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FOREST TREE IMPROVEMENT RESEARCH IN THE SOUTH AND SOUTHEAST

by

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on Southern Forest Tree Improvement

U. S. DEPARTMENT OF AGRICULTURE—FOREST SERVICE
Southeastern Forest Experiment Station
Asheville, North Carolina

This summary of forest tree improvement and forest genetics research projects in the southern pine region informs research workers and other interested people about work under way and where it is being done. The survey also strengthens and coordinates such research. The U. S. Forest Service is glad to foster the work of the Committee on Southern Forest Tree Improvement by publishing this report.

T. F. McLINTOCK, DIRECTOR
Southeastern Forest Experiment Station

Foreword

The Committee on Southern Forest Tree improvement has directed its Subcommittee on Tree Selection and Breeding to summarize the projects by agencies doing forest tree improvement research in the South and Southeast. This area corresponds roughly to what is known as the southern pine region. The project summaries and the consolidated report were to be patterned after those issued from the Lake States and from the Western states including British Columbia, Canada.

The Southern and Southeastern report describes 305 research projects being conducted by 36 research agencies at various locations. The survey gives reasonably good coverage of present forest tree improvement research in the area. The report is presented for the consideration of those conducting or supporting forest tree improvement and forest genetics research, and for others interested in the broad forestry research program that is developing in the South and Southeast.

Any survey of research in an active field of work is somewhat out of date by the time it is printed. However, studies that are costly and run for many years do not change quickly, and it is these that should not be duplicated. It is hoped that the survey of current work will help researchers to avoid such duplication.

Often there is no sharp distinction between tree improvement or forest genetics studies and certain other fields of forestry. The only logical basis for classifying many studies is their basic purpose. For example, seed orchard culture is an important general subject of interest to many people. Yet individual studies are appropriately classified under basic subjects such as variation and inheritance of flower production, flower induction, nutritional studies, tree spacing studies, vegetative propagation, pollen flight, tree crown shaping, cone or seed insect control, cone or seed disease control, and others relating to growing trees or managing areas of trees for seed production. Classification of studies by the basic subject or subjects covered has made extensive cross referencing unnecessary.

Each statement shows the scientific names of the tree species, or the group, such as hardwood or softwood. Occasionally the word "General" is used instead of the species name to indicate broad projects applying to many genera.

Work under the Regional Project, "Forest Tree Genetics, S-23," of the State Agricultural Experiment Stations is indicated for some studies under the college or university of the State involved. The following State experiment stations cooperate at present in this project: Alabama, Mississippi, Louisiana, Tennessee, Texas, Georgia, Florida, North and South Carolina.

No attempt has been made to report all seed orchards and seed production areas established by all agencies. This activity was the object of a special survey by the U. S. Forest Service, and acreage figures were published in Tree Planters' Notes No. 74, December 1965. However, some agencies have included seed orchards in their survey reports because of the research aspects, or for other reasons.

This report supersedes one published in 1952, "Directory of forest genetic activities in the South," Southeastern Forest Experiment Station, Station Paper No. 17.

The Subcommittee on Tree Selection and Breeding gratefully acknowledges the assistance of research agencies and workers who generously gave their time in preparing the project statements, the men who assembled the report by States, and the Forest Genetics Research Foundation, which stimulated this work and set a pattern for the report.

KEITH W. DORMAN, CHAIRMAN
Subcommittee on Tree Selection and Breeding

AGENCIES CONDUCTING RESEARCH

Code Number	Name		Number of Projects Reported
1	Auburn University		8
2	Buckeye Cellulose Corporation		1
3	Clemson University		8
4	Continental Can Company		10
5	Florida Forest Service		3
6	Florida Forests Foundation		3
7	Ida Cason Callaway Foundation		2
8	International Paper Company		4
9	Louisiana State University		2
10	North Carolina State University		11
11	Tennessee Valley Authority		4
12	Texas Forest Service		10
13	Union Bag-Camp Paper Corporation		8
14	United States Forest Service, Forest Products Laboratory		1
15	United States Forest Service, Region 8		1
	United States Forest Service, Southeastern Forest Experiment Station		88
16	Asheville, North Carolina	11	
17	Athens, Georgia	8	
18	Blacksburg, Virginia	5	
19	Charleston, South Carolina	10	
20	Cordele, Georgia	3	
21	Fort Myers, Florida	2	
22	Franklin, Virginia	1	
23	Macon, Georgia	14	
24	Marianna, Florida	6	
25	Olustee, Florida	28	
	United States Forest Service, Southern Forest Experiment Station		98
26	Alexandria, Louisiana	7	
27	Crossett, Arkansas	17	
28	Gulfport, Mississippi	53	
29	Harrison, Arkansas	4	
30	Stoneville, Mississippi	17	
31	University of Florida		6
32	University of Georgia		11
33	University of Tennessee		14
34	University of Virginia		1
35	Virginia Division of Forestry		1
36	West Virginia Pulp and Paper Corporation		10
		Total	305

CONTENTS

Forest Tree Improvement Research in the South and Southeast

A Survey

by the Committee on Southern Forest Tree Improvement

by

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THE PATTERN OF THE PROJECT DESCRIPTIONS

In the following pages, each person in charge of the work describes his current forest tree improvement research project in the South and Southeast in a brief statement consisting of the title, description of the objectives and methods, a list of cooperators (if any), and the names of those responsible for the study.

Each statement is preceded by a hyphenated reference number for identification of the project in cross references and the indexes; the first number identifies the research agency, and the second the project under that agency. Following the title are classification numbers showing the subject-matter category of the project. These categories are listed on page 84 in accordance with a classification systems prepared by Dr. Scott S. Pauley.

To insure that pertinent material is seen, the reader should study the subject-matter classification outline before attempting to review various topics.

RESEARCH PROJECTS

1. AUBURN UNIVERSITY, DEPARTMENT OF FORESTRY
Auburn, Alabama

1-1. **VARIATION IN** *Cupressus*. 111.0, 111.1, 111.3. *Cupressus arizonica, Cupressus* spp.

OBJECT : (1) Investigate phenotypic variation in species of *Cupressus* native to the United States, and (2) determine genetic variation in *Cupressus arizonica.*

METHODS : Collect seed from and study all species in their native habitats. Seed is kept separate by mother tree to establish one open-pollinated progeny test planting of approximately 10 acres. Provenance test plantings of all species will be established in different regions of Alabama.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-2. **TRIALS OF EXOTIC SPECIES.** 111.0, 211.0. Softwood and hardwoods.

OBJECT: Evaluate promising exotics as replacements for currently grown species and establish these exotics as a source of breeding material.

METHODS : Introduce trees not native to the area. Establish in plots and evaluate in terms of growth, form, wood quality, insect and disease resistance, and tolerance to climate.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-3. **VARIABILITY WITHIN FOREST TREE SPECIES.** 111.1, 111.2, 111.3, 211.1, 211.2, 211.3. *Pinus taeda, P. virginiana, Liquidambar styraciflua,* and others to be selected.

