species investigated were: Red Oak, Red Ash, Sugar Maple, Silver Maple, White Birch, Aspen, White Poplar, Balsam Fir, White Pine, Red Pine, White Spruce and Tamarack. All trees were 10 to 15 years old and were growing 6 feet apart under nursery conditions. The air-layering method used is essentially that described by Mergen (Naval Stores Rev. Oct. 1953). The branches selected for rooting are prepared by removing completely a 1/4-inch wide ring of bark and cambium. Moist fresh sphagnum moss, commercial peat moss, or vermiculite is then wrapped around the treated part and covered with a sheet of moisture-proof polythene plastic. Both ends of the polythene film were wrapped tightly with grafting tape so that no evaporation from the rooting medium occurred.

In some cases, napthalene acetic acid or indole-3 acetic acid in talcum powder (concentration of 50 ppm) was applied on the upper girdle of the wound in order to stimulate root formation.

All air-layers were made in June. After a couple of weeks or more, depending on the species and the position of the branch on the tree, a callus was formed at the level of the upper girdle of the wound. Later on roots sprouted from the callus and grew in the rooting medium. According to their capacity of forming calluses and roots, trees have been classified into three categories:

1) trees which form neither callus or root (Red Oak, White Pine, Red Pine and White Spruce),

2) trees which form a callus but do not form roots, (Sugar Maple, Aspen, Balsam Fir, Tamarack and Red Ash),

3) trees which form both calluses and roots, (Silver Maple, White Birch, White Poplar).

The application of hormones at the concentration used did not stimulate root formation. As a rooting medium, fresh moist sphagnum proved to be highly preferable to both peat moss and vermiculite.

Appendix "M"

TREE BREEDING SUB-STATIONS

Letter from

Dr. Heimburger

Southern Area

Holst suggests an area of 300 to 500 acres in the southernmost part of Ontario, but points out that Point Pelee National Park might not be suitable because of one-half million visitors to this park each year. My own experience in this respect indicates that protection of such an area from trespassing and against injury by domestic animals, game and vermin of all kinds is one of the most important requirements and will be quite a problem, especially as the area in question conceivably also will be used for the growing of some hardwood species. Therefore, I believe that an area of this size should preferably be located near a residence of a zone forester or a foreman in the employ of our Department, who would be able to look after it from time to time. Perhaps an area near the St. Williams Forestry Station would be most suitable, although not fully as satisfactory from a climatic standpoint than an area further to the south. The area would otherwise not need any continuous crew on it, nor any special buildings, at least not within the foreseeable future. If in the future the need for a tree breeding substation in Southwestern Ontario should arise, such an area could come under its administration. As there already is a greenhouse that will be used for routine grafting of seed orchard materials in the near future at the St. Williams nursery, it seems at present that an area quite close to St. Williams and operated in conjunction with the St. Williams Nursery or one of its annexes is the most logical choice. Holst proposes a more detailed inspection on the spot during this summer, after preliminary decisions have been arrived at. I understand that you have initiated the steps by means of which this can be achieved.

Northern Area

Holst wants about 200 acres for hardiness tests and provenance experiments with spruce on well drained soil near Cochrane. I believe this area will not need such an intensive protection against trespassing as the southern one, but that fully satisfactory fire protection might be one of the most important requirements. Illegal cuttings of Xmas trees may also become a problem in time. Such an area should not be too difficult to find and it should not become nearly as difficult a problem to make it ready for planting and to maintain as the area in Southwestern Ontario. The testing of hybrid aspens may also enter the picture at some future date on this area, and this would mean some intensification of the protection problem.

North-central Area

I want an area at about the latitude of Soo-Sudbury-North Bay, but with a moister climate than Petawawa. The area should comprise about 300-500 acres to begin with, but should be expandable to cover about 3 times that much. Because of geographic and climatic factors it is bound to become a larger forest tree breeding centre than Maple in the long run, and this should be kept in mind right from the start. In cost of establishment and maintenance it will probably occupy an intermediate position between the southern and northern areas. It would be important to keep it away from the smelter fumes of Sudbury and other industrial centres of that latitude, and otherwise in a fairly easily accessible locality. Provision should be made to have it staffed and equipped with nursery and greenhouse facilities reasonably soon after establishment.

Appendix "I"

Report to Committee on Forest Tree Breeding

Covering the studies in British Columbia up to December 31, 1954, carried out by W.A. Porter at Forest Biology Laboratory, 409 Federal Building, Victoria, B.C.

The objective of the work to date is essentially the testing of material selected from the field for resistance to disease. No controlled pollinations have been made. Most of the work has been testing white pine, *Pinus monticola* Dougl., for resistance to blister rust, *Cronartium ribicola* Fischer. Some initial work has been done on the testing of western red cedar, *Thuja plicata* D. Don, for resistance to cedar needle blight, *Keithia thujina* Durand.

White Pine Studies

A total of 97 pine trees have been selected in the field for testing to determine if they have true resistance or only apparent resistance. Testing involves artificial and natural inoculation of grafted scions from selected trees. To date 40 of the selected trees with controls have been propagated by grafting. Thirty grafts were generally made from each clone. Some were planted in the disease garden, (receiving natural and artificial inoculation) and some in a forest planting area (receiving natural inoculation only).

Very preliminary results from the first grafts inoculated show that with one exception they are free from cankers but show considerable needle flecking. The known susceptible control pines now have rust cankers. Much additional testing is required for conclusive results. It is proposed to establish that some degree of resistance exists before controlled pollination work is attempted.

