RESEARCH PAPER NC-5
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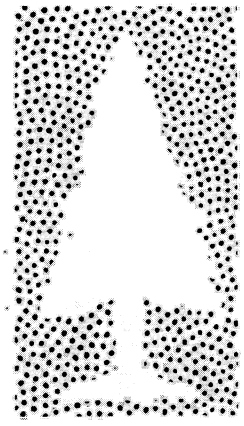
FOREST GENETICS and Related Research

at the LAKE STATES FOREST EXPERIMENT STATION



An Annotated Bibliography 1924-1965

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U. S. DEPARTMENT OF AGRICULTURE

CONTENTS

EXPLANATION OF LISTING

The 172 articles listed and annotated in this publication are the results of research by staff members (names printed in capital letters) and cooperators of the Lake States Forest Experiment Station. Since 1955, when the Institute of Forest Genetics was established at Rhinelander, Wis., most of the research reported has been done there. Previous publications were prepared primarily by Station staff members engaged in artificial regeneration research in various parts of the Lake States.

This Paper updates a list published in 1953 in "Proceedings, Lake States Forest Genetics Conference, March 31-April 1, 1953."[1/] The new list is especially timely because it is complete for genetics publications issued under the name of the Lake States Forest Experiment Station. Beginning in 1966, publications from the Institute of Forest Genetics (Rhinelander, Wis.) and other Station workers in Minnesota, Wisconsin, Michigan, Indiana, Illinois, Iowa, and Missouri will be issued under the name of the North Central Forest Experiment Station.

Included are a few papers that were based on research done before, but published after, the authors were employed by the Lake States Station. Such papers are identified by an asterisk (*).

The papers are arranged alphabetically by authors, but two indexes at the end provide references to each article by subject matter and tree species.

Note: Paul O. Rudolf, who compiled this list, is Principal Silviculturist, North Central Forest Experiment Station. The Station is maintained at St. Paul, Minn., by the Forest Service, U.S. Department of Agriculture, in cooperation with the University of Minnesota.

1/ Miscellaneous Report 22, Lake States Forest Experiment Station.

THE RESEARCH REPORTS

1. Anderson, Neil A., and RALPH L. ANDERSON. 1965. The susceptibility of jack pine and lodgepole pine and their hybrids to sweetfern rust and eastern gall rust. U.S. Forest Serv. Res. Note LS-56, 4 pp., Lake States Forest Exp. Sta., St. Paul, Minn.

   (Presents evidence that lodgepole pine and lodgepole pine x jack pine hybrids are more susceptible to sweetfern rust and eastern gall rust than is local jack pine.)

2. AREND, JOHN L., Norman F. Smith, Stephen H. Spurr, and Jonathan W. Wright. 1961. Jack pine geographic variation--5-year results from Lower Michigan tests. Mich. Acad. Sci. Arts, Lett. Pap. (1960 meeting) 46: 219-238, illus.

   (Two seed origins from western Lower Michigan grew significantly faster than any others in the test; they were followed by two from eastern Lower Michigan, several from Wisconsin and Minnesota, and last, four from Upper Michigan. There were also significant differences among provenances in the susceptibility to bark beetles, white pine weevil, and sawfly, but not in earliness of cone production, resistance to other pests, or oak-pine gall rust.)

3. AVERELL, JAMES L. 1927. The Swedish "Better Sires" campaign of 1904. J. Forest. 25: 742-744.

   (Describes Swedish experience with Scotch pine of wrong origin and efforts to promote use of local seed.)

4. BATES, CARLOS G. 1928. Tree "Seed Farms." J. Forest. 26: 969-976.

   (Points out the possibilities of and needs for seed farms. The use of both mature stands with proper cultural treatment and selection, and the development of young stands with their advantages, are thoroughly discussed.)

5. BATES, C. G. 1929. Some problems of seed production, collection, and distribution. Forest. Chron. 5: 17-29.

   (Stresses need to use seed of suitable geographic origin in reforestation and points out desirability of mother tree selection, progeny tests, and seed control - preferably voluntary.)

6. BATES, C. G. 1929. Why nurserymen prefer southern seeds. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 19, 1 p. Also J. Forest. 28: 232-233. 1930.

   (Points out that seed from the southern parts of the red pine range gives better germination, larger seedlings--and in a shorter time, and has heavier seed. Speculates that because of less favorable growing conditions in the southern localities (based on temperature, not latitude) only the heavy-seeded strains were able to survive generation after generation.)

7. BATES, CARLOS G. 1930. Review of "Racer af douglasie og sitkagran (Races of Douglas-fir and Sitka spruce)" by A. Oppermann. J. Forest. 28: 219-220.

8. BATES, CARLOS G. 1930. Review of "The varieties and geographical forms of Pinus pinaster Soland. in Europe and South Africa," by C. E. Duff. J. Forest. 28: 220-221.

9. BATES, CARLOS G. 1930. The frost hardiness of geographic strains of Norway pine. J. Forest. 28: 327-333.

(Results of an indoor experiment designed to "anticipate" field comparisons, which were started at the same time, show in general that seedlings from the cooler part of the range survived much better than those from warmer portions, although there were some deviations from the trend.)

10. BATES, C. G. 1931. A new principle in seed collecting for Norway pine. J. Forest. 29: 661-678, illus.

(Based on red pine cones and progenies from 39 Lake States and 2 New England sources, concludes that thin crowned trees generally produce more vigorous seedlings than heavy crowned trees of comparable size and age. Stresses that while the geographic origin and climatic adaptability of different strains are important in reforestation within a given locality, certain types of trees are much more efficient seed bearers than others.)

11. BATZER, H. O. 1961. Jack pine from Lake States seed sources differ in susceptibility to attack by the white-pine weevil. U.S. Forest Serv., Lake States Forest Expt. Sta. Tech. Note 595, 2 pp.

(Fifth and sixth year measurements of trees from 30 seed sources in a jack pine plantation near Cass Lake, Minnesota, showed significantly more weeviling in sources from Pine County, Minnesota; Douglas, Burnett, Marinette, Oneida, and Wood Counties, Wisconsin; and Gogebic County, Michigan, than was observed in the local source. No source had significantly less damage than the local source.)

12. BUCKMAN, ROBERT E., and ROLAND G. BUCHMAN. 1962. Red pine plantation with 48 sources of seed shows little variation in total height at 27 years of age. U.S. Forest Serv., Lake States Forest Exp. Sta., Tech. Note 616, 2pp.

(Average tree height among 8 regional groupings of Lake States red pine planted near Cass Lake, Minnesota varied only 0.7 foot from the grand average of 39.8 feet in a source-of-seed experiment. Of the 48 individual sources tested, only 1 near Ashland, Wisconsin, appeared to be significantly poorer than any of the others.)

13. CHURCH, T. W., Jr. 1963. Survival and growth of 12-year hybrid aspen compared to native Wisconsin stock. U.S. Forest Serv. Res. Note LS-22, 2 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(Twelve years after planting in northern Wisconsin in 1951, the hybrid Populus tremuloides Michx. (Massachusetts origin) X Populus tremula L. (Munich Germany) was superior to native Wisconsin Populus tremuloides in height, diameter, and percentage of survival. The native quaking aspen, however, had better stem form and considerably less canker.)

14. *CLAUSEN, KNUD E. 1962. Size variations in pollen of three taxa of Betula. Pollen et Spores 4: 169-174.

(Pollen of Betula pumila var. glandulifera was significantly smaller than that of B. papyrifera and of their natural hybrid and varied the least in grain size. The B. papyrifera pollen had most variation and could not be separated from the hybrid pollen on the basis of size.)

15. *CLAUSEN, KNUD E. 1962. Introgressive hybridization between two Minnesota birches. Silvae Genetica 11: 142-150.

(An analysis of a birch population in Minnesota demonstrated by means of a hybrid index and a pictorialized scatter diagram that introgression of Betula pumila var. glandulifera into B. papyrifera was taking place.)

16. *CLAUSEN, KNUD E. 1963. Characteristics of a hybrid birch and its parent species. Can. J. Bot. 41: 441-458.

(The ranges of variation in 24 morphological characteristics, 3 anatomical characteristics and 1 chemical characteristic were studied in a Minnesota population crossing of 150 Betula pumila var. glandulifera, 150 B. papyifera, and 47 individuals of their natural hybrid.)

17. *CLAUSEN, KNUD E. 1963. Introgression in Minnesota birches. In Proc. Forest Genetics Workshop, Macon, Ga. Oct. 25-27, 1962. pp. 55-58.

(Natural hybrids between Betula pumila var. glandulifera and B. papyifera occurring in a Minnesota bog were verified by means of hybrid index, pictorialized scatter diagram, and paper chromatography. The presence of eight backcrosses to B. papyrifera and the great amount of variation observed in this species suggest an introgression of B. pumila into B. papyrifera.)

18. CLAUSEN, KNUD E. 1963. Nursery selection affects survival and growth of birch. U.S. Forest Serv. Res. Note LS-31, 2 pp. Lake States Forest Exp. Sta., St. Paul, Minn.

(Survival of Betula pubescens and B. pendula plants after 9 years in the field was directly related to the initial size of the nursery stock. Height and diameter of the trees still reflected the original classification into large, medium, and small seedlings.)

