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FORESTRY BRANCH
DEPARTMENT OF RESOURCES AND DEVELOPMENT

PROCEEDINGS OF THE FIRST MEETING OF THE

COMMITTEE ON FOREST TREE BREEDING

Held in Lecture Room, Forest Products Laboratory,
Metcalfe and Isabella Streets, Ottawa,
on 2 March, 1953, at 9 A.M.

Attendance

Mr. H. D. Heaney, Chairman -
Mr. A. Bickerstaff -
Dr. J. E. Bier
Dr. W. H. Cram
Mr. J. L. Farrar -
Mr. J. D. B. Harrison -
Mr. J. M. Holst -
Dr. A. W. S. Hunter
Dr. R. J. Moore
Mr. A. W. McCallum
Dr. E. C. Smith
Dr. C. C. Heimburger, Secretary

1. Introduction

Mr. Heaney opened the meeting and stated that the present Committee on Forest Tree Breeding is being sponsored by the Forestry Branch, Department of Resources and Development, and is the successor of the Subcommittee on Forest Tree Breeding, Associate Committee on Forestry, National Research Council.

2. Minutes

The minutes of the last, twenty-fourth, meeting of the Subcommittee on Forest Tree Breeding, Associate Committee on Forestry, were read and APPROVED.

3. Welcome

Mr. Harrison welcomed the members of this Committee under the aegis of the Forestry Branch, Department of Resources and Development, and outlined the history of the Subcommittee on Forest Tree Breeding, Associate Committee on Forestry. The Associate Committee on Forestry has now ceased to function. It has served a useful purpose, chiefly in sponsoring the preparation of a manual on the handling of woodlots and in urging the Dominion Forest Service to develop research in forest economics. Of the two major Subcommittees, the one on Forest Fire Research is now being succeeded by the Associate Committee on Forest Fire Research. The National Research Council has facilities for testing fire pumps, fire hose and other fire fighting equipment and thus has the means of active contribution to this phase of forestry.

The Subcommittee on Forest Tree Breeding is being succeeded by the present Committee. Suggestions about terms of reference for this new Committee will be welcome. The Committee is of value for the exchange of experience between workers in genetics and forest tree breeding and a valuable means for interchange of correspondence in

these fields. The Canadian Pulp and Paper Association is at present conducting a study of forest plantations established by the member-industries and sending out questionnaires. The aim is to ascertain which Companies have planted what tree species and with what success. The inquiry concerns the areas planted and is supplemented by a special questionnaire on individual plantations. The last paragraph in this asks whether the Company would be interested in setting out small provenance test plantations of the species used. The Quebec Forest Service is also interested in this study. Mr. Heaney remarked that this survey would reveal areas that could be useful to tree breeders.

4. Dr. Cram's Report

Dr. Cram presented a report on his work at Indian Head, Sask. (see Appendix "A"). It deals with, (1) Caragana, (2) spruce and (3) pine, as in previous years. In Caragana studies of seed maturity and viability, self-fertility and vegetative propagation are reported. In spruce, seed germination of Colorado spruce after cold water pre-treatment and stratification were compared and in pine, the preliminary results of a strain of Scotch pine were presented. Mr. Holst and Dr. Heimburger questioned Dr. Cram about several details of his Caragana work, particularly the self-fertility studies, and recommended more work with white spruce as being of importance to prairie shelterbelts. Mr. Bickerstaff inquired how far from Indian Head the work of Dr. Cram extended. The answer was: concentration at Indian Head, but the work with Caragana covered the prairies pretty well. The selections of white spruce made by Dr. L.P.V. Johnson outside of Indian Head were also included in Dr. Cram's work, while the Scotch pine strains were derived from materials grown at Indian Head. Mr. Harrison stated that a general survey of forest plantations in Saskatchewan has been under-taken by the Forestry Branch and a report on this is being prepared. The information about the seed source of the stock planted was often inadequate.

5. Dr. Heimburger's Report

Dr. Heimburger presented a summary of his report, as the main body of the report was not ready at the time of the meeting. The complete report (see Appendix "B") deals with work in white pine, aspen poplars, the establishment of an arboretum and the initiation of a new project, namely work with 2-needled pines, concerned largely with resistance to the European pine shoot moth which is becoming a problem in Southern Ontario. The work has been seriously hampered by lack of adequate assistance in the abnormally early spring of 1952, but it was still possible to follow the program of previous years. In white pine acquisition of new materials comprised scions of P. Hunnewellii, a natural hybrid of P. Strobus with P. parviflora dis-covered by A. G. Johnson on the Hunnewell estate in Wellesley, Mass. and the scions of Himalayan white pine obtained from high elevations in Pakistan in the fall of 1951 and now successfully grafted. Other important acquisitions were a fairly large shipment of various white pine scions from Denmark, of P. Peuce from Finland and of western white pine from B.C. Crossing of white pine was undertaken on a fairly large scale and involved 243 bags; inoculation with blister rust was also carried out on a larger scale than previously, thanks to the assistance from the Dominion Laboratory of Forest Pathology in Toronto. In aspen poplar the acquisition of new materials, especially silver poplars from several parts of Europe was continued on a fairly large scale. A giant type, perhaps triploid, of large-

tooth aspen was found at Maple, Ont., used in crosses and yielded numerous progeny. Cuttings of several poplar clones were distributed to three paper companies for trial plantings on their limits, and further propagation. In 2-needled pines, acquisition of scions of several exotic species was started and four crosses were made. The arboretum was supplemented with a large number of poplars and some pine grafts.

In discussion, Dr. Smith mentioned a biological survey undertaken in the Maritime Provinces; included in this were chromosome number determinations of native poplars. Thus far counts have been made on about 150 clones of Populus grandidentata, 200 clones of P. tremuloides and 75 clones of P. tacamahacca, without detecting any polypoidy. Mr. Harrison mentioned the Heron Bay project, undertaken in cooperation with the Ontario Paper Company, where a small experiment in girdling of selected trees, to induce increased seed production, was planned. Mr. Holst described the girdling experiments under way at the Petawawa Forest Experiment Station, to induce early and abundant flowering. Red pine was being partially girdled and open-grown trees on a sand plain were being treated with fertilizers. Early-flowering spruce were being selected and an instance of flowering nursery stock of Scotch pine was cited. Dr. Cram proposed experiments in lifting and root pruning of Scotch pine nursery stock, to induce early flowering.