OBJECT : (1) Determine phenotypic variation in selected characteristics within and

among races of major forest tree species in Alabama and surrounding areas, and (2) determine variation within and among progenies of races and selected individuals from Alabama and surrounding areas.

METHODS : Select sample trees within stands, sites, and physiographic regions. Measure growth, form, and wood characteristics. Analyze to estimate phenotypic variation within stands, between stands, and between regions. Collect seed from sample trees, selected as above, and plant seedlings in designed plantings on varying sites. As part of these studies a *Pinus taeda* provenance study was established 5 years ago. It involves eight seed sources in Alabama with plantings near each source. Phenotypic variation in growth and wood characteristics of *Liquidambar styraciflua* is also being investigated. Eighty-five 5-tree plots have been established throughout Alabama. Wood characteristics being studied are percent heartwood, specific gravity, and fiber length.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-4. **WOOD CELL ANATOMY.** 111.3, 151.321, 151.322, 211.3, 251.321, 251.322, 251.324. *Pinus taeda, Liquidambar styraciflua.*

OBJECT : (1) Determine a practical, accurate method of measuring cell diameters and wall thicknesses; (2) determine the within-tree variation in cell diameter, wall thickness and length, and devise a method of sampling these characteristics; and (3) determine the degree of correlation between cell dimensions, specific gravity, percentage of summerwood, and rate of growth.

METHODS : Compare precision of cell diameter and wall thickness measurements made on macerated and solid wood samples under various combinations of transmitted and reflected normal and polarized light and fluorescence. Measure total variation with annual ring. Try sampling schemes to estimate means and variation. Use best scheme to measure variation along several radii at breast height. Extend sampling scheme to devise method for sampling cell dimensions in bole. Measure specific gravity, percentage summerwood, and rate of growth. Use correlation techniques to investigate relations between these characteristics and cell dimensions.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-5. **HYBRIDIZATION.** 112.01, 112.02. *Pinus* spp.

OBJECT : Develop hybrid forest trees for problem sites such as the dry, shallow-soiled sites found in the southern Appalachians.

METHOD : Cross within and between species parent trees selected for improved wood quality, insect and disease resistance, and ability to grow on the problem site involved.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-6. **DEVELOPMENT OF IMPROVED CYPRESS CHRISTMAS TREES.** 122.1. *Cupressus arizonica.*

OBJECT : Develop an improved synthetic variety of *Cupressus arizonica* for use as a Christmas tree.

METHODS : Collect seed from native habitats in the southwestern U. S. and grow trees in various regions of Alabama. Select outstanding trees from these plantings and transfer by vegetative propagation to seed orchards. Recurrent selection procedures will be used in developing the improved variety.

ASSIGNMENT : James F. Goggans, Associate Professor.

1-7. **DEVELOPMENTOFIMPROVEDTREES.** 122.1 *Pinus taeda, P. palustris, P. elliottii, P. virginiana, P. echinata.*

OBJECT : Develop improved synthetic varieties of forest trees.

METHODS : Use selection procedures combined with seed orchards to develop synthetic varieties.

COOPERATOR : Alabama Department of Conservation, Division of Forestry.

ASSIGNMENT: James F. Goggans, Associate Professor.

1—8. **ROOTING STUDIES.** 151.02, 251.02. *Cupressus arizonica, Pinus virginiana, Liquidambar styraciflua.*

OBJECT: Develop and try techniques of rooting forest tree species in order to make the production of large quantities of asexually reproduced trees easier.

METHODS : Try Arizona cypress rooting techniques developed by the Horticulture Department of the Arkansas Agricultural Experiment Station. Try these techniques on Virginia pine also. The above developed techniques involve initial treatment with-20 ppm IBA solution, and after 45 days, rewounding and treatment with 500 ppm IBA or NAA solution Other root inducing substances will be tried also. Methods developed by the Horticulture Department of the Alabama Agricultural Experiment Station will be tried on all three listed species. These methods involve treatment with material extracted from germinating chestnut seeds or placing the cutting directly in a germinating chestnut seed.

ASSIGNMENT : James F. Goggans, Associate Professor.

2. BUCKEYE CELLULOSE CORPORATION
Perry, Florida

2-1. **SLASH PINE RACIAL VARIATION.** 111.1. *Pinus* elliottii.

OBJECT : To investigate the existence of a Gulf coastal race of slash pine.

METHODS : Reciprocal plantings were made on coastal and inland sites during 1959-60 planting season. Open-pollinated seedlings grown from typical inland and coastal forms were planted in completely randomized experimental designs-single-tree plots, 10- x lo-foot spacing. Crown shape was selection basis for source trees. Anatomical features of needles, i.e., resin ducts, marginal teeth, number and size of stomates, etc., to be used for initial separation of ecotypes. Crosses of source trees in both directions are planned. Coastal outplanting : Sec. 22 of T9S, R9E, Taylor County, Florida. Inland outplanting: Sec. 9 of T5S, R7E, Taylor County, Florida.

ASSIGNMENT : Walter L. Beers, Jr., Research Forester.

3. CLEMSON UNIVERSITY, DEPARTMENT OF FORESTRY
Clemson, South Carolina

3-1. **SEED SOURCE STUDY IN EASTERN REDCEDAR.** 111.1. *Juniperus virginiana.*

OBJECT : To locate and propagate strains of eastern redcedar suitable for Christmas trees in South Carolina.

METHODS : Two hundred seedlings are being obtained from each of 24 states, mostly from state nurseries. These will be grown in a South Carolina state nursery for one year to minimize original nursery effects, and then will be outplanted on the Clemson Forest.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

3-2. **VARIATION IN LONGLEAF PINE.** 111.1, 111.2, 111.3. *Pinus palustris.*

OBJECT : To study variation in longleaf in South Carolina.

METHODS : Cones have been collected from 5 trees in each of the 34 counties in South Carolina where the species occur. These will be grown in a South Carolina nursery and outplanted on a coastal plain and a sandhills site.

COOPERATORS : South Carolina Commission of Forestry; Atomic Energy Commission, Savannah River Project.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

3-3. **VARIATION IN VIRGINIA PINE.** 111.3. *Pinus virginiana.*

OBJECT: To ascertain the variation among the progeny of individual trees growing in South Carolina.

METHODS: Seed has been collected from 65 trees located in 10 counties of the upper Piedmont, S. C. Seedlings were outplanted in January 1965 on the Clemson Forest. A 10-

tree randomized row plot was used. Number of replications varied from 3 to 10 depending on the supply of seedlings.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

3-4. **SUPERIOR TREE SELECTION IN LOBLOLLY PINE.** ***111.3, 112.02.*** *Pinus taeda.*

OBJECT: To locate superior trees and use these in breeding studies.