19. CONLEY, WILLIAM T., DAVID H. DAWSON, and ROBERT B. HILL. 1965. The performance of 8 seed sources of ponderosa pine in the Denbigh Experimental Forest, North Dakota. U.S. Forest Serv. Res. Note LS-71. 4 pp. Lake States Forest Exp. Sta., St. Paul, Minn.

(The data strongly indicate that different geographic races of ponderosa pine do exist in the eastern outliers of the species, and that eastern Montana sources may be the best adapted to the northern Great Plains environment.)

20. DAWSON, DAVID H. 1965. A seed source study of ponderosa pine for the Great Plains Region. Cent. States Forest Tree Impr. Conf. Proc. (1964): 38-41, publ. by Neb. Agr. Exp. Sta., Lincoln.

(Reports the development and progress to date of a plains-wide ponderosa pine seed source variation study involving nursery and field testing of 80 seed sources.)

21. DAWSON, DAVID H., and Ralph A. Read. 1964. Guide for selecting superior trees for shelterbelts in the prairie plains. U.S. Forest Serv. Res. Pap. LS-13, 22 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(Discusses and illustrates desirable characteristics such as growth rate, crown form, and resistance to pathogenic and physiogenic diseases of 17 tree species; for use in selecting superior phenotypes for shelterbelt purposes.)

22. DICKERMAN, M. B. 1955. Recent progress in forest genetics work at the Lake States Forest Experiment Station. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 40: 1-3.

(During the last 2 years the Station has assigned 2 full-time scientists to genetics, selected a forest genetics field center at Rhinelander, Wis., begun construction work there, assembled laboratory equipment, started vegetative propagation studies in white spruce, assembled seed for a comprehensive variation study of white spruce, and developed cooperative projects with the University of Wisconsin and the Institute of Paper Chemistry. Reports recent results of seed source studies for red pine, jack pine, and the spruces and for tests of hybrids between lodgepole pine X jack pine and western white pine X eastern white pine.)

23. GEVORKIANTZ, S. R. 1955. Notes on statistical methodology in forest tree improvement work. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 40: 74-80.

(Outlines some statistical phases involved in the relatively new field of tree improvement work. Chief purposes were to show that only by the use of proper statistical methods can the effects of hereditary and environmental factors be distinguished one from the other. Coupled with a knowledge of genetic principles and the peculiar characteristics of the tree species involved, these statistical designs and techniques will contribute a great deal to the acquisition of the fundamental knowledge needed for tree improvement.)

24. HAISSIG, BRUCE E. 1965. Organ formation in vitro: A review of literature applicable to forest tree propagation research. Bot. Rev. 31: 607-626.

(Literature concerning the influence of auxins, adenine, kinetin, light, heat, time, age, and physical characteristics of the medium on in vitro organ formation by sterile seed-plant fragments is reviewed and integrated.)

25. HEINSELMAN, M. L., and E. I. ROE. 1963. The record of some Pleistocene trees and shrubs from Itasca County, Minnesota. Forest Sci. 9: 336-337.

(Wood specimens found beneath 100 feet of glacial drift in northern Minnesota proved more than 38,000 years old by carbon-14 dating, and included Picea, Larix laricina, Abies balsamea, Pinus banksiana, Populus, Alnus, Vaccinium (and cones similar to those of Picea mariana) showing that forests at that time were very similar to those of today.)

26. Jensen, Raymond A., T. Schantz-Hansen, and PAUL O. RUDOLF. 1960. A study of jack pine seed source in the Lake States. Univ. Minn. Forest. Note 88, 2 pp., illus.

(Included is a brief description of the study involving 29 Lake States seed sources set out in 17 plantations. Fifth year average results in height development are given for 6 Minnesota plantations.)

27. *KING, JAMES P. 1965. Seed source X environment interactions in Scotch pine. I. Height growth. Silvae Genet. 14: 105-115, illus.

(Describes 3- and 4-year height growth of 55 Scotch pine seed sources growing in test plantations in Michigan and Illinois, and discusses some causes and consequences of the seed source X environment interactions.)

28. *KING, JAMES P. 1965. Seed source X environment interactions in Scotch pine. II. Needle length and color. Silvae Genet. 14: 141-185, illus.

(Describes needle length and color of 55 Scotch pine seed sources growing in test plantations in Michigan, and discusses the effect of seed source X environment interactions on a selection program.)

29. KING, JAMES P., HANS NIENSTAEDT, and John Macon. 1965. Super-spruce seedlings show continued superiority. U.S. Forest Serv. Res. Note LS-66, 2 pp., Lake States Forest Exp. Sta., St. Paul, Minn.

(White spruce seedlings, selected for superior nursery performance, have maintained their height growth advantage over average 2-2 nursery stock after 7 growing seasons in the field. The "super-spruce" also show less damage from late spring frost than the average stock.)

30. KITTREDGE, JOSEPH JR. 1924. Review of "Tree ancestors," by Edward Wilbur Berry. J. Forest. 22: 210-213.

31. *LARSON, PHILIP R. 1957. Effect of environment on the percentage of summerwood and specific gravity of slash pine. Yale Univ. School Forest. Bull. 63. 78 pp., illus.

(A range-wide study of slash pine showed that summerwood percentage increased from north to south and from west to east. A number of environmental factors accounted for a large part of the variation in both summerwood percentage and specific gravity.)

32. LARSON, PHILIP R. 1958. Effect of gibberellic acid on forcing hardwood cuttings for pollen collection. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 538, 2 pp.

(Flower-bearing cuttings of red maple, paper birch, bigtooth aspen, quaking aspen, and pin cherry treated with gibberellic acid broke dormancy earlier and developed more rapidly than did controls.)

33. LARSON, PHILIP R. 1960. A physiological consideration of the springwood-summerwood transition in red pine. Forest Sci. 6: 110-122, illus.

(The transition from springwood to summerwood has been related to the cessation of activity of the terminal meristem. From experimental evidence, it was proposed that springwood formation results from high auxin activity, and the transition to summerwood occurs when auxin production declines.)

34. LARSON, PHILIP R. 1960. Gibberellic acid-induced growth of dormant hardwood cuttings. Forest Sci. 6: 232-239, illus.

(Gibberellic acid brought about a resumption of growth from different conditions of dormancy in several woody species.)

35. LARSON, PHILIP R. 1961. Influence of date of flushing on flowering in Pinus banksiana. Nature (London) 192 (4797): 82-83.

(Four-year-old jack pine trees were brought into the greenhouse at 4 different dates in early spring to test the theory that time of flushing may influence flower initiation. Pronounced differences in the number of both male and female flowers were noted for the various dates.)

36. LARSON, PHILIP R. 1962. The indirect effect of photoperiod on tracheid diameter in Pinus resinosa. Amer. J. Bot. 49: 132-137, illus.

(The influence of photoperiod on tracheid diameter was studied by independently exposing the buds and needles to different photoperiods. It is suggested that the effect of photoperiod is indirect and associated with the auxin production and distribution of the terminal meristems.)

37. LARSON, PHILIP R. 1962. Auxin gradients and the regulation of cambial activity. In Tree Growth (edited by Theodore T. Kozlowski), Ronald Press, New York, pp. 97-117.

(The development of the xylem is discussed in terms of (1) the initiation of cambial activity, (2) the formation of the annual ring, (3) the regulation of stem form. It is suggested that the size and distribution of the xylem tracheids are regulated by auxin gradients originating in the foliar organs of the crown.)

38. LARSON, PHILIP R. 1962. A biological approach to wood quality. TAPPI 45: 443-448.

(A unifying concept is presented in which all variations in wood quality can be related to crown development.)

39. LARSON, PHILIP R. 1963. The indirect effect of drought on tracheid diameter in red pine. Forest Sci. 9: 52-62, illus.

(Moderate drought conditions cause a decrease in tracheid diameter in the wood of the stem. It was suggested that the influence of drought was directly on the growth of the terminal meristems and only indirectly on tracheid diameter through the intermediate action of auxin.)

40. LARSON, PHILIP R. 1963. Stem form development of forest trees. Forest Sci. Monogr. 5, 42 pp.

(The biological concept of stem form, or stem taper, is discussed on the basis of a comprehensive review of the literature.)

41. LARSON, PHILIP R. 1964. Contribution of different-aged needles to growth and wood formation of young red pines. Forest Sci. 10: 224-238, illus.

(Each age class of needles contributes differently to total stem growth, distribution of growth along the stem, and the structure of the wood produced. The contributions of the needles also vary during the growing season.)

42. LARSON, PHILIP R. 1964. Evaluating the environment for studies of the inheritance of wood properties. In World Consultation of Forest Genet. and Tree Impr. Proc. Vol. II (7/1): i-v, 1-6.

(A unified concept of wood quality is presented whereby the effects of environment from many situations may be interpreted.)

43. LARSON, PHILIP R. 1964. Microscopic wood characteristics and their variation with tree growth. Int. Union Forest Res. Organ., Forest Prod., Sect. 41 Proc., Sept. 11-13, 1963, 24 pp.

(An attempt is made to relate different tracheid dimensions (diameter, length, wall thickness) to growth processes within the tree crown by tracing pertinent developmental processes.)

44. LARSON, PHILIP R. 1964. Some indirect effects of environment on wood formation. In "The Formation of Wood in Forest Trees," pp. 345-365, illus. New York: Academic Press.

(The role of environment, particularly photoperiod, light intensity, and drought, are discussed with regard to their influence on tracheid diameter and secondary wall thickening.)