6. Telegram from Mr. Carman

At about this time the following telegram arrived from Mr. R. S. Carman, of Angus, Ont.: "Unable to attend meeting due to illness stop hope you have a good session."

7. Mr. Holst's Report

Mr. Holst read his report on tree breeding activities at the Petawawa Forest Experiment Station (see Appendix "C"). It deals with white spruce, red pine, and other species of the Laricioneae group, jack pine and propagation techniques. In spruce provenance studies were continued. A refugium of white spruce near the Great Lakes is postulated. In Norway spruce, a correlation of weevil damage with crown form was found. In red pine, provenance studies were continued and crosses made between strains of different geographic origin as well as species crosses. Experiments to induce early and abundant flowering were continued. In jack pine, a provenance test was started and crosses made between different strains and with several other related species. Grafting was started in the new greenhouse, and experience gained in maintaining the grafts indoors. Transplanting of spruce and pine seedlings in the nursery was undertaken on a rather large scale.

In the discussion, Dr. Cram mentioned his studies of germination behaviour of white and Colorado spruce seeds in relation to dormancy and stratification requirements. Cone insects of pines are a problem in Saskatchewan; a chalcid infected about 50% of the seeds. A 3-way cross in pines was made, to determine combining ability. Dr. Heimburger asked if propagating materials of selected Norway spruce could be made available for establishing seed orchards elsewhere and Mr. Holst stated that these materials are being propagated as rapidly as possible for just such uses in the future. Mr. Bickerstaff suggested that the atomic energy plant at Deep River could be used for studying radiation effects on red pine and to

induce mutations in spruce but Mr. Holst was of the opinion that this would not be immediately useful. Mr. Heaney said that land for reforestation purposes had been made available by the Atomic Energy Commission at Deep River and some of it could be used for provenance tests, as part of a single reforestation project.

8. Dr. Hunter's Report

Dr. Hunter presented his report on the selection of elm for resistance to the Dutch elm disease (see Appendix "D"). The crosses U. pumila x americana was repeated using cut branches with flower buds in the greenhouse, but no true hybrids were obtained. To-date only one definite hybrid, obtained in 1949, is at hand. Resistant elm varieties have been imported from Holland. Several interspecific Ribes hybrids have been produced, that should be sterile, susceptible to white-pine blister rust and thus could be used in breeding work with white pines.

9. Work of Mr. Porter

Mr. Heaney asked Dr. Bier to describe the work of Mr. W. A. Porter in British Columbia. Mr. Porter has since 1952 been engaged in a survey of white-pine blister rust in B.C., mainly in the Coast region, and has selected trees free from disease under conditions of severe infection. Grafts from these trees are being inoculated with blister rust and tested further in a disease garden where they are subjected to natural infection. Scions are being exchanged with Dr. A. J. Riker in Madison, Wis. and Dr. Heimburger. Dr. Bier then mentioned a proposed new project dealing with a leaf disease of Douglas fir caused by Rhabdocline Pseudotsugae at Cowichan Lake. The disease attacks the blue form as well as the green form of Douglas fir with plenty of variation in susceptibility within both forms. There are two reaction types of the fungus, and one that never produces fruiting bodies. It is proposed to collect cones from individual trees susceptible to one form of Rhabdocline and to inoculate the seedlings, to study the inheritance of susceptibility to specific reaction types of the fungus.

10. Mr. McCallum's Report

Mr. McCallum gave a general account of the spread of the Dutch elm disease in eastern Canada since its discovery in Quebec in 1944. The distribution is now continuous from Windsor, Ont. to the original place of outbreak in Quebec. General measures of control of this disease have been discontinued. The Government of Canada is still responsible for the identification of the disease. We do not know at present as much about the distribution of Dutch elm disease in Canada as formerly because there is no longer an organized survey.

11. Dr. Moore's Report

Dr. Moore summarized the work of the past year (see Appendix "E") on cytogenetic studies in Caragana. As many species and forms of Caragana as possible have been collected at the Dominion Arboretum and chromosome numbers of seedlings have been determined. Caragana arborescens seems to be a complex entity and the seedlings of different varieties and sub-species intergrade. Much new material has been obtained from foreign botanical gardens. No interspecific hybrids have as yet been obtained. Dr. Cram asked if the cross C. microphylla x arborescens had been successful. The answer was: No.

12. Status of the Tree Breeding Committee

Mr. Heaney reiterated the statement of Mr. Harrison (see minute 3) and read a letter received from Dr. N. H. Grace, at present director of the Research Council of Alberta. Dr. Grace felt that he could no longer be a member of the Committee since its dissociation from the National Research Council and cited certain disadvantages of the new status of the Committee. Mr. Heaney was of the opinion that these disadvantages could be outweighed by closer association of the Committee with the Research Councils of several Provinces and suggested that Dr. Grace be retained as a corresponding member. Dr. Bier thought that the Forestry Branch was the logical organization to sponsor the Committee. Dr. Heimburger was of the opinion that other sponsors of forest tree breeding should be present at the meetings of this Committee. Dr. Smith stated that the Provinces could contribute more to tree breeding; the matter of expenses is an important part which should be considered by sponsoring organizations.

