

PROCEEDINGS OF THE EIGHTH MEETING OF

THE COMMITTEE ON FOREST TREE BREEDING

IN CANADA

Held at the University of New Brunswick,
Fredericton, N.B., August 16-18, 1962.

PART I

MINUTES AND DISCUSSIONS

Prepared and Distributed by the

Forest Research Branch

Canada Department of Forestry

Ottawa

PROCEEDINGS OF THE EIGHTH MEETING OF
THE COMMITTEE ON FOREST TREE BREEDING
IN CANADA

PART I

MINUTES AND DISCUSSIONS

CONTENTS		<u>Page</u>
A.	ATTENDANCE	1
B.	BUSINESS MEETING	3
C.	TECHNICAL MEETING	9
	1. Discussion of Progress Reports	9
	2. Panel Discussion: Provenance Tests	14
	3. Introgression of <u>Picea rubens</u> and <u>Picea mariana</u>	16
	4. Visitors' Program Reviews	18
	5. Films on Forest Genetics	21
C.	FIELD TRIPS	22
	1. Acadia Forest Experiment Station	22
	2. Nashwaak Valley and Napadogan	23

A. ATTENDANCE

R. K. Allen	Nova Scotia Department of Lands and Forests, Middleton, N.S.
F. C. Bent	Acadia University, Wolfville, N.S.
L. P. Chiasson*	St. Francis Xavier University, Antigonish, N.S.
B. W. Dance*	Canada Department of Forestry, Forest Entomology and Pathology Branch, Maple, Ont.
J. T. Dorland	Kimberly-Clark Pulp and Paper Co. Ltd., Longlac, Ont.

* Denotes Committee members before new members were elected at this meeting.

J. J. E. Dosne Canadian Institute of Forestry, Montreal, Que.

W. G. Dyer Ontario Department of Lands and Forests, Timber Branch, Toronto, Ont.

D. P. Fowler* Ontario Department of Lands and Forests, Research Branch, Maple, Ont.

A. G. Gordon Ontario Department of Lands and Forests, Research Branch, Sault Ste. Marie, Ont.

C. G. Heimbürger*
(Chairman) Ontario Department of Lands and Forests, Research Branch, Maple, Ont.

M. J. Holst* Canada Department of Forestry, Forest Research Branch, Chalk River, Ont.

J. W. Ker University of New Brunswick, Faculty of Forestry, Fredericton, N.B.

H. G. MacGillivray* Canada Department of Forestry, Forest Research Branch, Fredericton, N.B.

Francois Mergen Yale University, School of Forestry, New Haven, Conn., U.S.A.

E. K. Morgenstern
(Acting Secretary) Canada Department of Forestry, Forest Research Branch, Chalk River, Ont.

Louis Parrot Université Laval, Faculté d'Arpentage et de Génie Forestier, Québec, Que.

J. L. Pleunis Valley Tree Nursery Ltd., Fredericton, N.B.

Arne Rosholm Consolidated Paper Corporation Ltd., Grand'Mère, Que.

E. J. Schreiner U.S. Forest Service, Northeastern Forest Experiment Station, Upper Darby, Pennsylvania, U.S.A.

H. S. D. Swan* Pulp and Paper Research Institute of Canada, Montreal, Que.

Oscar Sziklai* University of British Columbia, Faculty of Forestry, Vancouver, B.C.

John Torunski New Brunswick Department of Agriculture, Forest Extension Service, Fredericton, N.B.

B. BUSINESS MEETING

Morning and Afternoon, August 16th.

Eight members attended the business meeting. In addition, fourteen guests and prospective members were present.

96. Welcome

Dr. Heimbürger called the assembly to order at 9:45 A.M. and welcomed all members and guests. Upon his request each participant rose and introduced himself to the group.

Dr. J. W. Ker, Dean of Forestry, University of New Brunswick, was introduced by Mr. H. S. D. Swan. Dr. Ker welcomed the Committee to the University. He stressed the importance of such meetings for the rapid exchange of information, and he expressed his hope that this meeting might be successful.