45. LARSON, PHILIP R. 1964. Stem form and silviculture. Soc. Amer. Foresters Proc. 1963: 103-107, illus.

(Stem form, or stem taper, can be markedly altered by silvicultural measures such as thinning and pruning. In every case, the change in stem form is preceded by an alteration in crown size or vigor.)

46. LARSON, PHILIP R. 1965. Stem form of young Larix as influenced by wind and pruning. Forest Sci. 11: 412-424, illus.

(Removal of live crown by drastic pruning favored growth of the upper stem and decreased growth on the lower stem, whereas exposure to wind caused a pronounced downward shift of increment towards the stem base, most generally at the expense of upper stem parts.)

47. LARSON, PHILIP R., et al. 1962. The influence of environment and genetics on pulpwood quality: An annotated bibliography. TAPPI Monogr. 24, 316 pp.

(A comprehensively indexed bibliography containing 883 references with annotations.)

48. MCCULLEY, ROBERT D. 1953. The Committee on Southern Forest Tree Improvement. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 22: 48-49.

(Gives a brief discussion of the origin, development, and scope of activities of the southern regional tree improvement committee that was established in 1951.)

49. MCCULLEY, ROBERT D. 1958. Forest tree improvement activities at the Lake States Station during the past 2 years. In Third Lake States Forest Tree Impr. Conf. Proc. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 58: 30-34.

(Discusses Station progress during the past 2 years in physiology, white spruce grafting and breeding, nursery sowing of exotic species of known origin, assembling of seed of known origin of white spruce and eastern white pine from their entire ranges, studies of blister rust races, and maintenance of older seed source, hybrid pine, and species test plots. Plans are to expand genetics work.)

50. MCCULLEY, ROBERT D. 1958. Forest tree improvement in the Lake States. Wis. Christmas Tree Prod. Ass. Bull. 15: 3.

(Brief comments on forest tree improvement research in the Lake States and its potential value for Christmas tree growers.)

51. MCCULLEY, ROBERT D. 1963. Review of "Exotic Forest Trees in the British Commonwealth," by R. J. Streets (ed. by Sir Harry Champion), 760 pp., illus., Oxford University Press, N. Y. 1962. J. Forest.61: 306.

52. MACALONEY, H. J. 1953. Forest genetics problems in growing insect-resistant trees. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 22: 62-63.

(Surveys what is known about the resistance of trees to insect attack and concludes that, while there are a few leads, more research is needed before we can solve some of the factors that determine susceptibility or resistance.)

53. MEULI, L. J. 1936. Drought resistance of green ash as affected by geographic origin. Minn. Acad. Sci. Proc. 4: 38-42.

(See Meuli and Shirley, 1937.)

54. MEULI, L. J., and H. L. SHIRLEY. 1937. The effect of seed origin on drought resistance of green ash in the Prairie-Plains States. J. Forest. 35: 1060-1062, illus.

(Green ash seedlings of 39 seed origins from the Prairie-Plains region tested in a"drought machine" showed significant increases in drought resistance from south to north and from east to west, which was also correlated with regions showing the longest drought periods. Other factors which showed a south to north stratification were leaf color, seedling size, rapidity of germination, rate of growth, and time of dormancy.)

55. NIENSTAEDT, HANS. 1955. Problems of seed and pollen collection, shipment, and storage. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 40: 51-53.

(Surveys the problems and devotes special attention to pollen collection and storage. Briefly summarizes knowledge in this field and recommends that attention should be given to the development of better forcing techniques. Recommends that geneticists limit their requests for material and information to what is essential.)

56. *NIENSTAEDT, HANS. 1956. Receptivity of pistillate flowers and pollen germination tests in the Genus Castanea. Z. Forstgenet. Forstpflanzenzücht. 5 (2): 40-45.

(The Japanese and Chinese chestnuts studied were protandrous. Female flowers are receptive 5 to 13 days after beginning of anthesis of male catkins. Effects of emasculation on nut yield were studied and chestnut pollen germination techniques explored.)

57. NIENSTAEDT, HANS. 1956. The foundation for spruce improvement in the Lake States. Wis.-Mich. Sect. Soc. Amer. Forest.,pp. 17-28.

(A discussion of some of the methods used and results obtained in tree improvement work over the last decade. The characteristics of superior spruce trees are described in some detail.)

58. NIENSTAEDT, HANS. 1957. Review of "Plant Propagation" by John P. Mahlstede and Ernest S. Haber. J. Forest. 55: 383-384.

59. NIENSTAEDT, HANS. 1957. New tests for disease resistance in trees are needed. Der Züchter Suppl. 4: 84-87.

(Suggests that studies of the factors--particularly the chemical factors--causing disease resistance may reveal new methods for testing the resistance of host tissue directly. Discusses possible methods of approach to such studies.)

60. NIENSTAEDT, HANS. 1958. Height growth is indicative of the relative frost resistance of hemlock seed sources. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 525, 2 pp., illus.

(The severity of fall frost damage to 17 sources of eastern hemlock grown in northern Wisconsin was closely correlated to the climate at the location where the seed originated. Relative resistance to frost injury could be predicted on the basis of seedling growth under controlled indoor conditions.)

61. NIENSTAEDT, HANS. 1958. Receptivity of female strobili of white spruce. Forest Sci. 4: 110-115, illus.

(The period of receptivity of female strobili in white spruce was found to coincide with pollen shedding, to last 3 to 5 days, and to be quite uniform on an individual tree. An entire tree can, therefore, be pollinated successfully in a single operation at the time of maximum pollen shedding.)

62. NIENSTAEDT, HANS. 1959. The effect of rootstock activity on the success of fall grafting of spruce. J. Forest. 57: 828-832, illus.

(Results of fall grafting experiments with white spruce show that, while root stock activity at the time of grafting has little effect on survival and growth of the grafts, the right combination of chilling and daylength is essential. Discusses scheduling after grafting.

63. NIENSTAEDT, HANS. 1959. Fall grafting of spruce and other conifers. Plant Propagators Soc. Proc. 1958: 98-104.

(Briefly discusses the grafting of 10 species of spruce during September and October. By exposing the grafts to a combination of controlled daylength and low temperature, good results can be obtained with most species. Also discusses grafting of red and white pines in the fall.)

64. NIENSTAEDT, HANS. 1959. Forest tree improvement at the Northern Institute of Forest Genetics. In Proc. of the Comm. on Forest Tree Breeding in Canada, Part II, 1958: Q-13-16.

(Describes briefly some results in tree improvement and physiology and outlines the more important current work.)

65. NIENSTAEDT, HANS. 1960. The ecotype concept and forest tree genetics. In Fourth Lake States Forest Tree Impr. Conf. Proc. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 81: 14-25.

(Briefly discusses the objectives of studies of racial variation and methods of study. The patterns of variation within a native species in terms of ecotypes and clines are discussed.)

66. NIENSTAEDT, HANS. 1961. Induction of early flowering--a critical review of recent research. (Abst.) Vol. II, Ninth Int. Bot. Cong. Proc. (1959): 283.

(Distinguishes between flower induction--the induced production of flowers in material in a juvenile stage of development--and flower stimulation--the artificial augmentation of flowering in plants already capable of producing flowers. With this definition in mind, suggests that flower induction through common methods such as ringing and root pruning is likely to be ineffective. Calls for basic research on auxin metabolism and photoperiodism in relation to flowering.)

67. NIENSTAEDT, HANS. 1964. A look at forest tree improvement work in Scandinavia, West Germany, and Holland. J. Forest. 62: 456-462.

(Describes forest tree genetics and tree breeding work in Sweden, Norway, Denmark, West Germany, and Holland. Stresses research. Discusses the relationship between the research breeding approach and the forest management practices in evolutionary history of important European species.)

68. NIENSTAEDT, H. (n.d., circa 1965.) Red pine progeny test, 1931 and 1933 Minnesota planting. In Comm. Forest Tree Breeding Can. Proc. 9: 151-156. (Meeting of Sept. 16-18, 1964.)

(Discusses the results of individual tree progeny tests established in 1931 and 1933 with open-pollinated seed from 69 individual tree collections;

indicates that the differences in height and diameter growth, and survival of the progenies all were significant at the 1-percent level; expresses the view that, even though variation in red pine is comparatively smaller than in other northern conifers, an improvement program in red pine would be profitable; and recommends economic evaluation of such a program.)

69. NIENSTAEDT, HANS. 1965. Grafting northern conifers with special reference to white spruce. U.S. Forest Serv. Reg. 9 Nurserymen's Meeting Proc. (1965): 41-45.

(Presents a brief general treatment of grafting methods; states that grafting of white spruce can be extended over practically the entire year; discusses grafting crew organization and output.)

70. NIENSTAEDT, HANS, Franklin C. Cech, Francois Mergen, Chi-Wu Wang, and Bratislav Zak. 1958. Vegetative propagation in forest genetics research and practice. J. Forest. 56: 826-839, illus.

(Reviews some recent literature on the grafting, air-layering, and rooting of cuttings of forest trees. Stresses our lack of understanding of fundamentals controlling these processes, and pleads for more basic research on these subjects.)

71. *NIENSTAEDT, HANS, and Howard B. Kriebel. 1955. Controlled pollination of eastern hemlock. Forest Sci. 1: 115-120, illus.