13. Functions of the Tree Breeding Committee

Mr. Heaney stated that the main function of the Committee should be to meet and to discuss the various phases of forest tree breeding. Dr. Heimburger asked about the relation of the Canada Forestry Act to forest tree breeding work. Mr. Bickerstaff replied that the Act possibly could be implemented to supply funds for forest tree breeding. Dr. Cram asked about the relation of the Forestry Branch to the Canada Department of Agriculture in matters of forest tree breeding and Mr. Heaney answered that it would be about the same as that under the former Subcommittee. Dr. Bier recommended two main functions of the Committee, namely, (1) an advisory function that should come from the workers to their sponsors and (2) the Committee should be a medium for work conferences. Mr. Heaney remarked that at the moment we are mainly discussing our work. Mr. Holst was also of the opinion that the Committee should advise on, promote and sponsor forest tree breeding. Mr. Farrar made two minor proposals, (1) lectures on forest tree breeding should be given at each of the forestry schools, perhaps every other year, to acquaint forestry students with our aims and methods, and (2) we should take steps to preserve genetically superior native materials. Logging, as carried out according to current methods, usually takes the best and leaves the worst--we should preserve superior stands or individuals. Mr. Holst stated that we should locate superior stands and preserve them, but that this would entail rather difficult administrative problems. He further recommended setting up of a fund for lectures on forest tree breeding. Mr. Heaney then summarized the present functions of the Committee as set forth in the second part of the terms of reference outlined at the 20th meeting of the former Subcommittee. Dr. Cram asked if the Committee eventually should handle forest tree breeding on a Canada-wide scale. The consensus of the opinion of the meeting was in the affirmative. Mr. Farrar moved that a committee consisting of Messrs. Heaney, Holst and Heimburger draw up new terms of reference. This was seconded by Dr. Smith and was APPROVED. Mr. Bickerstaff suggested that every organization concerned with the activities of this Committee should also receive a copy of the new terms of reference. Mr. Farrar recommended that the Forestry Chronicle should receive an abstract of the minutes covering about one-half page. This was approved by Mr. Holst and Dr. Bier. Dr. Bier suggested further that (1) the Minister of Resources and Development be asked to contact the heads of other organizations

concerned with forest tree breeding and request attendance of members to meetings of this Committee--this would give more bite in the organization at a high level, (2) we invite an outstanding geneticist in the United States of America to attend our meetings and (3) asked if the meetings always would be held in Ottawa. Mr. Farrar moved that the Secretary be authorized to submit a notice about the organization of this Committee to the Forestry Chronicle--a generalized idea of things being done. This was seconded by Mr. McCallum. It was further suggested that an editorial committee of two be set up for this, consisting of the Secretary and Chairman. Dr. Bier asked if the Committee would make steps to obtain financial help within the year. Dr. Heimburger asked for more cooperation from the entomologists which have been absent from the meetings for several years.

14. Provenance Studies and Acquisition of Materials

Mr. Holst outlined his current and proposed provenance studies with spruce and 2-needled pines. The aim is to study the composition of the species concerned in respect to climatic races and biotypes. This should form the basis of evaluation of available materials and be a guide to present and future breeding work. Some cooperation in this is being given by the Ontario Department of Lands and Forests. Further cooperation and assistance by the Provinces and the industry will be needed in the future. The Forestry Branch is already cooperating with Dr. Heimburger in strain tests of white pine.

15. The Disease Garden at Connaught Ranges

Dr. Hunter stated that the disease garden had been weeded in 1952. Mr. Holst had made a survey of the white pine there, and a report on this is available. Dr. Heimburger inquired about the observations made by Dr. Riley and Dr. Skolko on incidence of blister rust in the materials while they still were in the National Research Council nursery at Eastview, and at the time of setting out at the Connaught Ranges. It is important to follow the incidence of the disease within all populations tested by means of periodic observations. It has thus far not been possible to obtain the data from these earliest observations. These are needed for correlation with the more recent tallies, as an aid in the evaluation of the present materials. This should be done before it is too late to derive maximum benefit from the tallies. Dr. Bier promised to look into this matter, to obtain the missing old data and to direct a new tally of the white pine materials.

16. Membership and Officers

Mr. Heaney stated that it would be desirable to have the membership of this Committee restricted to active tree breeders and their sponsors. After considerable discussion about this matter, it was moved by Dr. Cram and seconded by Mr. Farrar to establish a membership Committee consisting of the Chairman and Secretary, to report to the next meeting. This was APPROVED. It was also decided to retain the present Chairman and Secretary for one year.

17. Adjournment

The meeting adjourned at 4.45 P.M. A recess for lunch from 12 noon to 1.30 P.M. was taken.

1952 Summary Report on Tree Breeding at the Indian Head F.N.S.

(W.H. Cram)

As previously reported the work was divided into three main projects: 1) caragana, 2) spruce, and 3) pine.

Caragana (C. arborescens, Lam.)

The influence of seed maturity upon viability of seed from caragana was investigated. When seed was harvested from four seedtrees on six dates, both size and viability of the seed increased with maturity. Maximum viability of caragana seed was attained 60 days after the date of first bloom, or, in other words, 16 days prior to natural maturation (and dehiscence) on the tree. (Incidentally, the seed of Colorado spruce was previously found to be fully mature 16 days prior to natural release.)

Self- and open-fertility determinations for 93 vigorous selections were carried out in 1952. As a result of fertility determinations for over 200 seedtrees since 1947 twelve caragana seedtrees have been selected for propagation into polycross tests. The twelve seedtrees were selected on the basis of either self-sterility, or low self-fertility, combined with a high degree of natural cross compatibility. It was found that the frequency distribution, for self-fertility values of 197 selections, exhibited asymmetry with positive skewness and negative kurtosis. This divergence, from the fertility curve expected for a normal population, indicated that the local collection of C. arborescens contained an excess of seedtree with low self-fertility. It is possible that selection for vigor may have been automatic selection for low sexual-viability, although this seems unlikely in view of the high cross-fertility of such selections. A more plausible explanation of the excess of low self-fertility seedtrees would be natural mass inbreeding within a limited population (i.e. sibbing between descendents of one small original seed collection.) By such a process self-fertility of the progeny would gradually decrease; however, this would also tend to be associated with reduced vigor. To offset such a possibility new seed collections from various origins are being made to ensure genetic diversity.

Vigor of inbred progenies resulting from the 1948 self-fertility determinations of 30 selections was recorded in 1952. Mean height of the 4-year-old progenies ranged from 80.0 $\pm$ 2.4 cm. to 164.4 $\pm$ 3.7 cm. Thus, the vigor complex of some seedtrees would appear to be twice as favorable as that of others. Inbred progenies seem to offer potentialities as parental material for increasing vigor.