Seed, scions and rooted material for testing have been received from Ontario, Wisconsin and Idaho and local scions and pollen have been exchanged. The second interim report on blister rust testing in British Columbia has been distributed.

Red Cedar Studies

The object of this study is to explain observed differences in the symptomology of adjacent red cedar trees on the basis of variation in host, fungus or microclimate. Scions from trees in different stands, different trees in same stand and different parts of the same tree were rooted. These were inoculated under several natural and artificial conditions. A report on this work is in preparation. Progeny testing following controlled pollination is contemplated if disease resistance appears in the scions under test. Progeny of a thuja cross reputed resistant in Denmark have been received for testing under B.C. conditions. Scions of *Thuja occidentalis* L. have been received for testing.

<u>General</u>: The following co-operative work is in continuous progress.

Scions from superior *Pinus contorta* individuals have been supplied to the University of Wisconsin. Scions or pollen from superior *Populus trichocarpa* individuals was supplied to Ontario.

Sitka spruce pollen (*Picea sitchenis* Bong) has been supplied to Ontario for crossing with *P. glauca*. Pollen from *P. glauca* has been received to make the reciprocal cross.

Appendix "J"

FOREST TREE BREEDING AND GENETICS AT

PETAWAWA FOREST EXPERIMENT STATION 1954

Mark Holst

1. General

The work during 1953-54 has mainly been in consolidating the existing program without initiating new experimental work. The bringing of research data and experimental files up to date has been completed.

On October 1, 1954, Mr. C.W. Yeatman was appointed as my assistant for the tree breeding projects. The Petawawa Forest Experiment Station tree breeding now includes two foresters and two technicians. Our most immediate needs are for a combined compiler and typist and a year-round labourer.

Other facilities are starting to get crowded. Soon the green-house and work rooms will be too small for the amount of material to be handled and new facilities are required to take care of the expansion. In all, the tree breeding projects have been growing at a bit faster rate than estimated.

2. Problem 1 - Selection, Breeding and Genetics of Spruce

Current work is concentrated on an investigation of material established in plantations and elsewhere to attain a sketchy idea of the problems involved in breeding spruce.

The provenance problem in white spruce was followed up with phenological observations of provenances grown at the Station. The data were compiled during the summer and it is evident that rather typical differences are in existence. A temperature-latitude cline is clearly indicated, and a summer precipitation cline mostly effective in Eastern Canada is strongly suspected.

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

In 1953 the C.P.P.A. was contacted for co-operation in provenance studies and selection of superior phenotypes of white spruce in the Great Lakes—St.Lawrence Forest Region. Cone production was extremely low over most of Ontario and Quebec, and only a few seed samples were obtained for the provenance experiment (1955 will probably be a poor seed year too, due to the very wet summer of 1954). However, using a new technique of fall grafting, it was possible to locate and collect scions from 23 elite white spruce and make about 1340 grafts of this material. Data were also collected for a pamphlet on selection of elite white spruce. This material has not yet been worked up.

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

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

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

Selection of Norway spruce resistant to the white pine weevil was continued. Single trees of a slender genotypical crown type are apparently highly resistant, but by no meams immune. Several such slender types have been found on the Station area and propagated for future use. Also plantations near Grenville and St. Jovite, Quebec, and in New York are under observation for future selection. It has furthermore been attempted to hybridize the susceptible Norway spruce with the resistant white spruce, but after several years'work we have not obtained one hybrid plant. As Norway spruce can hybridize with both Sitka and white spruce, and natural hybrids of Sitka spruce and white spruce have been found in northern B.C. and many places in Europe, it is now being attempted to establish a crossing bridge from Norway spruce to white spruce via Sitka spruce for transfer of the weevil resistance from white spruce to Norway spruce. My note in the New York Forester drew attention, and two experiments were placed on the west coast to try out if white spruce and Sitka x white spruce hybrids are resistant to the Sitka spruce weevil.

The spruce pollinating work was very limited this year due to absence of flowers. The few flowers that could be found in white spruce and Norway spruce were saved for pollination with Sitka spruce. However, the Sitka spruce pollen arrived late - too late to be used on isolated white spruce flowers. The Norway spruce flowers were almost closed, but pollination was attempted just the same. Most of the Sitka pollen was saved for pollinating white spruce in a northern and later flowering area, (Cochrane) for production of winter hardy white spruce x Sitka spruce hybrids. (Danish and German Sitka x white spruce hybrids have not been hardy at Petawawa).

The spruce breeding program in the spring of 1954 was planned for 150 pollinating bags, half of which were not used. Pollination on the Cochrane white spruce was done on open flowers.

The Sitka x white spruce crosses done for us in B.C. by Mr. W.A. Porter, did not pan out due to unforeseen difficulties.

Work Proposed for 1954-55

1. Make a set of self-pollinations in the three native spruces and in Norway spruce (as flowering is expected to be extremely low in 1955 this work may not be possible).

2. In co-operation with Mr. Porter in B.C. to make Sitka x white spruce crosses; and make the reciprocal cross (Petawawa and) on boreal white spruce.

3. Make further selection of elite white spruce in the Great Lakes--St. Lawrence Forest Region.

4. If white spruce cone crop is satisfactory to organize cone collections for the white spruce provenance experiment.

5. To select and propagate weevil resistant Norway spruce in Quebec and New York plantations.

6. To prepare the following publications: One on the white spruce provenance experiment; one on selection of elite white spruce; one dealing with the red spruce - black spruce problem.

7. To plant out a long string of spruce experiments.

List of Active Projects and Reports Submitted

Projects:

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

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

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

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

P-135 Investigation of the red spruce - black spruce problem.

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