(Tests of black cloth, white cloth, unpainted kraft paper, kraft paper painted black, kraft paper painted white, parchment paper, polyethylene, polyethylene and kraft paper, and sausage-casing bags in pollinating eastern hemlock in Connecticut indicated marked differences among the different types of bags in yield of viable seed. The highest seed yield per cone was given by the bags in this order: white cloth bags, parchment paper bags, and kraft bags. Other types of bags yielded very little viable seed. Presents the reasons for the results, including temperatures, moisture conditions within the bags.)

72. *NIENSTAEDT, HANS, and J. S. Olson. 1961. Effects of photoperiod and source on seedling growth of eastern hemlock (Tsuga canadensis (L.) Carr.). Forest Sci. 7: 81-86, illus.

(Thirty seed sources grown under controlled photoperiods and thermoperiods showed a distinct clinal variation pattern in their responses, but this does not exclude the possibility of relatively abrupt genetic changes either on a broad or local geographic scale. Determined "critial" photoperiod for vegetative growth to be 15 to 16 hours. Obtained best growth at alternating temperatures, with 27°C. day and 17°C. night being near the ideal.)

73. *Olson, Jerry S., and HANS NIENSTAEDT. 1957. Photoperiod and chilling control growth of hemlock. Science 125 (3246): 492-494, illus.

(The length of the period of the growth in hemlock is a function of photoperiod. Maximum period of growth, and therefore elongation, is obtained at a 20-hour photoperiod. Other phases of the growth, controlled or modified by photoperiod, are dormancy and seed germination.)

74. RUDOLF, PAUL O. 1932. A weevil-resistant strain of jack oak. J. Forest. 30: 749-750.

(Search for Quercus ellipsoidalis acorns in a poor seed year in Lower Michigan revealed a very small number of trees with predominantly sound acorns. Speculated that these might be resistant to weevil attack since it was such a prevalent condition.)

75. RUDOLF, PAUL O. 1936. Pedigreed trees. Minn. Conserv. 37: 4-5. June.

(Stresses the importance of using seed of suitable provenance and from good mother trees.)

76. RUDOLF, PAUL O. 1937. (Recommendations for improvement of forest trees.) U.S. Dep. Agr. Yearbook 1937: 1266.

(Indicates the need to extend source of seed tests, selection of individual trees and stands, progeny tests, hybridizations in a number of genera not previously worked on; and to study mechanism of inheritance in important tree species.)

77. RUDOLF, PAUL O. 1940. Review of "Fichtenformen and Fichtenrassen in Glatzer Schneegebirge (Forms and races of Norway spruce in the Glatz Schneegebirge)," by R. Hassenberger. J. Forest. 38: 979-980.

78. RUDOLF, PAUL O. 1947. Importance of red pine seed source. Soc. Amer. Forest. Proc. 1947: 384-398.

(Deals with the evaluation of a 16-year-old plantation of 37 seed origins which shows significant source-related differences. Goes into considerable detail especially on techniques, parent trees, and seed characteristics.)

79. RUDOLF, PAUL O. 1948. How about our seed supply? J. Forest. 46: 741-743.

(Points out the need for high-quality seed. Advocates tree-seed reservations of good trees or stands, along with the establishment of plantations for the purpose of producing high-quality seed. Mentions possibility of royalties to small owners. Points out the desirability of making and evaluating test plantations from each seed source.)

80. RUDOLF, PAUL O. 1948. Hybrid poplar planting in the Lake States. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 14, 17 pp.

(Plantings in Michigan, Minnesota, Wisconsin, and North Dakota of hybrids mostly produced by the Oxford Paper Company have given disappointing results. They cannot replace any of the species commonly used under ordinary planting conditions. In contrast, nursery tests gave fairly good results. The paper contains several tables giving growth, parentage, and ecological data for the various plantings.)

81. RUDOLF, PAUL O. 1948. Local red pine seed develops best plantations. U.S. Forest Serv. Lake States Forest Exp. Sta. Tech. Note 296, 2 pp.

(A 16-year-old plantation on the Superior National Forest showed that of 37 seed origins tested, those from home localities performed best and those from New England, Lower Michigan, and Central Wisconsin sources, worst based on survival, average height, average diameter, basal area per acre, volume per acre, trees of good form, proportion of better dominants and codominants, and volume per acre of satisfactory trees. See 78 for detailed reports.)

82. RUDOLF, PAUL O. 1948. Winter damage to Scotch pine in northern Minnesota. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 305, 1 p.

(Observations on the Chippewa National Forest in northern Minnesota in 19-, 17-, and 12-year-old Scotch pine plantations, disclosed that foliage injury during the winter of 1947-48 varied greatly according to seed origin. Trees grown from seed native to localities in the same climatic zone as Cass Lake were largely uninjured, but those grown from seed originating in milder climates experienced much heavier injury and mortality.)

83. RUDOLF, PAUL O. 1948. Source of seed. In Woody Plant Seed Manual, U.S. Dep. of Agr. Misc. Publication 654: 14-19.

(Discusses the implications of seed source under the following topics: Importance of a known seed source, certification of seed, development of races, individual tree variations, and hybrids and tree breeding. Includes a table of known races of 32 American and 35 foreign species of trees and shrubs.)

84. RUDOLF, PAUL O. 1950. Variation in Scotch pine. Mich. Acad. Sci., Arts, Lett. Pap. (1948 meeting) 34: 57-68.

(Results of a Scotch pine seed source planting in Lower Michigan are compared with a Minnesota planting of the same sources. At the same age (16 years in the field) the Minnesota pines had much better diameter and volume, and a little better survival and height. Trees planted in Michigan had better form, a larger proportion of satisfactory trees, and such trees had a greater cubic-foot volume per acre. Seed sources potentially best suited for erosion control, timber production, and Christmas tree planting are noted.)

85. RUDOLF, PAUL O. 1950. Certifying forest seeds. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 14, 6 pp.

(Deals briefly with the problem and need of tree seed certification in the United States. Includes a resume of the policies and laws now in effect, their conditions, and their effectiveness. Mentions plans for the future.)

86. RUDOLF, PAUL O. 1951. Nursery behavior of red pine stock of different seed origins. U.S. Forest Serv. Tree Planters' Notes 8: 3-4.

(Data from 28 seed sources of red pine grouped into 8 seed collection regions and compared on the basis of the number of clean seeds per pound, germination in the laboratory and in the nursery, tree percent for 1-0 stock, and average weight for 1-0 seedlings showed that in general seed from the southern part of the red pine range was larger than that from the

more northerly areas and there is a distinct trend for larger seeds to produce larger 1-0 seedlings. However, there is enough variability in the lots within regions, so that nurserymen could not tell the region of origin of any given lot of red pine seed or stock from their average sizes.)

87. RUDOLF, PAUL O. 1951. Scotch pine seed sources for northeastern Minnesota. Minn. Acad. Sci. Proc. (1948 meeting) 16: 25-26.

(After 16 years in the field Scotch pine is better than red pine in survival, height growth, diameter, basal area, and total cubic volume. Red pine is superior in form and the percentage of premium trees. The overall evaluation showed red pine to be definitely the better species for the locality at present. North European and Asiatic Scotch pine were much better formed than those from Central Europe. However, the Central European sources gave best survival, height growth, diameter, basal area, and total cubic volume.)

88. RUDOLF, PAUL O. 1951. Winter damage and seed source of planted pines in northern Minnesota. Minn. Acad. Sci. Proc. (1949 meeting) 17: 74-79.

(Considering both actual damage and recovery resulting from the very severe winter of 1947-48 on seed source plantations of Scotch and red pine, red pine in general was best, with local sources giving the top showings; Northern European Scotch pine was a close second, and Central European Scotch pine was a very poor third.)

89. RUDOLF, PAUL O. 1953. The Forest Genetics Steering Committee of the Inland Northwest Region. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 22: 49-50.

(Outlines the organization and purposes of this northwestern regional committee established in 1950 and compares it with the Southern Committee on Forest Tree Improvement.)

90. RUDOLF, PAUL O. 1953. Forest genetics work at the Lake States Forest Exp. Sta. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 22: 1-10.

(Work done at the Lake States Station since its establishment includes (1) seed source studies of 8 forest tree species, (Pinus resinosa, P. sylvestris, P. ponderosa, P. banksiana, Picea spp., Larix decidua, L. sibirica, Fraxinus pennsylvanica), (2) field tests of a score of exotic species (out of 100+ tested in the nursery), (3) early attempts at breeding sugar maple, (4) field testing of 31 hybrid poplars, and (5) preparation for field testing stock of 10 hybrid pines involving crosses of Pinus monticola X P. strobus, and P. contorta X P. banksiana.)

91. RUDOLF, PAUL O. 1953. The Lake States Forest Tree Improvement Committee. First Northeast. Forest Tree Impr. Conf. Proc.: 97-98.

(An account of the inception and purposes of the Lake States Forest Tree Improvement Committee, and of the temporary subcommittees organized: Seed collection zones, tree and stand selection, bibliography and directory, and projects for study.)

92. RUDOLF, PAUL O. 1954. Forest tree improvement work in the Lake States. J. Forest. 52: 688-689.

(Summarizes the Lake States Forest Genetics Conference of 1953 and reports the formation of the Lake States Forest Tree Improvement Committee.)

93. RUDOLF, PAUL O. 1954. Age of seed tree and earliness of shoot growth in young red pine seedlings. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 422, 1 p.

(A test of 160 lots of red pine seedlings in a northern Minnesota nursery indicated the average date of flushing was latest in progenies of trees over 120 years of age and below 30 years of age, and earliest in progenies from trees of 81 to 120 years of age. Early flushing seedlings often continued to grow more than late flushers.)