97. Minutes of the Last Meeting

Dr. Heimbürger noted that the minutes of the last meeting had been prepared and distributed to members by the secretary. He regretted that his own contribution, an up-to-date summary of tree breeding in Canada, had not been prepared as a result of his illness.

98. Terms of Reference

In accordance with a motion adopted at the last meeting, a revision of the terms of reference had been undertaken by Messrs. Swan, Heimbürger and Yeatman. The revised terms were now submitted to the Committee for approval. The discussion of this matter was chaired by Mr. Swan because Dr. Heimbürger was interested in voicing his opinion which as chairman he was unable to do.

Dr. Heimburger reviewed the history of the Committee. Its first meeting was held in 1937 under the sponsorship of the Associate Committee on Plant Hormones of the National Research Council. This meeting was designated as a "Conference on Forest Tree Breeding and Propagation". In 1939 the "Subcommittee on Forest Tree Breeding" was formed within the Associate Committee on Forestry of the National Research Council. Finally in 1953 the "Committee on Forest Tree Breeding" was constituted under the auspices of the Forestry Branch, Department of Resources and Development. Since then the federal forestry authorities have relinquished the sole sponsorship of the Committee and it is now supported by both federal and provincial forestry organizations, universities, and the forest industries. At the same time the Committee's functions have become broader. At the beginning all members were actively contributing, the meetings were closed and confidential proceedings were distributed to members only. Now the membership is not only much larger but also consists of three classes, i.e. (i) sponsoring members who support the work of active members by nature of their senior supervisory and administrative positions, (ii) corresponding members who have a general interest in tree breeding and wish to keep informed of the Committee's work, and (iii) active members who actually conduct work in tree breeding or closely allied fields. Further, distribution of the proceedings is not limited to members but open to fellow tree breeders throughout the world.

The Committee then turned its attention to the revised terms of reference, two drafts of which had been submitted independently by Mr. Swan and Dr. Heimburger. It was noted that both drafts stated the same principles, but that Mr. Swan's wording was somewhat briefer - and therefore preferable. The revised terms of reference, replacing the terms adopted

at the twentieth meeting of the Subcommittee on Forest Tree Breeding held in 1948, were then adopted unanimously on a motion by Swan, seconded by Fowler. The text of the new terms is as follows:

"The objectives of the Committee are:

1. To facilitate the exchange of information between all members (active, corresponding and sponsoring) of the Committee with regard to forest tree breeding, forest genetics and allied fields.
2. To maintain interest in and support for the work of the active members of the Committee."

99. Publicity

Dr. Heimburger noted that he is satisfied with the contribution of the Department of Forestry in co-ordinating the publication and distribution of the Committee's proceedings.

In further discussion members raised several points such as whether (i) the distribution of the progress reports prior to the meetings is really necessary, (ii) the proceedings should be distributed to members only, and (iii) the publication of the proceedings in a better form might not be possible.

Mr. Swan stated that the distribution of progress reports prior to the meetings is an excellent arrangement. But he felt that an extra publication is needed, in addition to the highly technical progress reports of the individual active members. He suggested the publication of a tree-breeding newsletter written in a language understandable to sponsors and other supporters. This newsletter would be more widely read than the proceedings, and by giving the highlights of each meeting, it would maintain interest and support.

Mr. Dosne said that he is in favour of such a newsletter and that it should be published in the Forestry Chronicle, possibly together with abstracts of the reports presented at meetings. Mr. Fowler felt that it would be best to publish one article only about each meeting and that the newsletter type of report should be submitted to the Forestry Chronicle. Mr. Swan agreed in general with these opinions but thought that abstracts would not be needed. Mr. Swan's suggestion was then put before the group in the form of a motion which was carried. It was also agreed that the outgoing chairman and secretary should write this newsletter. Mr. Swan offered his assistance.

100. Formalization of Co-Operative Arrangements
between Different Organizations in certain Breeding Projects

Dr. Heimbürger said that in co-operative projects involving several different provincial and federal departments, a more formal agreement seemed desirable than had been customary to date. As an example, he mentioned the form used by the Ontario Department of Lands and Forests when undertaking research projects involving several sections or branches of this Department. The following particulars were included: purpose of the experiment, the name of the project leader and of all other participants, and the estimated requirements with respect to materials and funds.