METHODS : Approximately 2,300 acres of 25- to 30-year-old plantations of loblolly pine on the Clemson Forest are being systematically searched for superior trees. Selected trees will be evaluated by standard methods. The trees will later be used in developing an experimental seed orchard for carrying on breeding studies.

COOPERATOR : Management staff of the Clemson Forest.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

3-5. **SEED PRODUCTION AREA IN LOBLOLLY PINE.** 122.0. *Pinus* ***taeda.***

OBJECT : To develop an area for temporary seed production, demonstration, and educational purposes.

METHODS : A lo-acre, 30-year-old planted stand has been rogued of undesirable trees and thinned to leave the best 40 trees per acre. A second cut next year will reduce the stand to 25 trees per acre. The central 2 acres will be the seed production proper. First seed collections will be made in fall 1966. These will partially meet the needs of management objectives of the Clemson Forest until improved seed from seed orchards become available.

COOPERATOR : Management staff, Department of Forestry, Clemson University.

ASSIGNMENT : R. E. Schoenike, Associate Professor; A. T. Shearin, Assistant Forester.

3-6. **INBREEDING IN VIRGINIA PINE.** 112.03, 141. *Pinus* ***virginiana.***

OBJECT: To determine the effect of self ing.

METHODS : Twenty-five trees on the Clemson Forest were selfed in 1963. A repeat wa: made in 1964. Observations will be made or nursery bed seedlings and on outplantings.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

3-7. **X-RAY EXAMINATION OF SEED EMBRYOS** 151.3, 251.3. *Pinus* ***palustris, P.*** *elli-* ***ottii, P. taeda, P. echinata,*** *Juniperus* ***virginiana, Fraxinus*** spp., *Liquidambar styraciflua,* ***Nyssa sylvatica,*** and *Liriodendron* ***tulipifera.***

OBJECT : (1) Attempt to obtain clear X-ray pictures of seed embryos within the intact seed, and (2) attempt to correlate embryo conditions determined from such pictures with seed viability as determined from actual germination tests or other tests.

METHODS : Seed samples are photographed with a low-voltage industrial X-ray machine using Type M film. The same seed are then tested by other methods to determine whether X-ray examination can replace or supplement conventional testing methods.

COOPERATOR: U. S. Atomic Energy Commission, Savannah River Operations.

ASSIGNMENT: W. H. Davis McGregor, Associate Professor.

3-8. **VARIATION IN** ***Quercus*** **SPP.** 211.1, 211.3. ***Quercus falcata.***

OBJECT : To study individual tree and racial variation in selected species of ***Quercus,*** beginning with ***Quercus*** falcata.

METHODS : Acorns will be collected from 5 trees in each of about 40 localities throughout the range of southern red oak. Material will be grown in a South Carolina nursery and outplanted in the Piedmont and coastal plain areas of the state.

COOPERATOR : S-23 Project members; South Carolina Commission of Forestry.

ASSIGNMENT : R. E. Schoenike, Associate Professor.

4. CONTINENTAL CAN COMPANY, INC.
Savannah, Georgia

4-1. **TRIALS OF SOME MEXICAN PINE SPECIES.** 111.0. *Pinus.*

OBJECT : To compare the performance of some of the Mexican pine species with slash and loblolly pine.

METHODS : Species under test include ***Pinus montezumae, P. rudis, P. Hartweggii, P. oocarpa, P. michoacana, P. Lawsoni, P. tenuifolia, P. Douglasiana, P. teocote, P. patula, P. durangensis, P. pseudostrobus, P. leiophylla, P. Herrerai, P. arizonica, P. chihuahuana,*** and slash and loblolly pine. Test plantings have been established in Florida, Georgia, and Virginia; 15-tree plots, 4-6 replications. Additional plantings are planned (initial survival was poor). This seed was collected in 1963 by the Cooperative Industry-North Carolina State College Group; wood samples, botanical specimens, and mensurational data were collected at the same time.

COOPERATORS : Kimberly-Clark Corp.; Bowaters Inc.; Union Bag-Camp Corp.; Champion Paper Co.; West Virginia Pulp & Paper Co.; and North Carolina State University.

ASSIGNMENT : D. E. Cole, Research Forester

4-2. **WOOD PROPERTIES OF SLASH, LOBLOLLY, AND LONGLEAF PINE IN NORTHEAST FLORIDA, EASTERN GEORGIA, AND SOUTHEASTERN SOUTH CAROLINA.** 111.0, 111.1, 111.3, 151.32. *Pinus* ***elliottii, P. taeda, P. palustris.***

OBJECT : (1) To determine the wood properties of these species as they vary with site, age, geographic area, species, between natural stands and plantations, etc., and (2) to locate trees with outstanding wood properties for future use.

METHODS : Twenty-tree plots of dominants and codominants only; 50 slash plots, 30 plots each of loblolly and longleaf are planned. Four site classes, four age classes, three geographic areas, and two plots in each condition class are used. Two trees per plot (random selections) are felled, weighed bolt by bolt, and each bolt sampled with 10mm. cores and wedges; 2 trees per plot are sampled with two 10mm. breast height cores; and the other 16 trees sampled with a single 10mm. breast height core. Wood properties determined are moisture content, specific gravity, tracheid length, percent compression wood, percent extractives, chemical heartwood and cellulose content (plot average) ; separate determination, all properties, for corewood and outerwood.

ASSIGNMENT : D. E. Cole, Research Forester.

4-3. **WOOD PROPERTIES OF OPEN-POLLINATED PROGENIES OF SLASH AND LOBLOLLY SELECT TREES.** 111.0, 111.1, 111.3, 112.02, 141, 151.32. *Pinus* ***elliottii, P. taeda.***

OBJECT : (1) To establish the correlation between the wood properties of various slash and loblolly select trees and their open-pollinated progenies; (2) to get an estimate of the heritability of these properties; (3) to see if any effect of geographic origin is detectable on wood properties; and (4) to establish a base for correlation between juvenile and mature characteristics of wood.

METHODS : Bark-to-bark 10mm. cores were pulled from 6-year-old trees in open-pollinated slash and loblolly progeny tests; 10 trees per plot, 4 replications; 13 slash clones, 3 loblolly clones, and about 12 check lots. Living parent trees will be resampled for wood properties and regraded for bole and crown characteristics. Progenies will be evaluated for bole and crown characteristics. Wood properties to be determined are moisture content, specific gravity, extractive content, tracheid length, summerwood cell wall thickness, percent compression wood, and cellulose content.

COOPERATOR: University of Florida

ASSIGNMENT : D. E. Cole, Research Forester

4-4. **A COMPARISON OF THE WOOD PROPERTIES OF SLASH, LOBLOLLY, AND LONGLEAF PINE IN A MIXED NATURAL STAND.** 111.0, 151.32. *Pinus elliottii, P.* ***taeda,*** and ***P. palustris.***

OBJECT : (1) To compare the wood properties of these species where age, site, and spac-

ing are uniform; (2) to determine which species produces the most wood under these conditions; and (3) to see if there is any correlation between species, wood properties, and bole and crown characteristics.