94. RUDOLF, PAUL O. 1954. Seed source and earliness of shoot growth in young red pine seedlings. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 423, 1 p.

(More than 160 lots of red pine seedlings from 8 seed collection regions in the Lake States examined early in June of their second year in the seedbeds showed a general trend for earlier flushing among the seed sources from the southern part of the red pine range in the Lake States, but there are fast and slow starters from all but one region, and time of flushing is not a sufficiently constant factor to be of value in determining the probable source of young red pine seedlings of unknown origin.)

95. RUDOLF, PAUL O. 1955. Tree races and forest tree improvement. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 35: 8 pp. Also Third S. Conf. Forest Tree Impr. Proc. 1955: 4-10.

(Briefly reviews and illustrates the present status of knowledge concerning the importance of tree seed origin and the use of races as a basis for tree improvement. Suggests that studies of racial variation, selection, and breeding, although interdependent, can be carried out more or less simultaneously.)

96. RUDOLF, PAUL O. 1956. Laying the foundation for forest tree improvement in the Lake States. Wis.-Mich. Sect. Soc. Amer. Forest. Proc., pp. 1-7.

(Brief discussion on forest tree improvement--what it is, how it is done, activities in the Lake States and similar regions, applications, and future prospects.)

97. RUDOLF, PAUL O. 1956. Guide for selecting superior forest trees and stands in the Lake States. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 40, 32 pp., illus.

(Discusses the traits of forest trees generally considered to reflect heredity strongly. Special traits to be sought are listed for a number of individual species - Pinus resinosa, P. banksiana, P. strobus, Picea glauca, P. mariana, Abies balsamea, Larix laricina, Acer saccharum, Quercus rubra, Populus grandidentata, and P. tremuloides.)

98. RUDOLF, PAUL O. 1957. Prospects for tree improvement of northern hardwood species. Timber Prod. Bull. (Mich.) 13: 2-3, illus.

(The present potential of northern hardwoods can be improved by selection and controlled breeding of the best individuals, by crossing races within species, and by crossing species within a genus. First attention probably should be directed to sugar maple, yellow birch, and basswood.)

99. RUDOLF, PAUL O. 1957. Forest tree seed collection zones for the Lake States. Forest. Div., Mich. Dep. Conserv., (no series), 14 pp., illus.

(Proposes a series of seed collection zones for the Lake States based on (1) a summation of normal average daily temperatures per year above 50°F. ("growth degrees"), and (2) mean January temperatures.)

100. RUDOLF, PAUL O. 1958. Highlights of current forest tree improvement activities in the Lake States. In Northeast. Forest Tree Impr. Conf. Proc. 5: 11-13.

(Brief summary of forest tree improvement activities by all agencies in the Lake States.)

101. RUDOLF, PAUL O. 1959. A basis for forest tree seed collection zones in the Lake States. Minn. Acad. Sci. Proc. 24 (1956 meeting): 20-28, illus.

(Proposed seed collection zones for the Lake States are based on a summation of normal daily temperatures per year above 50°F. and mean January temperature. Development of 119 sources of red pine 20 years after planting showed agreement with the zones.)

102. RUDOLF, PAUL O. 1959. Forest tree improvement research in the Lake States. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 74, 56 pp.

(Gives brief reports on 113 forest tree improvement research projects conducted by 11 agencies in the Lake States. Includes indexes by genera, research workers, and cooperators.)

103. RUDOLF, PAUL O. 1959. The Lake States Forest Tree Improvement Committee; Its purpose and activities. In Proc. Comm. Forest Tree Breeding Canada (Fifth Meeting), Part II, 1957: N-1-4.

(Brief account of Lake States Forest Tree Improvement Committee covering its organization, membership, purposes, subcommittee activities, newsletter, and publications.)

104. RUDOLF, PAUL O. 1959. Seed production areas for the Lake States: Guidelines for their establishment and management. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 73, 16 pp., illus.

(Suggests standards and procedures for establishing seed production areas in the Lake States for red pine, jack pine, white pine, white spruce, and black spruce stands.)

105. RUDOLF, PAUL O. 1960. Current forest tree improvement research in the Lake States. In Proceedings of the Fourth Lake States Forest Tree Impr. Conf. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 81: 46-47.

(Brief summary of current activities of 70 research workers and 11 research agencies conducting some 113 formal forest tree improvement studies in the Lake States.)

106. RUDOLF, PAUL O. 1961. Selecting conifer seed production areas in the Lake States. In R-9 State Nurserymen's Meeting (Proc.) 1961: 2-12. Region 9, U.S. Forest Serv., Milwaukee.

(Gives guidelines for the selection, development, and maintenance of seed production areas in red pine, jack pine, white pine, white spruce, and black spruce stands in the Lake States. Probable seed costs and future activities (seed orchards) are mentioned.)

107. RUDOLF, PAUL O. 1962. Viewpoint of a forester on forest tree seed legislation. In Proc. Ass. Amer. Seed Contr. Offic. Conf. New York, Sept. 11-14, 1961, pp. 41-44.

(Presents "average view" of foresters, based on SAF Seed Certification Subcommittee opinion survey, that some control of seed origin is desirable, but that legislation should be deferred until foresters are better informed and better able to make a decision on the need for it.)

108. RUDOLF, PAUL O. 1962. Seed production areas - a step toward better seed. Second Cent. States Forest Tree Impr. Conf. Proc. 1962: 21-28. (Publ. by Ill. Agr. Exp. Sta.)

(Describes the purposes of seed production areas and outlines the steps required for establishing and maintaining such areas for the principal Lake States forest tree species.)

109. RUDOLF, PAUL O. 1964. Forest tree improvement in the Lake States, 1953-1963. In Sixth Lake States Forest Tree Impr. Conf. Proc. U.S. Forest Serv., Lake States Forest Exp. Sta., St. Paul, Minn. (no series) pp. 1-16.

(Reviews the status of forest tree improvement work in the Lake States in 1953 when the Lake States Forest Tree Improvement Committee was formed; summarizes the advances from 1953 to 1963 by agencies and by subject matter (includes contributions of action agencies); and takes a look ahead.)

110. RUDOLF, PAUL O. 1964. Forest tree seed certification in the United States and some proposals for uniformity. In World Consultation Forest Genet. Tree Impr. Proc. Vol. II, FAO FORGEN 63-8/3: i-v, 1-9.

(Traces the history and development of forest tree seed certification in the United States and stresses recent activities of the States, independent agencies, International Crop Improvement Association, and the Society of American Foresters. Points out the international need for uniform tree seed certification standards and proposes that the ICIA - SAF Scheme be used as a guide. Suggests 4 classes of seed be designated in an international scheme: Certified, selected, source identified, and general run.)

111. RUDOLF, PAUL O. 1965. Tree seed certification progress in the United States. In Int. Crop. Impr. Ass. Annu. Rep. 46: 95-99.

(Based on a survey of all agencies known to be engaged in tree seed certification activities in the United States, it appeared that as of the end of 1964, 6 states made legal provisions for tree seed certification activities. Their standards generally were similar to the minimum standards approved by the International Crop Improvement Association.)

112. RUDOLF, PAUL O. 1965. A technical discussion of the "Draft OECD Scheme for the Control of Forest Reproductive Material Moving in International Trade." In Int. Crop Impr. Ass. Annu. Rep. 46: 99-102.

(The second revision of the Scheme for the Control of Forest Reproductive Material Moving in International Trade, as developed by a committee appointed by the Organization for Economic Cooperation and Development, seemed generally agreeable to United States foresters. Presented a few suggestions for revision and clarification.)

113. RUDOLF, PAUL O. 1965. State tree seed legislation. Tree Planters' Notes 72: 1-2.

(A brief statement on State tree seed laws as they pertain to tree seed indicated that 13 states have such legislation as of 1965.)

114. RUDOLF, PAUL O. (n.d., circa 1965). Some evidence of racial variation in red pine (Pinus resinosa Ait.). In Comm. Forest Tree Breeding Can. Proc. 9 (Part II): 143-149. (Meeting of Sept. 16-18, 1964.)

(Evidence, based primarily on the Lake States Forest Experiment Station field trials of 1931 and 1933, indicates that red pine exhibits a pattern of variation in survival and growth over its range within the United States although it is an unusually uniform species genetically. Sources from Central Wisconsin, Lower Michigan, and the Northeast responded differently than those from other parts of the Lake States in northeastern Minnesota.)

115. RUDOLF, PAUL O. 1965. The certification of forest tree seeds. U.S. Forest Serv. Reg. 9 Nurserymen's Conf. Proc. (1965): 24-33.

(Provides some background on the development of forest tree seed certification activities in the United States, and describes the situation in the United States and internationally as of 1965.)

116. RUDOLF, PAUL O. 1965. Availability of tree seed testing in the United States - 1964. Tree Planters' Notes 73: 12-14.

(Based on contacts with all public seed testing laboratories in the United States, presents a list showing which ones now test tree seeds and which ones would be willing to do so. Also includes reference to some private seed testing laboratories.)

117. RUDOLF, PAUL O., and John W. Andresen. 1965. Botanical and commercial range of red pine in the Lake States. U.S. Forest Serv. Res. Note LS-62, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(The botanical and commercial ranges of red pine in the Lake States are described in the text and illustrated by maps. A supplemental map shows the source of location of specimens in established herbaria, forest survey plots, and similar reliable data. Commercial occurrence is indicated for each county that has at least 1,000 cords of red pine on commercial forest land.)