Mr. Holst felt that any arrangements should go through the top channels and include provisions to check on the progress of the experiment. At the same time formalities should be kept at a minimum.

Mr. Swan asked whether a copy of the form could be circulated to members. Dr. Heimbürger agreed and the secretary was asked to do this.

101. Membership

a. Planning of work and support of individual members.

A discussion arose on the question whether the Committee could exert some influence on the type of work being undertaken in forest genetics in Canada. Regarding the work of individual members who lacked adequate support by their employer, there was agreement that the Committee should try to improve the individual member's possibilities for more fruitful work. Regarding the work of the Committee as a whole, it was agreed that no joint plan of action could be devised and that co-ordination of efforts should be the Committee's function.

b. Changes in membership.

(i) Deceased members. Dr. N. H. Grace and Mr. G. C. Cunningham had died and the group rose in commemoration.

(ii) Resignations. Mr. J. S. Ball had informed the secretary that he wished to resign from the Committee.

(iii) Changes in membership status. Notification of the following changes had been received by the secretary:

From active to sponsoring membership:

Dr. R. Pomerleau

From active to corresponding membership:

Mr. A. Beckwith
Dr. A. W. S. Hunter
Dr. A. Lafond
Dr. E. C. Smith
Mr. J. Salm

From sponsoring to corresponding membership:

Dr. R. M. Balyea

(iv) New members. The following new active members were elected:

Dr. F. C. Bent, Acadia University;
Mr. J. T. Derland, Kimberly-Clark Pulp and Paper Co. Ltd.;
Mr. W. G. Dyer, Ontario Department of Lands and Forests;
Mr. J. C. Heaman, British Columbia Forest Service;
Mr. E. K. Morgenstern, Canada Department of Forestry;
Dr. L. Parrot, Université Laval;
Dr. P. J. Pointing, Canada Department of Forestry.

Mr. W. A. Reeks, Canada Department of Forestry, was elected sponsoring member.

As recorded in the minutes of the seventh meeting, the Committee had attempted to establish stronger ties to the Canadian forest industries. The response to a questionnaire mailed to forestry-conscious companies was favourable and most replied that they were interested in receiving the proceedings and in membership for one of their foresters. As a result the following men were elected corresponding members:

Mr. R. H. Armstrong, Spruce Falls Power and Paper Co. Ltd.;
Mr. D. D. Avery, The K.V.P. Co. Ltd.;
Mr. H. W. F. Bunce, Columbia Cellulose Co. Ltd.;
Mr. R. S. M. Bunney, Dryden Paper Co. Ltd.;
Mr. D. I. Crossley, North Western Pulp and Power Ltd.;
Mr. L. Holt, Bowaters Mersey Paper Co. Ltd.;
Mr. E. L. Howie, Fraser Companies Ltd.;
Mr. W. McGhee, Crown Zellerbach Canada Ltd.;
Mr. D. M. McLeod, Rayonier Canada (B.C.) Ltd.;
Mr. S. I. O. Rasmussen, Tahsis Company;
Mr. W. D. Start, The Ontario-Minnesota Pulp and Paper Co. Ltd.;
Mr. R. W. B. Thomson, The Ontario Paper Co. Ltd.;
Mr. T. G. Wright, formerly Canadian Forest Products Ltd.,
now University of British Columbia;
Mr. A. Rosholm, Consolidated Paper Corp. Ltd.;
Mr. G. R. Sonley, Marathon Corp. of Canada Ltd.

102. Location and Date of Next Meeting

Two possible locations were considered: the Southern Research Station at Maple and the Petawawa Forest Experiment Station at Chalk River. It was agreed that Chalk River appeared more suitable and that the meeting should be held there. The approximate date of this meeting will be August, 1964.

103. Election of Officers

Nominations for the positions of chairman and secretary were called for and ballots were held. Mr. M. J. Holst was elected chairman and Mr. E. K. Morgenstern elected secretary.