METHODS : Fifty sample trees, dominant or codominant, were selected for each species in a 15-acre old field stand, Bulloch County, Georgia. Bark-to-bark 10mm. cores were pulled at b.h. from each tree; height, diameter, and bole and crown were measured. Wood properties determined were moisture content, specific gravity, percent extractives, percent compression wood, percent corewood, tracheid length, and cellulose content; separate determinations, all properties, for corewood and outerwood. Then 5 trees with high specific gravity and 5 trees with low specific gravity were selected for each species; these trees were felled, weighed bolt by bolt and each bolt sampled with 10mm. cores and wedges. Finally, pulp and paper tests were run on one high and one low specific gravity tree of each species.

COOPERATOR : North Carolina State University.

ASSIGNMENT : D. E. Cole, Research Forester

4-5. LOCAL SEED SOURCE TESTS OF LOBLOLLY AND SLASHPINE FOR THE SAVANNAH, AUGUSTA, HODGE, LOUISIANA, AND HOPEWELL, VIRGINIA, WOODLANDS DISTRICTS. 111.1 *Pinus taeda,* P. *elliottii, P. virginiana, P. palustris.*

OBJECT : (1) To establish test plantings of slash and loblolly pine in the various major areas where the company collects seed, so as to compare the performance of seedlings from these areas in the areas where they originate and in other areas where that species might be planted; (2) to get a comparison of the performance of slash and loblolly by including one plot of loblolly in each of the slash blocks and vice versa; and (3) to design the plantings so that valid comparisons can be made with later plantings representing our various seed production areas and seed orchards.

METHODS : The design is as follows: Plots of 49 seedlings, spacing 7 x 9 feet; eight seed sources are represented in both the slash and loblolly blocks; each block is replicated foul times. There are slash plantings at five locations; loblolly plantings are duplicated at foul of these locations and there are loblolly plantings at three other locations. Slash plantings are located in Jasper County, South Carolina Appling County, Georgia; Long County, Georgia; Baker County, Florida; and Bullock County, Georgia. Loblolly plantings are duplicated in each of the first four slash plantings and also in Bleckley County, Georgia; Hancock County, Georgia; and Saluda County South Carolina. Most of the slash plantings are on flatwoods or upper coastal plain soils the loblolly plantings range from the flatwoods to the Piedmont.

This study, established in 1958-59, has been expanded to cover the Hodge, Louisiana, and Hopewell, Virginia, Districts.

The plantings in the Hodge District include six Louisiana, Arkansas, and East Texas loblolly seed sources, slash from Southeast Louisiana, the loblolly testers from the Hopewell and Savannah District tests, and the slash tester from the Savannah District test. There will be plantings at five different locations on company lands.

The plantings in the Hopewell District include six Virginia and North Carolina loblolly pine seed sources, one Virginia source of Virginia pine, the loblolly pine testers from the Hodge and Savannah Districts, and the slash pine tester from the Savannah District.

There will be plantings at six locations in Maryland, North Carolina, and Virginia.

A series of supplemental plantings are being established in the Savannah and Augusta Districts. This will include two Georgia sources of longleaf pine, slash pine from southeast Louisiana and Georgetown, South Carolina, a Georgia coastal plain loblolly pine seed source, the loblolly pine testers from the Hodge and Hopewell Districts, and the slash and loblolly pine testers from the Savannah and Augusta Districts.

Twenty-five tree plots and four replications are to be used in the Hodge and Hopewell Districts. Forty-nine tree plots are being used for the supplemental plantings in the Savannah and Augusta Districts but only the 25 trees in the middle of the plots will be measured. Spac-

ing is 9 x 9 in all cases; planting sites have been chosen to sample a range of soil types. These plantings were established in winter of 1962-63.

ASSIGNMENT : D. E. Cole, Research Forester.

4-6. **TESTING VARIATION AMONG INDIVIDUALS.** 111.3. *Pinus elliottii, P. taeda.*

OBJECT : To locate individual trees with a high degree of resistance to *Cronartium fusiforme* for use in a program to develop strains resistant to *Cronartium fusiforme.*

METHOD : Open-pollinated progenies from trees being used in our slash and loblolly seed orchards and from sample trees on seed production areas are grown in plots and force-inoculated with *Cronartium fusiforme.* The following winter the infection rate is checked. Any which show appreciable resistance will be control-pollinated to determine if they pass on to their progeny any of their apparent resistance. Results to date are negative.

ASSIGNMENT : D. E. Cole, Research Forester

4-7. **TESTING VARIATION AMONG INDIVIDUALS.** 111.3. *Pinus taeda, P. elliottii.*

OBJECT: To establish open-pollinated progeny tests of various trees represented in slash and loblolly seed orchards which have been established in cooperation with the University of Florida and North Carolina State College.

METHOD : Test design and production of progeny test material will be done according to plans developed by cooperative forest tree improvement projects.

COOPERATORS : University of Florida; North Carolina State University.

ASSIGNMENT : D. E. Cole, Research Forester.

4-8. **CROSSES OF NATURAL SLASH-LOBLOLLY HYBRID AND INDIVIDUAL SLASH AND LOBLOLLY SELECT TREES.** 111.3, 112.02. *Pinus* spp.

OBJECT: To assay the genetic makeup of an apparent slash-loblolly hybrid by using pollen from it on both slash and loblolly select trees.

METHOD : This hybrid is represented in the open-pollinated progeny test of slash select trees referred to in project 3; its seedlings appear to be significantly higher than the average at the end of the first year in the field. First pollinations using pollen from this tree were made in the spring of 1962.

ASSIGNMENT : D. E. Cole, Research Forester.

4-9. **ESTABLISHMENT OF CERTIFIED SEED PRODUCTION AREAS.** 122.0, 122.2. *Pinus taeda, P. elliottii.*

OBJECT: To develop sources of seed of the best possible quality until our seed orchards come into quantity production.

METHODS : Establish slash and loblolly seed production areas according to the standards of the Georgia Crop Improvement Association. To date we have two certified loblolly production areas, one in Jeff Davis County, Georgia, and one in Hancock County, Georgia, with a total of 17 acres. We also have three certified slash seed production areas which total 42 acres; one in Long County, and two in Emanuel County, Georgia.

These areas are being fertilized and observations will be made on the effect of fertilization of seed production. Progeny tests will be established as seed becomes available. The first harvest on the oldest certified areas was in the fall of 1960.

Progeny tests were established during the 1962-63 winter in Bryan County, Georgia; Emanuel County, Georgia; Twiggs County, Georgia; Nassau County, Florida; and Jasper County, South Carolina, with 25 tree plots and 6 replications. Seed lots include slash and loblolly certified seed production area seed, slash and loblolly uncertified seed production area seed, seed collected from the isolation zone of certified seed production areas and from the adjacent unrogued stand, and the tester seed lots from our local seed source test.