Vegetative propagation studies with caragana demonstrated the superiority of cuttings over budding. Increased rooting of both hardwood and softwood cuttings was obtained by the use of hormones. Vermiculite proved superior to sand as a rooting medium. One polycross block was planted in 1952 with rooted cuttings from 12 selections, which demonstrated a fertility range from self-sterility to high self-fertility. Polycross progenies, which will be obtained from this planting by natural pollination, will evaluate combining ability for vigor as well as provide an estimate of the relationship between self-fertility of seedtrees and vigor of their progeny.

Spruce

The efficiency of cold water pretreatment, as a means of breaking dormancy of Colorado spruce seed, was investigated in 1952. Germination speed was materially increased by both the stratification and the cold water pretreatments. On the other hand, cold water pretreatment resulted in a lower germination capacity than stratification. It seemed evident that both 5 and 15 days pretreatment in cold water were excessive. Seedling progenies from 36 selections were transplanted into plots for vigor comparisons.

Pine

Data, pertaining to the vigor and productivity of six geographic races of Scotch pine, have been summarized in Table 1. These results, although based on very small samples incapable of precise comparisons, suggest the relative adaptability of the races under prairie conditions. The Finnish race exhibited the highest survival and the Scottish race the greatest vigor. However, it would appear that the Russian race demonstrated the best combination of survival and vigor. On the other hand, the Rigensis race, which exhibited inferior vigor, proved the most consistent producer of seedcrops.

Table 1. Survival, Vigor and Productivity of Seedtrees within Six Geographic Races of Pinus sylvestris
(originally 100 plants per plot)

Character	Geographic Races					
	Germ.	Riga	Scot.	Russ.	Aber.	Finn.
Year planted	1908	1913	1913	1913	1924	1924
Survival % in 1949	20	25	26	40	43	79
Height in 1949:-						
range (ft.)	31-46	24-39	30-49	25-42	18-33	19-29
mean (ft.)	39.8±1.1	28.4±0.8	39.5±0.9	34.9±0.7	25.3±0.7	25.0±0.3
D.B.H. in 1949:-						
range (in.)	4.6-9.2	2.6-8.4	4.6-9.5	3.1-7.7	1.5-5.9	2.5-5.0
mean (in.)	6.8±0.3	4.8±0.3	6.3±0.3	5.3±0.2	3.4±0.2	3.2±0.1
Trees with more than 25 cones in:-						
1947 (%)	?	20	31	35	53	58
1948 (%)	60	44	69	45	63	58
1949 (%) †	15	44	19	12	0	15
1950 (%)	0	36	0	2	21	0
1951 (%) ‡	?	?	?	?	?	?
1952 (%)	0	16	15	10	12	5
Average (%)	18.7	32.0	26.9	21.0	29.8	27.1

† - Frost on May 23, 1949, may have damaged floral organs and embryonic cones.
‡ - Squirrels removed 1951 seedcrop prior to record taking, only light crop.

Comparative data, concerning the 1948 seed and seedling characteristics for 121 seedtrees of Scotch pine races, appear in Table 2. The Rigensis race was outstanding for large seed size, while the Finnish race produced the smallest seed. The low viability (10-18%) manifested by seed from several seedtrees of the Finnish, Scottish and Russian race has been attributed to dormancy. No relationship was found to exist between seed viability and seed size or seed yield, although seed size was found to be associated with seed yield in a negative manner for some races. Absence of any association between germination capacity and seedling losses suggested the possibility that the progenies differed in their reaction to seed-bed diseases and/or other causes of seed-bed losses. It was evident that each race contained at least one seedtree capable of producing sufficient 1/0 seedlings to account for 60 per cent of the seed sown.

Table 2. Summary of Yield, Size and Viability of the 1948 Seedcrop and of the 1949-50 Seedbed Performance of the Seedlings from 121 Seedtrees involving 7 Geographic Races of Pinus sylvestris

Race	No. Trees	Seed Yield (Seeds/Cone)		Seed Weight (gm./1000)		Germination Capacity(%)		1/0 Plants* (% of Seed)	
		Range	Mean	Range	Mean	Range	Mean	Range	Mean
Finn.	44	8-33	20.8	4.6-8.4	6.2	10-72	40.0	8-57	29.8
Russ.	17	5-31	15.0	4.4-7.8	6.4	18-76	52.7	17-58	38.3
Aber.	15	4-25	12.5	5.2-7.9	6.7	25-81	56.4	18-59	39.8
Scot.	12	8-46	14.4	5.2-7.2	6.3	14-76	57.0	13-62	42.2
? †	6	12-31	18.2	4.9-8.2	6.5	44-84	60.4	29-60	46.2
Fren.‡	7	14-33	19.2	4.8-9.7	6.3	48-80	65.2	29-64	46.9
Riga	9	9-24	18.7	6.4-10	8.2	46-83	65.6	34-60	47.6
Germ.	11	9-29	18.4	4.8-9.0	6.6	43-85	65.6	32-73	47.3
Means			17.7		6.5		52.2		38.2

† - Selected seedtrees of unknown origin planted in 1908 and 1910.

‡ - Selected seedtrees from a 1906 plantation of imported French seedlings.

* - 1950 survival of 1949 germination in terms of % seed sown.

Report on Forest Tree Breeding in 1952

C. Heimburger

Working conditions

Lack of adequate assistance still hampered the normal progress of the work. In the fall of 1951 this caused a backlog of unfinished work in the nursery. In the spring of 1952, 74% of the required assistance in terms of man-days from the staff of the Station was available. The very rapid onset of warm weather at that time caused an unusual pressure of seasonal work and resulted in rather high mortality of the transplanted and outplanted breeding materials. The backlog of the fall of 1951 was then not regained. In the fall of 1952 still less assistance in terms of man-days was available from the staff of the Station than in the spring. At that time it was possible to employ a graduate forester on a temporary basis, which largely overcame the lack of assistance from the regular staff of the Station. The warm fall weather and late open season made it possible to continue nursery and other outdoor work beyond the normal span, and only then was the backlog from the fall of 1951 successfully overcome. It was then also possible to carry out much additional work, so that this situation was more favourable than during several previous years. The working conditions in the spring of 1952 were the worst encountered thus far at the Station, and any progress made during the year must be evaluated with this as a background.