B. TECHNICAL MEETING

Afternoon, August 16th

1. Discussion of Progress Reports

Progress reports of 18 active members are published as Part II of the Proceedings of the Eighth Meeting. These constitute alphabetical sections in Part II as follows:

A - M. G. Boyer	K - W. H. Hancock
B - A. J. Carmichael	L - C. C. Heimbürger
C - L. P. Chiasson	M - M. J. Holst
D - W. H. Gram	O - H. G. MacGillivray
E - B. W. Dance	P - R. J. Moore
F - L. F. Ebell	Q - A. L. Orr-Ewing
G - J. L. Farrar	R - L. Parrot
H - D. P. Fowler	U - C. R. Sullivan
I - D. A. Fraser	V - O. Sziklai

During the technical meeting only the reports of the 8 active members present at this meeting could be discussed. A summary of this discussion follows.

L. P. Chiasson

Dr. Chiasson briefly reviewed his work in interspecific hybridization of Abies. He had experienced considerable difficulties with seed storage. Even A. balsamea seed used for control germinated poorly. He mentioned that in further studies it is planned to study fertilization and to try embryo culture.

In the discussion Mr. Holst suggested fall sowing to overcome poor germination. Dr. Mergen said that pollen collection, storage and shipment are more difficult in Abies than, for example, in Picea or Pinus, and that special techniques will have to be worked out. Dr. Heimburger concluded that Dr. Chiasson's work constitutes an important undertaking. At this stage it is valuable in working out the new techniques required and it could later lead to a larger program in which the crosses of A. balsamea with A. veitchii, A. sibirica and A. fraseri might be given special attention.

B. W. Dance

Mr. Dance is testing techniques for inducing disease in Populus species and varieties and is assessing the resistance of the hosts to different pathogens. In 1960 and 1961 he was working especially on Gloeosporium sp., Hypoxyton pruinatum, and Dothichiza populea.

Dr. Heimburger stressed the genetic aspects of such studies seen in a regional perspective. The native Populus grandidentata suffers little from Gnomonia but the hybrid Populus alba x grandidentata is susceptible while the Asiatic aspens P. sieboldii, P. tremula var. dauriana are very susceptible. He suggested bark grafting as an inoculation technique which is used by Dr. Ahlgren in Minnesota.

Dr. Chiasson asked whether any natural resistance to Venturia had been observed and Mr. Dance replied that his studies in this genus were limited essentially to establishing the taxonomic status of one Venturia species.

D. P. Fowler

Mr. Fowler's report described recent work dealing with inbreeding of Pinus resinosa and Pinus banksiana, and selective fertilization and grafting methods in Pinus resinosa. A discussion arose on the grafting of Pinus resinosa where he had tried different methods of scion storage and deep freezing.

Mr. Sziklai mentioned that he had good results with whip grafting. Mr. Holst said that in his experience fall-grafted scions seemed to survive at first but died later unless kept in a high-humidity environment. In interspecific grafting P. resinosa scions on P. sylvestris rootstocks died when man-high. Therefore P. resinosa should preferably be used. Dr. Schreiner agreed and said that it is always best to use rootstocks of the same species, especially for seed orchards. Dr. Heimburger remarked that incompatibility could sometimes be alleviated by deep planting.

C. C. Heimburger

Dr. Heimburger gave notice of one correction that is necessary in his report. The last sentence on page L-1 should begin: "Hybridization in 1960 was centered on intraracial work ...".

Referring to his breeding work for resistance to blister rust, he said the bottleneck is the amount of pollen available from a few trees that have shown to be good breeders. An example is the cross of Pinus peuce with selected Pinus strobus that yields many resistant seedlings.

When Dr. Heimburger's work with aspens was discussed where rooting ability is critical, Dr. Schreiner mentioned that Populus alba of Spanish origin has shown this ability. Mr. Sziklai, likewise, reported this from

Hungary. Dr. Heimburger agreed that southern sources are often favourable but stated that they do not lignify early enough in the fall. Dr. Mergen cautioned all users of the rooting chemical "Rootone" as its composition has been changed repeatedly.