118. RUDOLF, PAUL O., and John W. Andresen. 1965. Botanical and commercial range of eastern white pine in the Lake States. U.S. Forest Serv. Res. Note LS-63, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(The botanical and commercial ranges of eastern white pine in the Lake States are described in the text and illustrated by maps. A supplemental map shows the source of location of specimens in established herbaria, forest survey plots, and similar reliable data. Commercial occurrence is indicated for each county that has at least 1,000 cords of eastern white pine on commercial forest land.)

119. RUDOLF, PAUL O., and John W. Andresen. 1965. Botanical and commercial range of white spruce in the Lake States. U.S. Forest Serv. Res. Note LS-73, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(The botanical and commercial ranges of white spruce in the Lake States are described in the text and illustrated by maps. A supplemental map shows the source of location of specimens in established herbaria, forest survey plots, and similar reliable data. Commercial occurrence is indicated for each county that has at least 1,000 cords of white spruce on commercial forest land.)

120. RUDOLF, PAUL O. 1965. Botanical and commercial range of black spruce in the Lake States. U.S. Forest Serv. Res. Note LS-74, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(The botanical and commercial ranges of black spruce in the Lake States are described in the text and illustrated by maps. A supplemental map shows the source of location of specimens in established herbaria, forest survey plots, and similar reliable data. Commercial occurrence is indicated for each county that has at least 1,000 cords of black spruce on commercial forest land.)

121. RUDOLF, PAUL O., John C. Barber, R. Z. Callaham, and Philip C. Wakeley. 1962. More on tree seed certification and legislation. (A report of the S.A.F. Seed Certif. Comm.) J. Forest. 60: 349-350, 352.

(Refers to previous Journal of Forestry statement by a group of foresters in the Pacific Northwest and points out certain misconceptions, answers some questions, and points to need for national consideration of forest tree seed certification and legislative questions.)

122. RUDOLF, PAUL O., et al. 1961. Society of American Foresters report on a study of seed certification conducted by the Committee on Forest Tree Improvement. J. Forest. 59: 656-661.

(A nationwide survey of opinion made by the SAF Tree Seed Certification Subcommittee showed a strong majority in favor of some degree of certification for forest tree seeds. Based on these results, revised minimum tree seed certification standards were prepared for presentation to the International Crop Improvement Association.)

123. RUDOLF, PAUL O., et al. 1962. Report of the Subcommittee on Research Evaluation, Coordination, and Planning. In Proceedings of the Fifth Lake States Forest Tree Impr. Conf., U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 98: 7-15.

(Subcommittee presents an up-to-date roster of Lake States research workers in forest tree improvement and their specialties prepared as part of the development of a national roster.)

124. RUDOLF, PAUL O., et al. 1963. The seed we use: Part I. What we need to know about it. (Report of the SAF Seed Certification Subcommittee.) J. Forest. 61: 181-184, illus.

(Briefly summarizes the underlying scientific evidence for genetic diversity in wild stands, the need for identifying the source of seed used in artificial regeneration, some of the mechanics for seed source identification, and the probable costs of such activity. Concludes that the identification of seed source and the certification of genetic quality of forest tree seeds are obtainable at reasonable costs, and that the seed buyer should look upon them as an investment in insurance.)

125. RUDOLF, PAUL O., et al. 1963. The seed we use: Part II. How to assure reliable information about it. (Report of the SAF Seed Certification Subcommittee.) J. Forest. 61: 265-269, illus.

(Points out that for generally satisfactory identification or certification of seed, there must be some reliable agency, either voluntary or set up by law, charged with responsibility for such action. In the United States only 12 state laws are interpreted to cover tree seed. Laws of 9 of these states permit certification, and 5 have developed certification standards for tree seed. The Federal Seed Act backstops state seed laws covering agricultural and vegetable seed, but not tree seed, which enters interstate commerce. Federal legislation also requires fumigation and inspection of all imported seed, including tree seed.)

126. RUDOLF, P. O., et al. 1964. Report of the SAF Tree Seed Committee to the Division of Silviculture, Society of American Foresters. J. Forest. 62: 658-672.

(In its first year of activity, the SAF Tree Seed Committee agreed on 5 policy statements; summarized the situation concerning tree seed certification, legislation, and testing; established liaison with all SAF sections and with other organizations dealing with tree seeds; proposed actions to improve tree seed controls; and assembled a list of all committees and organizations concerned with tree seed in the United States and some foreign countries.)

127. RUDOLF, P. O., et al. 1964. Report of the SAF Tree Seed Committee: 1964 activities. J. Forest. 62: 910-914.

(Recounts the activities of the SAF Tree Seed Committee concerning tree seed certification, legislation, and related matters; and of other agencies concerned with tree seed. Points out action needed on tree seed matters and recommends action on tree seed legislation, other means of seed control, adequacy of present certification standards, and continued close contact with the SAF Sections and with other organizations concerned with tree seed problems.)

128. RUDOLF, PAUL O., and HANS NIENSTAEDT. 1958. Spruce improvement research at the Lake States Forest Experiment Station--an outline. In Northeast. Forest Tree Impr. Conf. Proc. 5: 54-57.

(Brief summary of the Station's studies in provenience, ecotypic variation, selection, and breeding of spruces.)

129. RUDOLF, PAUL O., and H. E. Ochsner. 1959. Registering and marking selections in the Lake States; a report of a subcommittee of the Lake States Forest Tree Improvement Committee. U.S. Forest Serv., N. Cent. Reg., 10 pp.

(Recommends methods and forms for reporting superior or unusual forest trees in the Lake States. Includes a regional list of registers. Suggests methods for marking selected superior trees.)

130. RUDOLF, PAUL O., and R. A. RALSTON. 1953. Do age of mother trees and age of cones affect development of young jack pines? J. Forest. 51: 121-124.

(Made 2 tests with cones collected from jack pine mother trees representing several age classes to determine their effects on yield, size, and viability of seed. Studied survival and growth of seedlings. Made one test of survival and growth of jack pines grown from seed of cones from several age classes. Findings show that it is relatively safe to use seed from jack pine cones up to 5 years old from trees of any age as long as tree form and growth are satisfactory.)

131. RUDOLF, PAUL O., and R. L. Schoenike. 1963. Botanical and commercial range of jack pine in the Lake States. U.S. Forest Serv. Res. Note LS-15, 4 pp., illus. Lake States Forest Exp. Sta., St. Paul, Minn.

(The botanical and commercial ranges of jack pine in the Lake States are described in the text and illustrated by maps. A supplemental map shows the source of location of specimens in established herbaria. Commercial occurrence is indicated for each county that has at least 1,000 cords of jack pine on commercial forest land.)

132. RUDOLF, PAUL O., and PAUL E. SLABAUGH. 1958. Growth and development of 10 seed sources of Scotch pine in Lower Michigan (15-year results). U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 536, 2 pp.

(Scotch pines of 10 European origins were compared by lot and found to have significant differences in total height growth and varying susceptibilities to insect attack.)

133. RUDOLF, PAUL O., and PAUL E. SLABAUGH. 1958. Growth and development of 12 seed sources of Norway spruce in Lower Michigan (15-year results). U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 537, 2 pp.

(Norway spruces of 12 European origins were compared by lot and found to vary widely in survival, height growth, and injury according to seed source.)

134. *RUDOLPH, T. D. 1962. Lammas growth and prolepsis in jack pine in the Lake States. Dissert. Absts. 22: 2156-2157.

(Summarizes the results of a study to determine the characteristics of lammas growth and prolepsis in Pinus banksiana Lamb., the variation in occurrence of these phenomena over the range of the species in the Lake States, their effects on height growth, tree form, and annual ring structure, and the possible factors influencing their occurrence in certain areas and on individual trees, especially seed origin.)

135. *RUDOLPH, THOMAS D. 1964. Lammas growth and prolepsis in jack pine in the Lake States. Forest Sci. Monogr. 6, 70 pp., illus.

(Presents results of a study made to determine the characteristics of lammas growth and prolepsis in jack pine, a variation in occurrence of these phenomena over the range of the species in the Lake States, their effect on height growth, tree form, and annual ring structure, and the possible factors influencing their occurrence in certain areas and on individual trees, especially seed origin.)

136. RUDOLPH, T. D. 1964. The radiation research project at the Institute of Forest Genetics, Rhinelander, Wisconsin. Proc. 9th Meeting Comm. on Forest Tree Breeding in Canada, Part II: 193-194.

(Describes and discusses the facilities in the recently initiated radiation research program at the Lake States Forest Experiment Station's Institute of Forest Genetics, the broad long-term objectives of the program, studies presently underway, and planned future studies.)

137. RUDOLPH, T. D. 1965. The effect of gamma irradiation of pollen on seed characteristics in white spruce. In The Use of Mutations in Plant Breeding, FAO-IAEA Meeting Rep. 1964: 185-191, illus.

(White spruce pollen, irradiated with gamma rays at 0, 400, 600, and 800 roentgens, was used to pollinate six maternal parents. Total seed yield per cone increased with increased gamma ray dosage to the pollen; the 600 r and 800 r treatments resulted in 23 and 27 percent more seeds, respectively, than the controls. As compared with the controls, seed germination was 12 percent less at 400 r pollen dosage, 10 percent greater at 600 r, and again 12 percent poorer in the 800 r dosage. Seed germination was significantly greater at 600 r than at the 400 r and 800 r levels.)