As in former years, the work has been divided into 3 main projects: 1) white pine, 2) poplar and 3) arboretum. An additional project, dealing with the breeding of 2-needled pines and concerned largely with resistance to the European pine shoot moth, was initiated in cooperation with Mr. Holst of the Petawawa Forest Experiment Station.

White Pine

The object of white pine breeding is to select and produce strains having a high degree of inherent resistance to blister rust and a favourable reaction pattern in respect to weevil injury, and satisfactory growth rate and growth form. Such strains are required primarily for use in reforestation in southern Ontario and should also possess the necessary climatic and soil adaptation for this. The breeding program is concerned mainly with the testing, evaluation and propagation promising native white pine materials. It deals also with white pine of other regions and of other kinds, in order to introduce valuable characteristics from these into the production of superior new strains. As in former years, the main efforts were directed towards the collection of breeding materials and their testing and evaluation. A limited amount of breeding work was done with selected individuals of native white pine, and a number of crosses with these were effected.

The acquisition of new materials resulted in 1529 successful grafts of 69 clones and 5115 living seedlings and grafts of 33 populations. Most of the materials were collected in the form of scions in Harvard Forest, the Arnold Arboretum and the Hunnewell Estate in Wellesley, Mass. during a trip there in January. As in 1951, some Pinus Peuce materials were received from Finland. Western white

pine from British Columbia and a collection of various white pine scions from Denmark comprised other important acquisitions. The scions of Himalayan white pine obtained from Pakistan in the fall of 1951 and mentioned in last year's report, were successfully stored in snow over winter and grafted early in 1952, resulting in 105 successful grafts. The seeds of the wild form of Japanese white pine received during the summer of 1951 yielded 1127 seedlings. Two of the white pine test plantations established in 1951 were supplemented, one with 2 strains of about 2500 plants, and the other with 3 strains of about 6000 plants. An additional test plantation was established this year, containing 21 strains and about 12000 plants. Good seeds were harvested from all 4 crosses effected in 1951. These have since yielded a fairly large number of seedlings. White pine planted in Harrison Park, Owen Sound, flowered abundantly in 1952 and the following crosses were made with these as female parents:

x Hunnewellii (Strobus x parviflora)	15 bags
x Peuce 2 (Peuce x strobus)	62 bags
x monticola (rust resistant from Idaho)	51 bags
x pentaphylla (timber form of Jap. white pine)	72 bags
x rust resistant W.P. Pointe Platon, P.Q.	43 bags
	263 bags

Weather conditions were more favourable for infection with blister rust than in 1951. Mr. E. Eggertson, of the Dominion Laboratory of Forest Pathology in Toronto, was detailed to undertake all inoculations this year. Black currant leaves were used from the plants grown in a lath house in the nursery and from bushes grown for berries by farmers in the vicinity. Installation of watering facilities in the compartment with the white pine grafts greatly facilitated the work. In addition to 2122 grafts belonging to 179 clones, 592 control transplants were inoculated. Several of the grafts and controls inoculated earlier, 1950 and 1951, were beginning to show signs of infection. No seedlings were inoculated in 1952.

A small plantation of Korean white pine, just starting to flower, was found at the Provincial Forest Nursery in Orono and pollen from this was collected and sent to California, for crossing with Sugar pine. One such successful cross had previously been made there and it was desirable to repeat it on a slightly larger scale. The trees in question did not have a sufficient number of female flowers to make the reciprocal cross worth while. A trip was made to Pointe Platon in Quebec and pollen collected from 2 resistant white pine there. This was used in our own crosses and portions were sent also to Idaho and Wisconsin, for breeding work there. Two trips were made to Rochester, N.Y., to collect pollen of several 5-needled and 2-needled pines, used in crosses here and sent to Idaho and the Petawawa Forest Experiment Station. A good specimen of Himalayan white pine was found on the property of Glendon Hall in Toronto and its young cones were covered with cloth bags in the early spring, to prevent damage from insects. A fairly large number of good seeds were then harvested from these cones in the fall. These should yield a fair proportion of natural hybrids with native white pine, as usually is the case when the two species are grown and flower together. Cloth bags were also placed on all young cones resulting from last year's crosses. In this manner it was possible, for the first time, to harvest mature cones from the grafts in the nursery and to prevent their being picked by

trespassers. Outside grafting of white pine was again undertaken in early April, and was quite successful. A number of clones of western white pine from British Columbia and of Korean white pine from Orono were incorporated in the collection of this Station in this manner. June beetle larvae (white grubs) were quite destructive to some white pine grafts set out in the nursery and all new beds planted with grafts were treated with chlordane, to prevent further damage of this kind. In the fall of 1952 some white pine seedlings were sprayed with Z.I.P., a deer and rodent repellent, to find out if this was damaging to their foliage. No damage to the foliage was evident the following spring. This was done, because of heavy mouse damage to the tops of some of the grafts during the previous winter, and it was important to find out if they could be protected from similar damage in the future by application of the repellent. During the summer 17 plus-trees of white pine were selected and marked for future scion collection at the Petawawa Management Unit near Achray, and 64 trees in 3 plantations belonging to the St. Williams Provincial Forest Nursery.