M. J. Holst

Mr. Holst gave a brief summary of his work and mentioned some special problems. In nursery provenance experiments watering or available nutrients may lead to interactions that differ with the provenances, and this raises doubt as to the validity of some results, for example height growth differences. The black spruce-red spruce hybridization work, in general, has been disappointing in spite of good pollen germination. It remains to be seen whether this can be explained by (1) the unsuitability of pollination tents for black spruce, (2) regional differences in compatibility, or (3) the fact that pollen germination tests are not reliable indicators of actual pollen viability.

In surveying the possibilities of other species, Mr. Holst mentioned the limited value of the I.U.F.R.O. Norway spruce provenance experiment which had suffered from the white pine weevil. In larch experiments porcupines constituted a perpetual menace. On the other hand there are fewer dangers with jack pine which also grows fast and therefore is a promising species for the tree breeder.

In the discussion Dr. Heimburger disagreed with the idea of provenance hybridization with unselected trees in jack pine. He said that wolf trees might result. Mr. Holst conceded that this might happen but emphasized that one could not be certain before the problem had been studied. Regarding experiments in photo period, Dr. Heimburger thought the

long-day adaptation is dominant in many cases. As a result Norwegian aspen is unsuitable further south. In some other species and hybrids this trait is recessive and their progeny can be moved more freely.

Dr. Schreiner stressed the value of provenance tests based on single trees because of a large intraprovenance variance. He asked whether any weevil resistance had been observed in Norway spruce. Mr. Holst replied that provenance tests based on single trees were planned in the second stage after a large number of provenances had been compared. Regarding weevil resistance, few trees are completely free from attack but those that are attacked differ in their ability to recover. The ability to recover is therefore a better criterion of resistance than the presence or absence of the weevil.

L. Parrot

Dr. Parrot spoke briefly on his work at Laval University which he has begun recently. He was asked by Dr. Schreiner about the origin of his clones of Populus sp. and Dr. Parrot replied that these have come from the Ontario Paper Company at Thorold, Ontario, and from Europe.

O. Sziklai

In his report Mr. Sziklai had summarized all forest genetic studies at the University of British Columbia involving 15 investigators. His report also included a resume of a comprehensive study of basket willow grown on the Carpathian plain of Hungary. Measurements could be included that had been taken after Mr. Sziklai had come to Canada. Mentioning the results of five years of height measurements, Mr. Sziklai noted that first and second-year height differences did not prove to be reliable indicators

of total height differences measured at the end of the five-year period.

In the discussion Mr. Holst asked further details on Mr. Sziklai's wet-pollination method. Mr. Sziklai replied that Douglas-fir pollen is wingless, immediately wetttable and sinks in water, and can therefore be sprayed as a suspension on the flowers.

H. G. MacGillivray

In his recent work Mr. MacGillivray was concerned especially with provenance studies and trials of hybrids and exotics. Provenance experiments were initiated with Abies balsamea, Picea abies, P. rubens, and Pinus resinosa. Trials of Abies spp., Picea sitchensis, Picea glauca, and sitchensis x P. glauca hybrids have the aim of exploring their possibilities in humid East Coast areas, and to use them for breeding purposes. Mr. MacGillivray mentioned two reasons for working with Larix: (1) L. laricina appears to be the fastest growing conifer in New Brunswick, and (2) the porcupine is probably absent from Prince Edward and Cape Breton Island. This has encouraged further introductions of several lots of each of L. occidentalis, L. decidua, L. leptolepis, and of their hybrids.

2. Panel Discussion: Provenance Tests

Moderator in this discussion was Dr. Francois Mergen, Associate Professor, School of Forestry, Yale University. Panel members were Dr. C. C. Heimburger, Ontario Department of Lands and Forests; and Mr. M. J. Holst, Canada Department of Forestry. The participants had not been asked to prepare formal papers on their contribution as it was not planned to publish the discussion in full.