In addition, seed production areas have been established on Company lands in Virginia and Louisiana using the Georgia Crop Improvement Association Standards (these areas are not certified, however).

Harvests were made in all Districts in 1961 and in the Hodge and Savannah-Augusta Districts in 1962.

A new certified area has been established in Effingham County, Georgia; the one in Long County, Georgia, has been increased in size.

ASSIGNMENT : D. E. Cole, Research Forester.

4-10. A **COMPARISONOFTHEWOODPROPERTIES OF SWEETGUM, SYCAMORE, AND WHITE ASH IN A MIXED NATURAL STAND.** 211.0, 211.3, 212.02, 251.32. *Liquidambar styraciflua, Platanus occidentalis, Fraxinus americana.*

OBJECT : (1) To compare the wood properties of these species under conditions where age, site, and spacing are uniform; (2) to determine relationship between wood properties and bole form, crown characteristics, growth rate, etc.; (3) to establish relationship between the wood properties of selected sample trees, ramets established vegetatively from them, and their open-pollinated progenies; and (4) to establish the relationship between wood properties, bole and crown characteristics, and the properties of pulp and paper.

METHODS : Twenty-five dominant or co dominant sample trees were selected for eacl species in an even-aged natural stand, Han cock County, Georgia. Bark-to-bark 10mm cores were taken at b.h. from each tree anc they were measured for bole, crown, anc growth characteristics. Seed and cuttings have been taken from the sycamore sample trees an attempt will be made to collect seed fron the ash and sweetgum next fall (1965). Tht sycamore cuttings are in the greenhouse anc part of the seed will be sowed this spring Wood properties to be determined are moisture content, specific gravity, fiber length, percent vessels by volume, cellulose content, percent corewood volume. Separate determination: will be made for all properties in the corewooc and outerwood.

COOPERATOR : North Carolina State University.

ASSIGNMENT : D. E. Cole, Research For ester.

5. FLORIDA FOREST SERVICE
Tallahassee, Florida

5-1. **SLASH PINE SEED PRODUCTION AREAS.** 122.0. *Pinus elliottii.*

OBJECT : To collect as much seed as possible from phenotypically selected stands for the production of better seedlings in the State nurseries.

METHODS : A total of 600 acres of slash pine stands have been rogued of the poorer phenotypes and thinned to permit fuller crown development. One seed production area of 225 acres is located in the rolling uplands of west Florida on the Blackwater River State Forest. A second area containing 375 acres of former plantations on a flatwoods site is located in Camp Blanding Military Reservation near Starke, Florida.

ASSIGNMENT : R. A. Jordan, Reforestation Supervisor.

5-2. **SEED ORCHARDS FOR PINE SEED PRODUCTION.** *122.1. Pinus elliottii, P. elliottii* var. *densa, P. palustris,* and *P. clausa.*

OBJECT : To improve the genetic quality of seedlings produced in State nurseries by collecting seed from selected clones of slash pine.

METHODS : Work on this project was begun in 1958 with the initial selection of over 400 phenotypically superior trees. These selections will be screened more closely and the final selections propagated by grafting. The ultimate goal is a total of 900 acres of seed orchards. Individual orchards will be located on the Blackwater River State Forest and the Withlachoochee State Forest.

Of this acreage approximately 37 acres will be *Pinus palustris,* approximately 50 acres will be *Pinus clausa,* 50 acres high gum yield *Pinus elliottii,* and approximately 15 acres of *Pinus elliottii* var. *densa.*

COOPERATORS : University of Florida.

ASSIGNMENT : R. A. Jordan, Reforestation Supervisor; H. R. Kok, Tree Improvemenl Supervisor; M. H. Zoerb, Jr., Tree Improvement Forester.

5-3. TROPICAL **INTRODUCTION RESEARCH.** 111.0, 211.0. Softwoods, hardwoods.

OBJECT: To introduce various tropical forest species that will grow and produce forest products in south Florida.

METHODS : Seeds of exotic tropicals are planted in our nursery located near Punta Gorda, Florida, and seedlings produced therefrom are planted on various sites in south Florida to test their performance on these sites and weather conditions. As species prove themselves worthy, they are placed on the market to the public for forest planting.

ASSIGNMENT : E. A. Schory, Tropical Research Forester.

6. FLORIDA FORESTS FOUNDATION
Fort Myers, Florida

6-l. **SITE-PHOSPHATE STUDY.** 211.0, 251.09. ***Eucalyptus camaldulensis*** (two seed sources), ***E. grandis, E. grandis*** × ***camaldulensis, E. robusta, E. rudis.***

OBJECT : (1) To define the adaptability of promising eucalypts to representative southwest Florida land types, and (2) to determine if application of ground rock phosphate alters species adaptability patterns.

METHODS : The following land types are represented by single sites: acid flatwoods, sweet flatwoods, wet prairie, palmetto prairie, and dry ridge. Each site is an independent experiment with species planted with 0 and 1,250 pounds per acre of ground rock phosphate. The design is a four-replicated, randomized block with 25-tree square plots. Planted 1963.

COOPERATORS : American Agricultural Chemical Company; Babcock Florida Company; Lykes Bros. Inc.; Florida Forest Service.

ASSIGNMENT : George F. Meskimen, Research Forester.

6-2. **SPECIES AND SEED SOURCE COMPARISON.** 211.0, 211.1. ***Eucalyptus botryoides, E. camaldulensis, E. grandis, E. robusta, E. rudis, E. saligna, E. tereticornis,*** *Casuarina equisetifolia,* ***C. glauca, Grevillea robusta.***

OBJECT : To compare the southwest Florida performance of rapidly growing exotic hardwood species; and to indicate the importance of seed source in species introduction.

METHODS : A 25-acre acid flatwoods site was disced, bedded, and planted in 1961. Design is randomized block with four replications and 64-tree square plots. Individual species represented by 2 to 12 seed sources; a total of 50 seed sources in the project.

COOPERATOR : The Collier Company.

ASSIGNMENT : George F. Meskimen, Research Forester.

6-3. **OPEN-POLLINATED PROGENY TEST.** 211.1, 211.3. Eucalyptus *grandis.*

OBJECT : (1) To compare performance of progenies from Florida-selected, plus phenotypes; (2) to compare progeny performance against the Australian seed sources from which the mother trees were selected; and (3) to compare several Australian seed sources.

METHODS : Open-pollinated seed was collected from eight 2-year-old trees selected for form and vigor under local conditions. Progeny were outplanted with seedlings from the original Australian seed sources and other recently introduced sources of ***E. grandis.*** Design is completely randomized with single-tree plots. Each progeny or source is represented by 48 to 100 trees. Planted 1964.

COOPERATORS : Lykes Bros. Inc.; Florida Forest Service.

ASSIGNMENT : George F. Meskimen, Research Forester.