Poplar

The main purpose of poplar breeding at the present time is the production of new strains of aspen poplars, for growing in southern Ontario. This is being accomplished through hybridization of native and exotic aspen species with various silver poplar materials, in order to transfer the good rooting capacity and resistance to rust from some of the latter to the aspens. The end product should be aspen-like in its ecological requirements, growth form and wood quality, and easy to propagate by means of stem cuttings and to establish in forest plantations on an industrial scale. Therefore, this project requires the acquisition and testing of silver poplar as well as aspen materials. A fairly large collection of scions of various silver poplars, mainly from the western Mediterranean region, was received early in the year from the Barres Arboretum at Nancy, France and another, of more northern materials, from the Arboretum Tennenhoft, near Hamburg, Germany. Rooting capacity tests with the silver poplar clones at hand did not disclose superior rooting from stem cuttings of more recently acquired foreign materials as compared with the silver poplar commonly planted in Ontario. In fact, silver poplars from Prince Edward and Dufferin counties in Ontario showed consistently superior rooting capacity and have the added advantage of flowering materials being immediately available for breeding. However, much additional material of this kind is gradually being grown and incorporated in the tests as it begins to produce cuttings in sufficient numbers. Thus the silver poplar from Hungary, of superior growing form, this year yielded some cuttings for such a test, as did the very rapidly growth silver poplars from Belgium. New silver poplar genes were also acquired this year in the form of a portion of pollen from Germany, which was used in a cross with one of our silver poplars. Since some silver poplars planted in southern Ontario have shown some of the best rooting capacities in the tests, more such material was collected in various places in southern Ontario, so as not to neglect the possibilities of this material while acquiring new materials from abroad. The joint C.I.F.-S.A.F. annual meeting in Montreal in the fall of 1952 was utilized in acquiring a fairly large collection of silver poplar and other cuttings from that city and its surroundings, with the generous assistance of the Montreal Botanical Garden.

Mr. J.A.C. Grant, of the U. of T., started some post-graduate work this year, comprising a study of the influence of length of day on the growth of aspen and jack pine. For this purpose he collected aspen seeds, of both native species, from a wide latitudinal range in Ontario and Quebec. The seedlings for these experiments were grown at this Station and portions of each population incorporated in our collection. During a trip to the Arnold Arboretum in January, scions of Japanese aspen species, Populus Sieboldii, were obtained and successfully grafted in the greenhouse. Additional scion material of large-tooth aspen was obtained from the Lakehead region, from the northwestern most part of the range of this species. A specimen of largetooth aspen, with very large leaves and other "giant" characteristics was located at this Station, investigated for pollen size and used in breeding. Although the actual chromosome count has not yet been made, it is suspected that this tree may be triploid and, therefore, of very great potential breeding value. It is being propagated, to supply material for more detailed cytological investigations. Additional material of the dwarf, early flowering form of trembling aspen was also assembled and propagated to test it for its flower inducing capacity when used as a stock in grafting for other aspen and silver poplar materials. Some new European aspen materials were received from Norway and Holland. A promising clone of Czechoslovakian aspen was propagated for further tests after the original tree was girdled by mice during the winter of 1951-52, and was thus saved from extinction. The following successful poplar crosses were made during this year:

Population No.	Female parent	Male parent	Living seedlings in 1953
37	alba (Lawrence Park)	grandidentata (Maple)	66
40	grandidentata (Minaki)	alba Bolleana (Toronto)	3
41	grandidentata (Maple)	grandidentata, giant (Maple)	25
42	canescens (Ottawa)	grandidentata (Maple)	51
43	alba (Ottawa)	grandidentata, giant (Maple)	770
44	alba (Ottawa)	alba (Germany)	58
45	grandidentata (Maple)	alba (Germany)	3
54	alba (Germany)	alba (Germany)	2
			978

Some attempts to cross silver poplar with Lombardy poplar and with an European cottonwood hybrid were unsuccessful; some aspen crosses did not produce seeds because the catkins failed to mature. A number of rooted cuttings of a natural P. alba x grandidentata population, selected for good rooting capacity from stem cuttings, were sent to the Provincial nursery at Fort William, for further propagation and testing in that area, in cooperation with the Great Lakes Paper Company. A fairly large number of poplar cuttings of several clones, consisting mostly of cottonwood and balsam poplars and their hybrids, were given to the Howard Smith Paper Mills Ltd. in Cornwall, to be grown in their recently established poplar nursery there, for testing and propagation in that region. Some cuttings of hybrid cottonwoods were again given to the nursery of the Ontario Paper Company at Gore Bay. In connection with a field meeting of the New York Section of the S.A.F. in the southeastern portion of New York State another "giant" form of largetooth aspen was discovered on

the Delaware River. Later, scions were obtained and successfully grafted at this Station. In 1951 a beginning was made of a reference collection of herbarium specimens of all poplar species and hybrids grown at this Station. This collection was considerably enlarged in 1952, especially in regard to the now rather extensive silver poplar and aspen hybrid materials.

2-needled pines

The breeding of 2-needled pines was initiated with the chief aim of finding resistance to the attacks of the European pine shot moth in some species belonging to this group. By means of appropriate crosses it might be possible to incorporate this resistance into the native red pine, a species of great economic importance and most extensively used in reforestation in Ontario and elsewhere. The results of the red pine girdling experiment in Vivian Forest, to enhance flowering, are of basic value to this project. The discovery of a plantation of Japanese red pine in Midhurst, in 1951, is also of value as this species might be used as dwarfing stock, to induce early flowering of breeding materials. Some preliminary work in interspecific hybridization within this group has been done recently at Philadelphia, and results of older work in Europe and the U.S. have been published. Some of the experience in grafting of white pine might also be applicable to this group.

A fairly large collection of scions of several exotic species, related to red pine, was obtained in Rochester and at the Arnold Arboretum and successfully grafted outside on young Scotch pine. Some scions from plus-trees of Corsican pine were received from England, and of several other species from Denmark. All available cones were collected from the Jap. red pine at Midhurst and the seeds were sown there and at the Petawawa F.E.S., to produce stock for grafting. Seedlings of Jap. red and Jap. black pine were also raised at this Station, for further selection work and grafting. The following crosses were made:

Austrian pine (Glendon Hall)	x Jap. black pine (Rochester)	24 bags
Mugo pine (Maple)	x Austrian pine (Glendon Hall)	50 bags
Scotch pine (Maple)	x Austrian pine (Glendon Hall)	50 bags
Jap. red pine (Midhurst)	x red pine (Mixture of pollen of 4 origins)	67 bags
		191 bags

Pollen of several species was collected in Rochester together with pollen of several white pines, and used at this Station. It was also stored for further use and sent to the Petawawa F.E.S. for use there on native red pine. The red pine girdling experiment at Vivian Forest was continued. Again this year there were more flowers and young cones on the average girdled tree than on the controls, and more of the girdled trees had flowers and cones than the controls. The trees were not re-girdled this year.