Dr. Francois Mergen

Dr. Mergen introduced the subject by stating that variation between trees arises in the course of evolution whereby selection pressure and manner of pollen exchange constitute two particularly important factors. The pattern of genetic variation may be explored by physiological tests in the laboratory and by field tests. He stressed the point that when planning field tests, it is not only necessary to observe statistical theories as applied in forest genetics (recently well discussed by Evans, Barber and Squillace in the Proceedings of the Sixth Southern Conference on Forest Tree Improvement), but also to consider practical questions such as the magnitude of the job involved in measurement and evaluation of the data.

M. J. Holst

Mr. Holst took the view of the forest geneticist interested in the pattern of natural variation as a basic scientific problem without immediate consideration to breeding. Considering the sampling design and layout for a field test, he contrasted an all-range provenance experiment with a limited-range experiment. In an all-range experiment one might collect seed in about 100 localities across several regions, use small plots and confine measurements and observations to a short period. In a limited-range experiment seed may be collected perhaps in 50 localities in one region only, using transects. With these 50 provenances one could use larger plots and extend measurements to a longer period than in the all-range experiment. But these were merely examples and the exact design would always depend upon the species and the exact aim of the investigation.

C. C. Heimburger

Dr. Heimburger discussed provenance tests as a problem in the applied science of tree breeding. How could provenance tests best be used to select material for improvement by breeding? Mentioning the steps to be taken, he stressed the importance of shortening and simplifying the breeding process by provenance selection and treatment. This should be done by introducing provenances from the optimum of a species' range and also the part that is climatically most similar to the region where they will be planted. Further, large amounts of seed should be obtained, and the material should be culled heavily in the nursery, discarding everything that does not compare favourably with native stock. The remaining material can then be established in a breeding arboretum.

3. Introgression of *Picea rubens* and *Picea mariana*

Two illustrated talks were presented on red and black spruce introgression by Mr. E. K. Morgenstern, Canada Department of Forestry, and Dr. A. G. Gordon, Ontario Department of Lands and Forests.

E. K. Morgenstern

Mr. Morgenstern pointed out that the taxonomic position of P. rubens and P. mariana is not clear in Canada. According to Roland's "Flora of Nova Scotia" and Marie-Victorin's "Flore Laurentienne" they are not easily distinguished. These works also contain inadequate descriptions of their distribution.

To study this problem, 26 provenances of sapling age now growing at the Petawawa Forest Experiment Station were subjected to morphological examination. These provenances, 12 of P. mariana and 14 of P. rubens,

sampled the eastern distribution area of P. mariana and the whole area of P. rubens, with the overlapping distribution areas from Pennsylvania north to Quebec, New Brunswick, and Nova Scotia. Anderson's hybrid index method was used and introgressive hybridization could be demonstrated by a comparison of population uniformity, and by character association analysis. Details of this study are also reported in the Proceedings of this meeting, Part II, by J. L. Farrar, page "Appendix G" and by M. J. Holst, page "M-3". It remained to be emphasized that introgressive hybridization did not lead to the loss of species identity in the population studied. This was shown graphically by plotting hybrid index range and mean of each population. Ranges of individual trees of red and black spruce overlapped in many populations, but the means, giving the average score of each population, remained apart. Thus analogous to the findings of other workers studying introgression, both species were more similar in the overlapping than in the separate areas of distribution, but in most cases have still remained distinct entities. Nevertheless, the narrowing of the gap between both species in populations of the overlapping areas explains the taxonomical difficulties mentioned above.

A. G. Gordon

Dr. Gordon has published several papers on the morphological characteristics of the spruces and has studied especially the distribution of P. rubens in Ontario where it occurs in isolated stands in several areas and is not well known. He stated that in Ontario it is found in Thornthwaite's B₃ and B₄ moisture regions, especially the Algonquin Uplands. The sites occupied vary and include slopes and plateaus where the species grows in association with yellow birch and hemlock, thus

showing considerable adaptability and tolerance of soils and competition. Dr. Gordon mentioned that he, too, had seen evidence of introgression but disputed that it occurs as extensively as claimed by Mr. Morgenstern. Often all three spruces, P. glauca, P. rubens and P. mariana grew side by side and could still be easily distinguished. This was shown by colour slides, taken from the ground and air, that were of considerable ecological interest.