7. IDA CASON CALLAWAY FOUNDATION
Pine Mountain, Georgia

7-l. **PINE TREE BREEDING PROJECT.** 112.01, 112.02. *Pinus palustris,* ***P. taeda, P. echinata, P.*** *elliottii.*

OBJECT: To develop improved strains of the four major species of southern pine for planting in west central Georgia (see project

8, SEFES, Macon, Georgia).

METHOD : Selections were made of slash, loblolly, shortleaf, and longleaf pines, and open-pollinated progeny tests established. Subsequently, controlled intra- and inter-specific crosses were made and planted in progeny tests. Emphasis is on growth, form, and disease resistance.

COOPERATOR: U. S. Forest Service, Southeastern Forest Experiment Station.

ASSIGNMENT : Eitel Bauer, Forester.

7-2. DEVELOPMENT OF COMMERCIAL SEED ORCHARDS OF SLASH AND LOBLOLLY PINE. 122.1. *Pinus* ***taeda, P. elliottii.***

OBJECT : To establish sources of improvec tree seeds for commercial use.

METHOD : Parental selections were made based on progeny tests in project 1 above. Orchards of open-pollinated seedlings from selected parents were established beginning in 1954. Acreages established are 2 loblolly and 49 slash pine. A study is being conducted on methods of grading individual trees and roguing the areas to insure seed of improved genetic constitution.

COOPERATOR : U.S. Forest Service Southeastern Forest Experiment Station.

ASSIGNMENT : Eitel Bauer, Forester.

8. INTERNATIONAL PAPER CO., SOUTHLANDS EXPERIMENT FOREST
Bainbridge, Georgia

8-1. RACIAL STUDIES IN SLASH PINE. 111.1. *Pinus* ***elliottii.***

OBJECT : (1) To test the possibility of ecotypic differentiation within slash pine and (2) to test the superiority of certain slash pine seed sources on wet and dry sites.

METHODS : Replicated tests of slash pine seed sources have been established in three locations; one in Decatur County, Georgia, one in Calhoun County, Florida, and the other in Mobile County, Alabama.

ASSIGNMENT : Roy W. Stonecypher, Silviculturist; Coleman Carr; Claude O'Gwynn.

8-2. TESTS OF COMPANY SEED PRODUCTION AREAS. ***122.0.*** *Pinus.*

OBJECT : To test the gains obtained by use of planting stock derived from Company seed production areas.

METHODS : Replicated tests comparing nursery run to seed production area seedlings have been established in Florida and Alabama. Similar tests of all Company seed production areas are planned.

ASSIGNMENT : Roy W. Stonecypher, Silviculturist.

8-3. TESTS OF COMPANY SEED ORCHARDS 122.1. *Pinus.*

OBJECT : To progeny test all Company seed orchard selection.

METHODS : Replicated progeny tests of each seed orchard or section are being established in at least two locations in each Company region.

ASSIGNMENT : Roy W. Stonecypher, Silviculturist.

84. USE OF ELECTRONIC COMPUTER IN ANALYZINGFORESTGENETICSRESEARCH. ***153*** *Pinus.*

OBJECT: To develop computer programs to efficiently manipulate and analyze data obtained from basic quantitative genetics studies and progeny tests.

METHODS : Computer programs are being written for use on the Company's IBM 1620 computer.

ASSIGNMENT : Roy W. Stonecypher, Silviculturist.

9. LOUISIANA STATE UNIVERSITY, SCHOOL OF FORESTRY AND WILDLIFE MANAGEMENT
Baton Rouge, Louisiana

9-1. EFFECTS OF GEOGRAPHIC SOURCE OF SEED ONPLANTED LOBLOLLY PINE. 111.1 ***.Pinus taeda.***

OBJECT: To discover if there are any important differences among sources of loblolly pine which would warrant delineating seed

collection zones within the state.

METHODS : (1) Exploratory plantation established in coastal plain soil in Washington Parish, La., in winter of 1954. There were four seed sources. A randomized block design was used, with four replications of each seed source. Seedlings were planted at 6 x 6 spacing in a square of 11 rows of 11 trees each, the two outermost rows serving as border strips. (2) January 1958 plantations: five sources, three locations-Washington, East Feliciana, and Vernon Parishes. (3) January 1959 plantations: 12 sources, Claiborne Parish; 10 sources, East Feliciana Parish. Statistical design of 1958 and 1959 plantations: See "Standardized Working Plan for Local Tests of Seed Source," prepared by the Committee on Southern Forest Tree Improvement, Subcommittee on Geographic Source of Seed, dated October 25, 1951. The study is part of the S-23 project.

ASSIGNMENT: A. B. Crow, Professor.

9-2. **NATURAL VARIATION IN AMERICAN SYCAMORE. 211.3.** *Platanus occidentalis* L.

OBJECT: To assess the natural variation in botanical features and certain wood characteristics of American sycamore; and to assess the relationship of such variation to the existence of geographic races, clines, or to environmental influences.

METHODS : (1) Variation will be determined in fiber length, growth rate, specific gravity, and ash content of increment-core samples, and in leaf, fruit, and twig characteristics collected from within the natural range of sycamore and will be correlated with geographic, climate, or site characteristics. (2) Outplanting will be made of trees grown from seed from geographic locations throughout the natural range. The study is part of the S-23 project.

ASSIGNMENT: P. J. Fogg, Instructor.

10. NORTH CAROLINA STATE UNIVERSITY, SCHOOL OF FORESTRY
Raleigh, North Carolina

10-1. **COLLECTION AND STUDY OF MEXICAN PINES.** 11. *Pinus.*

OBJECT: To collect seed, foliage, and wood. specimens of various Mexican pines. To test these seed in a number of plantings throughout the Southeastern United States, Brazil, and Hawaii.

METHOD : Collections were made from a total of 110 trees representing 15 species by a 6-man team in 1952, sponsored by six industries and North Carolina State. Pilot-plant studies are underway throughout the southeast.

COOPERATORS : Hiwassee Land Company (Bowaters) ; Continental Can Company; Kimberly-Clark Corporation; Champion Papers Inc.; West Virginia Pulp and Paper Company; Union Bag-Camp Paper Corporation.

ASSIGNMENT: L. C. Saylor, Assistant Professor; R. L. McElwee, Geneticist; B. J. Zobel, Professor; R. C. Kellison, Liaison Geneticist; Foresters from cooperating agencies.

10-2. **VARIATION AND INHERITANCE OF WOOD PROPERTIES.** 111, 141, 151.32, 211, 241, 251.32. *Pinus taeda, P. elliottii, P. serotina, P. strobus, P. virginiana, Liriodendron tulipifera, Liquidambar styraciflua.*

OBJECT : (1) To determine variation within trees, among trees, and among stands in wood quality factors; (2) to isolate wood quality factors important in final products; and (3) to determine inheritance patterns of the factors.