Arboretum

The purpose of the breeding arboretum is to constitute a collection of breeding materials serving the 3 main projects reported on above. A large number of poplars were set out in the poplar arboretum. Heavy mouse damage occurred in the winter of 1951-52 and much pine and poplar material had to be re-grafted in

the spring, to save it from extinction. In the fall of 1952, all pine grafts and selected trees and all poplars in the arboretum and in the nursery were supplied with wire netting sleeves near the ground. Heavy applications of warfarin in the nursery were also made. This effectively reduced the mouse damage during the following winter to an insignificant level. Miss Little, of Richmond Hill, prepared a detailed plan of the northern part of the property of the Station, for an extensive arboretum, but no further work was done in this direction.

Other work

A seminar on forest tree breeding was conducted at Harvard Forest, during the scion collecting trip there in the winter. The report on the trip to Europe, made in the spring of 1951, submitted in July 1951, was finally published in September 1952. The tree breeding section of this Station was visited by Mr. J. Walker, superintendent, Forest Nursery Station, Indian Head, Sask., and by Mr. B. Harkness, taxonomist, Highland Park, Rochester, N.Y. A shipment of scions of Larix Lyallii was obtained from Lake Louise, Alta. and shipped to Denmark and Finland. A collection of aspen and birch scions was obtained from S.E. Alaska and shipped to Finland. A collection of seeds of red pine, of different geographic origin, was assembled and sent to Germany. Aspen pollen was again produced in fairly large quantities and sent to several European countries for hybridization work there.

Appendix "C"

Report of the Tree Breeding Activities at Petawawa Forest Experiment Station

1952

M. Holst

The tree breeding work at Petawawa has been centered around obtaining more information about the species we are to work with. This has led to a reorganizing of the existant projects and brought about outlines of the general problems we have at hand and suggestions of how they may be solved.

Spruce

The provenance experiment in white spruce was followed by measurement of annual growth etc., and the measurements must be continued for one more year before the results can be published.

Our main effort has been to get the planted red spruce started and the cone collection organized. To that end a trip was made to the mountains of easterm U.S. to make arrangements about cone collection and to study the red spruce of the south.

Information has been gathered about white spruce and black spruce to make it possible to draw plans for provenance experiments with these species. A trip was taken during the summer from Petawawa to Manitoba and following the southern boundary of white spruce through the Lake States.

The flowering in white spruce was very light in the spring of 1952 and the following crosses were made:-

	No. Crosses	No. Bags	No. Cones	No. Seed
White Spruce	7	33	65	1840
Norway Spruce	14	77	65	3100

An investigation was made of white spruce in the Petawawa area to see if the branching habit is correlated with yield. Such correlation was not found and the collected information may at a later date be used for a growth study of this species.

Another study was made of the white pine weevil damage on Norway spruce. A correlation was found between narrow crown - brush spruce - light weevil damage on the one side and broad crown - comb spruce - heavy weevil attack on the other side.

A study has been started of the black spruce - red spruce problems. Several hybrid swarms have been located and described in Quebec. Further material must be collected before any definite conclusions can be made.

Red Pine

A nursery provenance experiment in red pine was laid out with 9 provenances mainly from Ontario. A similar experiment with 13 one parent progenies was also planted in the nursery. Twenty-four new provenances were sown in the nursery as a preliminary test of the provenance material for a large scale provenance experiment. The strains we have obtained for this experiment so far are:

S. 1712, Raco, Michigan, U.S.A.
S. 1713, Trout Lake, Wisconsin, U.S.A.
S. 1714, Petawawa F.E.S., Ont.
S. 1715, Thessalon, Ont.
S. 1716, Point aux Pins, Sault Ste. Marie, Ont.
S. 1717, Regina Bag, Ont.
S. 1718, Sturgeon Falls, Ont.

Strains from extreme eastern and extreme western areas are still lacking after two years of request.

Not one cone was obtained in the fall of 1952 of the 16 red pine crosses made in the spring of 1951 with a total of 145 bags, the reason being a severe attack of several cone insects. (Conopthorus resinosae). Spraying with D.D.T. was started June 25 but was obviously too late. If a successful breeding program is to be undertaken in red pine some kind of control must be found.

The breeding work in red pine during the spring of 1952 was partly an attempt to cross different provenances (with pollen stored for one year) to the Petawawa type and partly to cross red pine with other species. The following crosses were made:

Provenance hybrids:

Petawawa X	(Cutfoot Exp. For., Minnesota, U.S.A.
	(Cedar Lake Field Sta., Vermilion Bay, Ont.
	(Grand Lake, N.B.
	(Sault Ste. Marie, Ont.
	(Massey, Ont.
	(Rochester, N.Y.

(13 crosses and 190 bags)

Species hybrids:

Pinus resinosa X	(P. nigra var. austriaca X densiflora
	(P. nigra var. austriaca
	(P. nigra var. monstrosa
	(P. densiflora X sylvestris
	(P. densiflora
	(P. Thunbergii

(10 crosses and 140 bags)

The study of how to get red pine to flower early and abundantly was continued.

A preliminary study of shoot moth resistance in the Lariciones was started in co-operation with Dr. C. Heimburger.

Jack Pine

A nursery provenance experiment including 14 strains of jack pine was laid out with 1/o seedlings.

Seed for a large scale provenance experiment was obtained and the following lots are now in storage.

S. 1812 Vermilion Bay, Ont.
S. 1813 Kenora, Ont.
S. 1814 Barry's Bay, Ont.
S. 1815 Stevens, Ont.
S. 1816 Douglas, Ont.
S. 1817 Chapeau, Que.

The results of the 1951 hybridization work turned out quite favourably. Sixteen crosses were made with 153 bags, and 191 cones were obtained which gave 2656 seed.

The hybridizating work in 1952 included 7 provenance hybrids (with pollen stored for one year) and 3 species hybrids. The following crosses were made:

Species hybrids:

P. banksiana X (P. contorta latifolia
(P. densiflora X sylvestris
(P. nigra X densiflora

Provenance hybrids:

Petawawa X (Smith, Alberta
(Chippawa Nat. For., Minnesota
(Grand Lake, N.B.
(Sault Ste. Marie, Ont.
(White Shell Forest, Manitoba
(Riding Mountain, Manitoba
(St. Williams, Ont.