138. RUDOLPH, T. D., and HANS NIENSTAEDT. 1962. Polygenic inheritance of resistance to winter injury in jack pine - lodgepole pine hybrids. J. Forest. 60: 138-139, illus.

(Evaluation of winter injury in hybrids and backcross progeny resulting from crosses of jack pine and lodgepole pine indicated that resistance to this injury is a characteristic under control of multiple factors, or polygenes, necessitating use of the backcross breeding method if a hybrid is to be produced possessing both winter hardiness and other desirable characteristics of the parent species.)

139. RUDOLPH, T. D., and HANS NIENSTAEDT. 1964. Rooting, shoot development, and flowering of jack pine needle fascicles. Silvae Genet. 13: 118-123, illus.

(Results of a study designed to develop a technique for rooting jack pine needle fascicles showed that fascicles with preformed buds from 2-year-old trees could be rooted up to 70-percent success when treated with 0.1 percent indolebutyric acid and placed in a heated greenhouse bench. Shoot development was excellent on rooted fascicles with preformed buds and, occasionally, male strobili developed on the shoots shortly after the fascicles had rooted.)

140. *RUDOLPH, T. D., R. E. Schoenike, and T. Schantz-Hansen. 1959. Results of one-parent progeny tests relating to the inheritance of open and closed cones in jack pine. Minn. Forest. Notes No. 78, 2 pp.

(Open pollinated progenies of 28 jack pine trees known to bear either open or serotinous cones were evaluated for the cone-opening character. Segregation ratios presented indicate that multiple genes control this phenotypic expression and that the open cone character is dominant to the closed cone condition.)

141. *Santamour, Frank S., Jr., and HANS NIENSTAEDT. 1956. The extraction, storage, and germination of eastern hemlock pollen. J. Forest. 54: 269-270.

(Long daylength (20 hours) is beneficial in extraction of hemlock pollen from branches collected 3 months before normal pollen shedding. Stored hemlock pollen successfully at 50 percent relative humidity and 10 to 16°C.)

142. *Schoenike, R. E., T. D. RUDOLPH, and R. A. Jensen. 1962. Branch characteristics in a jack pine seed source plantation. Minn. Forest. Notes No. 113, 2 pp.

(Presents results of a study of the variation in branching and crown characteristics in 23 provenances of jack pine planted at Cloquet, Minnesota. Characteristics studied included total tree height, height to the base of the longest living branch, maximum crown radius, number of live branches in each of four of the lowermost whorls, and branch angle and diameter of the largest branch in each of the four whorls.)

143. *Schoenike, R. E., T. D. RUDOLPH, and T. Schantz-Hansen. 1959. Cone characteristics in a jack pine seed source plantation. Minn. Forest. Notes No. 76, 2 pp.

(Presents results of the variation in proportion of open and closed cones, length of cones, cone curvature and cone angle in 23 provenances of jack pine in a plantation at Cloquet, Minnesota.)

144. SHIRLEY, HARDY L. 1937. The relation of drought and cold resistance to source of seed stock. Minn. Hort. 65: 23-24, Feb.

(Briefly summarizes present knowledge primarily as concerns green ash that indicates a strong relationship between seed origin and drought and cold resistance of the resulting stock.)

145. SHIRLEY, HARDY L. 1937. Forest eugenics in Germany. Amer.-Ger. Rev., pp. 9-12. March.

(Briefly describes the status of seed source knowledge and regulations to utilize the best trees for producing progeny in Germany.)

146. SHIRLEY, HARDY L. 1937. Review of "The employment of species, types, and individuals in forestry," by C. Syrach Larsen. J. Forest. 35: 1169-1171.

147. SHIRLEY, HARDY L. 1939. Comments on "Some new aspects of seed certification" by Henry I. Baldwin. J. Forest. 37: 35-36.

(Both state and federal legislation may be desirable to secure uniformity of regulation. Questions whether we are ready for such action. Suggests we can make much more progress through voluntary action, particularly by foresters in public employ, and that after foresters become fully acquainted with certification techniques, they will be better qualified to decide whether legislation is needed, and if so, what kind.)

148. SKILLING, DARROLL D. 1960. A tractor-mounted ladder for tree-crown studies. Food and Agr. Organ. of the United Nations, Forest. Equip. Note A.20.60, 2 pp., illus. Also U.S. Forest Serv., Tree Planters' Notes 43: 9-10, illus.

(Describes an aerial ladder mounted on a crawler tractor suitable for tree-crown studies up to 45 feet. The principal advantages of this device are its ability to travel through forest terrain and its reasonable price - total cost $320.00 plus tractor.)

149. SLABAUGH, PAUL E., and PAUL O. RUDOLF. 1957. The influence of seed source on the development of Scotch pine and Norway spruce planted in Lower Michigan (15-year results). Mich. Acad. Sci., Arts, Lett. Pap. (1956) 42: 41-52, illus.

(Compares the performance of Scotch pine of 10, and Norway spruce of 12 European origins with that of red pine and white pine of Michigan origin. The native species have been less subject to damaging agents and are growing faster.)

150. STOECKELER, J. H. 1948. Tree breeding material shipped to Sweden for propagation study. Tree Tips, p. 3. Jan.

(Describes a shipment of quaking aspen material to Sweden for use in aspen breeding projects.)

151. STOECKELER, J. H. 1950. Bigger and better forest trees for Sweden. Sci. Mon. 70: 328-332, illus.

(Describes the Swedish programs for improving forest tree species, primarily Scotch pine and aspen, and involving selection and breeding.)

152. STOECKELER, J. H. 1950. Review of "Preliminary report on results of Italian researches on the races of Scotch pine," by Ernesto Allegri and Ricardo Morandini. J. Forest. 48: 507.

153. STOECKELER, J. H. 1953. Importance of seed source and the need for tree seed farms. U.S. Forest Serv., Lake States Forest Exp. Sta. Misc. Rep. 22: 74-79.

(Discusses the need for recognizing seed source in reforestation work under the following topics: Results of past experience, the U.S.D.A. seed policy of 1939, how good is the present control of seed source?, proposed tree seed farms, proposed seed collection zones, and suggested methods of improving control of seed source.)

154. STOECKELER, J. H. 1955. European larch seed sources compete successfully with tamarack during 5-year test in northeastern Wisconsin. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 440, 1 p.

(Gives results 5 years after planting of 8 lots of larch (6 European larch, one Siberian larch, and one tamarack) in northeastern Wisconsin. The best survival, height growth, and reaction to climate of the planting site were expressed by three lots of European larch from the colder and more northern part of the species range and the local tamarack source.)

155. STOECKELER, J. H., and PAUL O. RUDOLF. 1949. Winter injury and recovery of conifers in the Upper Midwest. U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 18, 20 pp.

(A survey of the coniferous species, natural and planted, in the Lake States after the damaging winter of 1947-1948 rated the species as to mortality, deformity, injury severity, and recovery. In general the native pines and spruces were superior to introduced species. Local sources or those from sources climatically similar to the planting site performed best.)

156. STOECKELER, J. H., and PAUL O. RUDOLF. 1956. Winter coloration and growth of jack pine in the nursery as affected by seed source. Z. Forstgenet. Forstpflanzenzücht. 5: 161-165, illus.

(Winter foliage coloration of 1- to 3-year-old jack pine nursery stock from 29 seed origins in the Lake States was strongly correlated with the latitude and number of degree days over 50°F. of seed origin localities.)

157. STOECKELER, J. H., and R. O. STROTHMANN. 1955. Early development of native and hybrid aspens. U.S. Forest Serv., Lake States Forest Exp. Sta. Tech. Note 427, 1 p.

(At 3 and 4 years after planting in northeastern Wisconsin, a hybrid between Populus tremuloides of Massachusetts origin X P. tremula of German origin was superior in growth to P. tremuloides of native origin and P. tremuloides of Massachusetts origin X P. tremuloides from Colorado in descending order. The local quaking aspen, however, had the best form.)

158. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1928. Climatic seed sources for Norway pine. Lake States Forest Exp. Sta. Tech. Note 5, 1 p.

(Stresses the importance of seed source in planning red pine plantations. Local seed should be used, and if not local, it should be from the same isotherm. General lines of average temperature are indicated for the Lake States.)

159. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1930. Frost hardiness of races of Norway pine seedlings. Lake States Forest Exp. Sta. Tech. Note 22, 1 p.

(Gives the results of a test to determine at what temperature hardy forms would survive, but less hardy forms would not. Points out the importance of seed source in red pine plantings.)

160. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1931. Centers for collecting seed of Norway pine. Lake States Forest Exp. Sta. Tech. Note 30, 2 pp.

(Describes 8 regions for seed collection in the Lake States, based on occurrence of sufficient stands (located in the paper) and climatic differentiation. Includes a map.

161. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1937. Seed origin affects survival of green ash in the nursery. Lake States Forest Exp. Sta. Tech. Note 128, 1 p.

(Stresses the importance of seed source with green ash based on survival percentages in the nursery at Denbigh, North Dakota. Seedlings of North Dakota seed origin gave the best survival; survival decreased with increasing distance south of the seed origin. Most of the loss was from lack of winter hardiness.)

162. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1939. A fast growing and winter-hardy poplar hybrid still to be found for the Lake States. Lake States Forest Exp. Sta. Tech. Note 153, 1 p.