4. Visitors' Program Reviews

The evening program of Friday, August 17th included two informal addresses given by Dr. Francois Mergen and Dr. E. J. Schreiner, and a film show.

a. Dr. Francois Mergen: Forest genetics research at Yale University.

Dr. Mergen's program of graduate training and research stresses the basic scientific principles of forest genetics. Nevertheless his review of some of the results, well illustrated by colour slides, showed that this program is most varied. In a discriminant analysis of Pinus thunbergii × Pinus densiflora hybrids 27 morphological and anatomical characteristics were used and by a step-wise regression analysis it was determined which of these could best be used to discriminate between the parents and hybrids and which would indicate hybrid vigour. Bud colour was the best discriminator for both species and the hybrid, and height growth the best indicator of hybrid vigour. Some further work included heritability studies in Picea abies, flower induction in Pinus palustris, the cytology of fertilization in Pinus nigra, inbreeding in Picea glauca, sex expression and hermaphroditism in Populus tremuloides, and experiments

with heteroplastic grafting. Provenance studies are also carried out in the field, and in the laboratory where controlled conditions of light and temperature provide for a more rapid and complete evaluation of racial differences than in field experiments alone.

Lately Dr. Mergen has initiated studies of the effect of gamma radiation in a joint program with the Brookhaven National Laboratory. Here attention will be focussed on the effects of radiation on the reproductive processes of oak and pine. Some results indicate that oak can withstand higher doses of radiation, apparently due to its greater nucleolar volume.

b. Dr. E. J. Schreiner: Planning for the next decade of tree improvement research in the Northeastern Region of the United States.

Dr. Schreiner is in charge of the forest genetics program of the Northeastern Forest Experiment station. This Station carries out all federal forest research in the twelve states north of Virginia. The genetics program is geared essentially to applied research. It was started in 1936 with three forest geneticists engaged at present. Some broad objectives of this program are to contribute improved trees for reforestation of the 4.9 million acres of plantable land and for interplanting in natural stands, and to carry out studies on mode of inheritance and heritability as a basis for the application of mass selection.

In considering problem selection, Dr. Schreiner emphasized that the genus, not the species, constitutes the individual improvement problem. Agricultural breeders have long recognized the value of this approach. They did not start with a single wild species but with mixed ancient stocks of unknown parentage, and they are still adding wild types to improve particular characteristics. When actually selecting the genera on which work is to be

done during the next decade, priorities could be assigned on the basis of either (1) present economic importance, or (2) forest area occupied by a particular species, or (3) improvement possibilities. Dr. Schreiner felt that the choice should be made on the basis of improvement possibilities. Based on past experience and experimental results in his region and elsewhere, he recommended the following priorities:

first priority: Picea, Pinus, Acer, Betula, Fraxinus, Populus;

second priority: Larix, Abies, Liriodendron, Prunus;

third priority: Tsuga, Castanea, Liquidambar, Quercus;

fourth priority: Chamaecyparis, Carya, Fagus, Magnolia, Platanus, Tilia, Ulmus.

For each genus specific study plans have been prepared, and taken together, the plans include work in 8 major fields: (1) improvement through breeding; (2) biosystematic studies of native species; (3) plus-tree selection and testing; (4) experimental seed orchards; (5) provenance studies; (6) clonal tests; (7) tests of promising exotics; and (8) research on the silvicultural and genetic aspects of genetic improvement of natural stands.

Dr. Schreiner stressed co-operation between various organizations and specialists. The search for plus-trees should not be undertaken by forest geneticists but by silviculturists with local experience. The establishment and maintenance of provenance tests is a job for silviculturists working in co-operation with forest geneticists. "Genetic improvement conversion" by planting of genetically superior stock into natural stands is likewise a silvicultural problem. This division of duties would make it possible for the forest geneticist to concentrate on the special genetic problems and thereby accelerate progress.