Other hard pines:

Only few hybrids have been made with other hard pines and our main effort has been to get together material which may prove valuable for breeding with the native pines.

White pine:

The provenance experiment in white pine was completed and a nursery provenance experiment laid out with 2 strains. As a whole we are not working with white pine.

The disease garden at Conaught Range was measured and a report made.

Nursery Work:

About 90,000 1/0 pine seedlings were transplanted in the spring, but transplanting of 1/0 seedlings proved not to be successful as they are generally too small for the dry conditions in lower nursery. 2/0 transplanting may prove more valuable, but the transplanting had to be undertaken as we in 1953 have to concentrate on transplanting spruce. About 40,000 1/1 seedlings are found in the nursery and about 150,000 seedlings of various age are found in the seed-beds.

The green-house was used for the first time during the grafting season 1951-52. 761 spruce grafts and 628 pine grafts were made with a survival percentage as follows:

	May 12	October 3
Spruce	61%	13%
Pine	88%	22%

These poor results have many causes.

First we stocked the greenhouse in the fall with root-stocks and left the greenhouse cold until February, to save fuel. The root-stocks dried out and got sunscalled, which resulted in high mortality. To improve on this condition we have built a root-stock bench with heating cables and have this year successfully tried warm water to cut the pots loose from the soil.

Second we had difficulties keeping the greenhouse moist and cool enough to secure good survival of the grafted scions. It is especially difficult to keep the temperature down in the latter part of the winter, and during February and March it was difficult to keep up the relative humidity due to the condensing effect of the cold glass. This condition has been improved on by building plunge benches along the sides and plunge pits in the floor of the greenhouse and by using poly-ethylene bags on the plants left on the open tables.

Thirdly we may have to reduce the top of the root-stocks in a faster tempo as many grafts died after they had been placed in the cold frames. The callus forming was too heavy and the living scion was knocked off.

As the grafting was done by experienced grafters it seems that it is the technical problem of how to handle a greenhouse in a continental climate that we have to get acquainted with.

Outside grafting of one year old seedlings proved unsuccessful even when grafted with the pocket graft method, obviously due to the small size of the scion.

In a few years the Petawawa breeding project will have grown so big that additional staff will be a necessity. New foresters must be trained in good time to fill these requirements.

Report for the Committee on Forest Tree Breeding
From the Division of Horticulture, Central Experimental Farm, Ottawa
1952

A. W. S. Hunter

Breeding for Resistance to Dutch Elm Disease

The cross Ulmus pumila x U. americana was repeated in 1952, using cut branches in the greenhouse. Some seed was produced and seven seedlings were obtained. However, chromosome counts were made on these plants and all proved to be diploids, indicating that they are not hybrids but merely U. pumila self pollinated. Thus the only sure hybrid that has resulted to date from this breeding work is the one produced in 1949. This is a triploid which is strong evidence of its hybrid origin.

Further crosses, incorporating some modification in technique suggested by Dr. R. U. Swingle, U.S.D.A., Worthington, Ohio, will be made early this spring.

Reports have frequently been heard of vigorous off-type seedlings in nursery plantings of U. pumila for hedge purposes. These are referred to as hybrids by the nurserymen. It is probable that this is correct and that some may be hybrids with U. Americana. This summer we propose to visit the Brookdale-Kingsway Nursery at Bowmanville, to see if we can locate any such trees.

Reportedly resistant Dutch elm varieties have been imported for testing in this country. We now have growing in our nurseries the varieties Christine Buisman, Bea Schwarz and an unnamed selection of U. vegeta.

Artificial Inoculation at L'Assomption

A start was made in 1952 at the Dominion Experimental Station, L'Assomption, Quebec, on the artificial inoculation of elm seedlings with the Dutch elm disease organism. The majority of the inoculated trees exhibited symptoms of the disease and many were killed. However, three seedlings showed no symptoms. These may be escapes and they will be reinoculated in 1953. Vegetatively propagated plants of apparently resistant elms will also be available for inoculation in 1953.

It has been the experience of others that trees which appear resistant when inoculated the first or even the second time may become severely infected when inoculated the third season. Whether this is due to escape the first two years or to a new strain of the pathogen is not known, but it does not suggest too bright a future for this work.

Sterile Ribes for White Pine Blister Rust Studies

In 1951, crosses were made between rust susceptible varieties of black currant and red currant in order to produce for Dr. Heimburger plants that would be susceptible to rust but that would not produce fruit. Some of the resulting seeds germinated in 1952 and about 20 small plants of various parentages are now growing. These can either be grown on at Ottawa for another year or shipped to Dr. Heimburger at Maple this spring.

Cytogenetic Studies in Caragana in 1952

R. J. Moore

An attempt has been made to collect all available species of Caragana for the Dominion Arboretum and Botanic Garden. Seed received through the Seed Exchange Service has been germinated and the chromosome number of all collections has been determined. When sufficiently large, the plants have been identified with the aid of the monograph by Komarov and the Flora of the U.S.S.R. Ten species have been grown and their identification verified:

C. arborescens,	C. maximowicziana
C. microphylla	C. densa
C. boisii	C. conferta
C. fruticosa	C. frutex
C. aurantiaca	C. spinosa

The latter two species are tetraploid, the others, diploid, 2n=16.

The many variations of C. arborescens have been studied. Several subspecific entities have been described and it is frequently difficult to separate these forms and the closely related species C. boisii, C. fruticosa and C. microphylla. All of these entities intergrade very frequently; it is doubtful that C. boisii and C. fruticosa are entitled to specific rank.

Crosses in many combinations have been attempted between 8 of these species: C. conferta and C. densa are very slow-growing and have not yet flowered. These interspecific crosses have been unsuccessful: the species seem to be genetically very well isolated. Crosses between different forms of C. arborescens have set seed.

During the past year the work has been confined chiefly to taxonomic studies - the identification of the more troublesome entities.