(Reports very discouraging results with 10 hybrid poplars planted 4 years ago on the Chippewa National Forest and in North Dakota. All 10 suffered winter injury, 7 of them even in mild winters. A table lists parentage, survival, and average height after 4 seasons.)

163. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1953. Lake States Forest Genetics Conference, March 31-April 1, 1953. Lake States Forest Exp. Sta. Misc. Rep. 22, 83 pp.

(Presents papers on forest genetics in the Lake States (10 papers), forest genetics in other regions (6 papers), forest genetics problems needing study (8 papers); and planning forest genetics research in the Lake States (3 papers). Includes resolutions passed at the Conference, including one to establish the Lake States Forest Tree Improvement Committee.)

164. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1955. Proceedings, Lake States Forest Tree Improvement Conference, Lake States Forest Exp. Sta. Misc. Rep. 40, 108 pp., illus.

(Publication includes progress reports from universities, Forest Service Experiment Stations and Research Centers, and private companies; short papers concerning (a) problems of seed and pollen collection, storage, and exchange, (b) vegetative propagation problems, and (c) testing for resistance to disease and insects; and reports on the activities of the subcommittees of the Lake States Forest Tree Improvement Committee.)

165. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1958. Proceedings, Third Lake States Forest Tree Improvement Conference, Sept. 17, 18, 1957. Lake States Forest Exp. Sta., Sta. Pap. 58, 87 pp., illus.

(Contains 20 papers on (1) applying tree improvement practices in the Lake States, (2) recent advances in tree improvement in the Lake States and other regions, (3) reports on the activities of the Lake States Forest Tree Improvement Committee, and (4) a description of the points of interest on the field trip.

166. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1960. Proceedings of the Fourth Lake States Forest Tree Improvement Conference, Oct. 6 and 7, 1959. Lake States Forest Exp. Sta., Sta. Pap. 81, 60 pp., illus.

(Includes a "short course" in forest genetics, and reports on (1) current tree improvement activities, and (2) activities of special subcommittees, and the parent Lake States Forest Tree Improvement Committee.)

167. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1962. Proceedings of the Fifth Lake States Forest Tree Improvement Conference. Lake States Forest Exp. Sta., Sta. Pap. 98, 42 pp.

(Presents (1) brief papers on the practical potential of a regional tree improvement program and what the papermaker wants from the tree improver, (2) reports by seed certification and research committees, (3) descriptions of field stops at the Northern Institute of Forest Genetics and tree improvement plots of the Lake States Forest Experiment Station, University of Wisconsin, Nicolet National Forest, Institute of Paper Chemistry, and Consolidated Water Power and Paper Company. This conference provided the technical program for the Wisconsin-Michigan SAF Section meeting.)

168. U.S. FOREST SERVICE, LAKE STATES FOREST EXPERIMENT STATION. 1964. Proceedings of the Sixth Lake States Forest Tree Improvement Conference, Sept. 1963. 90 pp., illus. (no series). Lake States Forest Exp. Sta., St. Paul, Minn.

(Includes papers on 10 years of tree improvement research; site preparation by mechanical means, herbicides, and fire; subcommittee reports, NC-51 Committee meeting, and descriptions of experiments seen on the field trip.)

169. WATT, RICHARD F., and Wm. H. Davis McGregor. 1963. Growth of four northern conifers under long and natural photoperiods in Florida and Wisconsin. Forest Sci. 9: 115-128, illus.

(Seedlings of white and red pines and white and black spruces were grown under natural and 20-hour photoperiods for 2 years. Long photoperiod permitted growth throughout 226-day Florida growing season; seedlings at the end of 2 years equaled or exceeded standards for northern grown transplants. Outplantings in Minnesota had good survival rates. The relatively short natural Florida photoperiod caused dwarfing of the spruce seedlings. Extended photoperiod in Wisconsin increased the size of 2-year spruce. Morphological changes were noted under long photoperiod at both locations; responses to photoperiod varied with age of plants.)

170. Wright, Jonathan W., and PAUL O. RUDOLF. 1962. A bibliography of forest genetics and forest tree improvement, 1958-1959. U.S. Dept. Agr. Misc. Publ. 906, 93 pp.

(More than 1,300 publications on forest tree improvement published throughout the world in 1958 and 1959 are listed alphabetically by authors. Included for each is a complete citation and brief annotation as to species and subject matter. A subject-matter index completes the publication.)

171. ZASADA, ZIGMOND A. 1958. Applying forest tree improvement practices in silviculture. In Third Lake States Forest Tree Impr. Conf. Proc., U.S. Forest Serv., Lake States Forest Exp. Sta., Sta. Pap. 58: 15-18.

(Although a good rate of growth can be maintained under several methods of cutting and over a wide range of stocking, little is known as to what is happening to the stands genetically. The geneticist must make his information on distinguishing good and poor trees available in simple language so the forest manager can use it.)

172. ZON, RAPHAEL. 1930. The search for forest facts. Amer. Forests and Forest Life 36: 421-423, 482, illus.

(Describes the establishment and development of Forest Experiment Stations by the United States Forest Service. Mentions efforts to determine proper source of seed as a basis for the successful establishment of the Nebraska National Forest.)

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1/ This classification was devised by Dr. Scott Pauley of the School of Forestry, University of Minnesota and has been used in the following publications:

1962. Forest genetics research in the Rocky Mountain and Pacific Coast States and British Columbia. Forest Genet. Res. Found., 36 pp.

Rudolf, Paul O. 1966. Forest tree improvement research in the Lake States, 1965. U.S. Forest Serv. Res. Pap. NC-1, 54 pp., North Central Forest Exp. Sta., St. Paul, Minn.

2/ The numbers refer to the publications listed alphabetically by authors in the main section of this bibliography.

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1/ Authorities for nomenclature are: Check list of native and naturalized trees of the United States, by Elbert Little, U.S. Department of Agriculture Handbook 41, 1953; Manual of Cultivated Trees and Shrubs, by Alfred Rehder, 1940, New York.

2/ The numbers refer to the publications listed in the text in alphabetical order by authors.

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Some Recent Research Papers
of the
Lake States Forest Experiment Station[1]

Recreational Use of the Quetico-Superior Area, by Robert C. Lucas. U.S. Forest Serv. Res. Pap. LS-8, 50 pp., illus. 1964.

Forest Owners and Timber Management in Michigan, by Con H Schallau. U.S. Forest Serv. Res. Pap. LS-9, 39 pp., illus. 1964.

The Causes of Maple Blight in the Lake States, by Lake States Forest Exp. Sta. U.S. Forest Serv. Res. Pap. LS-10, 15 pp., illus. 1964.

Identification of Hardwood Insects by Type of Tree Injury, North Central Region, by H. J. MacAloney and H. G. Ewan. U.S. Forest Serv. Res. Pap. LS-11, 70 pp., illus. 1964.

The Identification of Primary Red Pine Cone Insects, by John S. Hard. U.S. Forest Serv. Res. Pap. LS-12, 10 pp., illus. 1964.

Guide for Selecting Superior Trees for Shelterbelts in the Prairie Plains, by David H. Dawson and Ralph A. Read. U.S. Forest Serv. Res. Pap. LS-13, 22 pp., illus. 1964.

Black Bark as an Indicator of Bird Peck Defect in Sugar Maple, by John H. Ohman and Kenneth J. Kessler, Jr. U.S. Forest Serv. Res. Pap. LS-14, 8 pp., illus. 1964.

The Recreational Capacity of the Quetico-Superior Area, by Robert C. Lucas. U.S. Forest Serv. Res. Pap. LS-15, 34 pp., illus. 1964.

Sediment, Streamflow, and Land Use Relationships in Northern Lower Michigan, by W. David Striffler. U.S. Forest Serv. Res. Pap. LS-16, 12 pp., illus. 1964.

Fragmentation, Absentee Ownership, and Turnover of Forest Land in Northern Lower Michigan, by Con H Schallau. U.S. Forest Serv. Res. Pap. LS-17, 12 pp., illus. 1965.

Thinning Red Pine for High Investment Returns, by Allen L. Lundgren, U.S. Forest Serv. Res. Pap. LS-18, 20 pp., illus. 1965.

Characteristics of Family Campers Using the Huron-Manistee National Forests, by David A. King. U.S. Forest Serv. Res. Pap. LS-19, 11 pp., illus. 1965.

Estimating Crown Fuel Weights of Red Pine and Jack Pine, by James K. Brown, U.S. Forest Serv. Res. Pap. LS-20, 12 pp., illus. 1965.

Balsam Fir Dimension Lumber in Selected Minnesota Markets, by E. M. Carpenter and D. N. Quinney. U.S. Forest Serv. Res. Pap. LS-21, 13 pp., illus. 1965.

1/ As a result of a recent reorganization within the U.S. Forest Service, the Lake States Forest Experiment Station no longer exists. The newly formed North Central Forest Experiment Station, with headquarters in St. Paul, Minn., conducts federal forest research in seven states and issues publications in three new series identified by the symbol NC and a number.

THE FOREST SERVICE CREED

The Forest Service of the U.S. Department of Agriculture is dedicated to the principle of multiple use management of the Nation's forest resources for sustained yields of wood, water, forage, wildlife, and recreation. Through forestry research, cooperation with the States and private forest owners, and management of the National Forests and National Grasslands, it strives — as directed by Congress — to provide increasingly greater service to a growing Nation.