METHODS : Variation in wood properties among trees in different geographic races is determined. Wood variation with a tree; the basic inheritance patterns of wood specific gravity; and the inter-relations of wood characteristics are determined as well as gross heritabilities and parent-offspring relationships. The occurrence and importance of compression wood has been evaluated; the effect of certain wood and fiber qualities on final product will be worked out to aid selective breeding programs. The studies are part of the S-23 project.

COOPERATORS : Members of cooperators in Tree Improvement Program, especially International Paper Company, Union Bag-Camp Paper Corporation, Weyerhaeuser Timber Company, Continental Can Company (See Project No. 6), State and Federal Research Organizations, Staffs of cooperating companies.

ASSIGNMENT : B. J. Zobel, Professor; R. C. Kellison, Liaison Geneticist; J. W. Duffield, Professor; C. Browne, Laboratory Technician; M. Mathias and C. Kennedy, Research Assistants; Graduate students: F. Taylor (yellow-poplar) ; K. A. Taft (yellow-poplar) ; M. A. Taras (loblolly pine) ; C. Posey (loblolly pine) ; R. W. Stonecypher (loblolly pine) ; J. E. Kundt (Virginia pine) ; K. W. Kang (pond pine and pond × loblolly hybrid) ; T. Shelbourne (loblolly and slash pine) ; D. G. Nikles (Caribbean slash pine).

10-3. **HYBRIDIZATION, INTROGRESSION, AND CYTOGENETICS.** 111, 112.01, 141, 151.1, 211, 241, 251.1. *Pinus,* Liriodendron ***tulipifera, Liquidambar styraciflua.***

OBJECT : (1) To determine chromosome morphology in the genus *Pinus;* (2) determine the chromosome pairing patterns among pines; (3) conduct a "directed breeding" hybridization program; and (4) investigate variation, inheritance, and breeding characteristics of yellow-poplar and sweetgum.

METHODS: The chromosome morphology of over 70 species of pines from seed collected in Mexico and other areas are being studied and test plantings of trees are being made. The chromosome pairing patterns among wide crosses in pines produced at the Institute of Forest Genetics at Placerville, Institute of Forest Genetics at Gulfport, and Texas Forest Service, are being worked out. Hybridization to produce a tree suitable to grow on certain problem sites is being conducted for industrial use (Union Bag-Camp and West Virginia Pulp and Paper Companies). A study of introgression is being made based on the natural hybrid between loblolly and longleaf pine, loblolly and pond pine, and of the slash pine complex in the Caribbean. Morphological and growth characteristics of native sweetgum are being studied to work out individual, clinal, and ecotypic variation patterns. The degree of compatibility for yellow-poplar and sweetgum is being determined through use of recently developed techniques for controlling pollination in these two species.

COOPERATORS : B. Smith, N. C. State; W. Critchfield, Institute of Forest Genetics at Placerville; E. B. Snyder, Institute of Forest Genetics at Gulfport; Union Bag-Camp Paper Corporation; West Virginia Pulp and Paper Company; Halifax Company; numerous corn pany foresters.

ASSIGNMENT: L. C. Saylor, Assistant Pro fessor; B. J. Zobel, Professor; J. W. Duffield Professor; G. Namkoong, Research Forester Institute of Forest Genetics at Gulfport (U. S Forest Service); K. W. Kang, Graduate Assist ant (South Korea) ; D. G. Nikles, Graduate Stu dent (Australia) ; J. H. Roberds, Graduate As sistant; R. C. Kellison, Liaison Geneticist; J Hofmann, Albemarle.

1 0 4 . **INHERITANCE OF PHYSIOLOGICAL ANI CLOSELYRELATEDCHARACTERISTICS.111** 141, 211, 241. *Pinus* ***taeda.*** Hardwoods

OBJECT : To determine variation and inheritance of physiological and closely related characteristics in some forest trees.

METHOD : Studies are underway on photo, synthetic efficiency, differential photoperiodic reaction, nutrient content of needles, dry matter content of needles, salt-tolerant races of loblolly pine, drought-tolerant races of loblolly pine, and bark thickness in young loblolly pine

COOPERATORS : Members of North Carolina State-Industry Cooperative Program.

ASSIGNMENT : T. 0. Perry, Associate Pro. fessor; B. J. Zobel, Professor; J. W. Duffield Professor; T. E. Maki, Head, Department of Forest Management; F. Ledig, Graduate Assistant; W. Beineke, Graduate Assistant; C Franklin, Graduate Assistant; S. Land, Graduate Assistant; T. Shelbourne, Graduate Assist. ant.

10-5. **PROVENANCE STUDIES.** 111.1, 211.1 *Pinus,* ***Liquidambar styraciflua,*** *Liriodendron* ***tulipifera.***

OBJECT: To determine the existence of geographic races in certain forest tree species

METHODS : A study of racial variation in loblolly, established in 1958, consists of 20 acres of outplantings in the coastal plain replicated eight times in the design. A study of sweetgum was installed in 1959 with plantings of trees from various locations in North Carolina, and planting of seed from areas throughout the species range is completed. A study with yellow. poplar has been started, comprising investigation of wild stands in North Carolina from the seacoast to the mountains, and the growing of

seedlings from different stands for planting in areas on the coastal plain and Piedmont. In addition, studies are in progress for several other species of pines, including *P. virginiana*. A region-wide provenance study involving 140 individual tree seed lots (open-pollinated) from 28 locations is being established throughout the range of sweetgum in the South with seed from the 1964 and 1965 seed crops. All cooperators in the Hardwood Research Program are taking active parts in this study.

COOPERATORS : Members of North Carolina State-Industry Cooperative Program.

ASSIGNMENT : B. J. Zobel, Professor; R. C. Kellison, Liaison Geneticist; R. L. McElwee, Geneticist.

10-6. **DEVELOPMENT AND TESTING OF PINE SEED ORCHARDS FOR COMMERCIAL USE.** 111.3, 122. *Pinus*.

OBJECT : (1) To develop and apply selective breeding methods for mass production of improved seed with maximum genetic gain in the shortest time, and (2) to develop a tree bank with a broad genetic base from which to draw for improved, future seed orchards.

METHODS : (1) Trees used in the establishment of seed orchards by forest industries are selected, graded, and progeny tested. Progeny testing is by open- and control-pollinated seed, using a 4-tester system for the latter. Data from progeny tests will be used to develop improved selection indices. Seed production areas are developed for use until seed orchards begin production. Seed orchard management procedures, particularly fertilizer and irrigation schedules, will be worked out. (2) Inasmuch as future seed orchards may need genetic types much different from those we have today, it is prudent to develop a "gene pool" by preserving different genotypes in a tree bank. Trees that are well-formed and fast-growing and which also react well to fertilizer, intensive management, or cultivation are examples. Several hundred clones have been established to date; wide crosses within species and inter-specific crosses are made to insure a wide variety of different and new genotypes.

COOPERATORS : Cooperating agencies in the North Carolina State-Industry Tree Improvement Program. Organizations included are : Albemarle Paper Manufacturing Company, Catawba Timber Company (Bowaters) , Champion Papers Incorporated, Chesapeake Corporation of Virginia, Continental Can Company, Georgia Kraft Company, Hiwassee Land Company (Bowaters) , International Paper Company, Kimberly-Clark Corporation, American Can Company, North Carolina Forest Service, Riegel Paper Corporation, South Carolina Forestry Commission, Tennessee River Pulp and Paper Company, Union Bag-Camp Paper Corporation, West Virginia Pulp and Paper Company, Weyerhaeuser Paper Company.

ASSIGNMENT : B. J. Zobel, Professor; R. C. Kellison, Liaison Geneticist; L. C. Saylor, Assistant Professor; T. E. Maki, Professor; T. 0. Perry, Associate Professor; J. W. Duffield, Professor; Personnel from each cooperating organization; 15 graduate students.

10-7. **STATISTICAL METHODS IN FOREST GENETICS.** 141, 153, 253. Softwoods, hardwoods.

OBJECT : (1) To develop statistical methods applicable to quantitative genetics and to progeny testing forest trees, and (2) determine the role of inbreeding and selfing in pine.

METHOD : Assessment is under way to determine design efficiency and analyses that are characteristic of studies in quantitative genetics. Studies of the importance of plot size have been included, as well as comparative efficiencies between open- and control-pollinated progenies from the same trees. Extent and importance of inbreeding will be studied.

COOPERATORS : International Paper Company (Southlands Experiment Forest) ; National Science Foundation; National Institute of Health; Genetics Department, North Carolina State University.

ASSIGNMENT : R. W. Stonecypher, International Paper Company; G. Namkoong, Research Forester, Institute of Forest Genetics at Gulfport (U. S. Forest Service) ; J. H. Roberds, Graduate Assistant; H. F. Robinson, Head, Institute of Biology, N. C. State University; C. Cockerham, Institute of Statistics, N. C. State University.

10-8. **INHERITANCE PATTERNS, VARIANCE COMPONENTS, AND BREEDING PROCEDURES.** 141, 241. *Pinus*, hardwoods.

OBJECT : To determine inheritance patterns, variance components, and best breeding procedures for several species of pine and hardwoods.

METHODS : Inheritance patterns and variance components are being obtained from a large cooperative study located largely on the Southlands Experiment Forest of the International Paper Company. Characteristics such as needle anatomy, growth habit, wood properties, physiological reactions, disease resistance, and many others are being studied. Plantings have been made in the greenhouse and on Piedmont and coastal plain soils. Both open-pollinated and control-pollinated seed are used; the latter is a modification of N. C. State Design I, (male group method). Clonal material from the same parents used for open- and control-pollination will be established. Selected parent trees and some of their progeny will be cut and pulped to determine inheritance of certain wood characteristics. Also, seed orchard crosses from progeny tests will be used in studies of variance components. Juvenile-mature correlations will be computed. Variance components of yellow-poplar and Virginia pine will be determined by means of diallel crosses. Inheritance patterns in sweetgum and yellow-poplar will be determined from a series of open-pollinated progeny tests.

COOPERATORS : International Paper Company; Wood Products Department, N. C. State University; Members of cooperative Tree Improvement Program; Genetics Department, N. C. State; National Science Foundation; National Institute of Health.

ASSIGNMENT : B. J. Zobel, Professor; R. C. Kellison, Liaison Geneticist; R. W. Stonecypher, Silviculturist, International Paper Company; H. F. Robinson, Head, Institute of Biology, N. C. State; J. H. Roberds, Graduate Assistant; C. Franklin, Graduate Assistant; K. A. Taft, Graduate Assistant; B. B. Kinloch, Jr., Graduate Assistant; G. Namkoong, Research Forester, Institute of Forest Genetics at Gulfport, U. S. Forest Service.

10—9. **POLLEN FLIGHT CHARACTERISTICS.** 154.5. *Pinus.*

OBJECT: To determine the horizontal and vertical aspects of pollen flight in addition to the viability pattern of long-flight pollen, and to determine the value of radio-active material, to solution of pollen problems.

METHODS: Studies of pollination are essential to understanding the pattern among trees and the evolutionary significance of pollen spread. Future work will involve the use of radio-active materials to add to the information now available on pollen problems. 0. immediate, practical importance is information obtained on requirements for isolation of seed orchards and seed production areas and on degree of contamination to be expected in seed orchards. Differential pollination by individual trees will be studied.

COOPERATORS : Savannah River Project Atomic Energy Commission.

ASSIGNMENT: R. L. McElwee, Geneticist B. J. Zobel, Professor; J. B. Hatcher, Forester U. S. Forest Service.

10-10. **VARIATION AND INHERITANCE OF WOOD PROPERTIES.** 211, 241, 251.32. *Quercus phellos, Quercus* ***nigra, Nyssa*** *sylvatica* var. *biflora,* ***N. aquatica.***

OBJECT : (1) To determine variation within tree, among trees, and among stands in wood quality factors; (2) to isolate good quality factors important in final products; and (3) to determine inheritance patterns of the factors.

METHODS : Variation in wood properties within trees, among trees, and geographic areas is determined. The basic inheritance patterns of wood specific gravity, and the inter-relations of wood characteristics are determined. The effect of certain wood and fiber qualities on final product will be worked out.

COOPERATORS : Members of the Cooperative Hardwood Research Program; State and Federal research organizations, staffs of cooperating agencies; Albemarle Paper Manufacturing Co.; Champion Papers; Continental Can Co., Inc.; Georgia Pacific Corp.; International Paper Co.; Kimberly-Clark Corp.; Riegel Paper Corp. ; Riverside Manufacturing Co.; Union Bag-Camp Paper Corp.; Weyerhaeuser Co., and Williams Furniture Co.

ASSIGNMENT : R. L. McElwee, Geneticist, J. W. Duffield, Professor; J. B. Faircloth, Laboratory Technician; R. A. Usanis, Graduate Student.

10-11. **VEGETATIVE PROPAGATION OF FOREST TREES.** 251.02. ***Liquidambar*** *styraciflua,* ***Liriodendron tulipifera,*** *Platanus* ***occidentalis, Fraxinus americana.***

OBJECT: To develop methods of vegetative propagation for sweetgum, yellow-poplar, sycamore, white ash.

METHODS : Methods of grafting in the greenhouse and field are under way for all species.

COOPERATORS : Several cooperating industries.

ASSIGNMENT : R. L. McElwee, Geneticist; B. J. Zobel, Professor; T. Shelbourne, Graduate Assistant.

11. TENNESSEE VALLEY AUTHORITY, DIVISION OF FORESTRY DEVELOPMENT Norris, Tennessee

11-l. **SELECTION AND TESTING OF IMPROVED FOREST TREES.** 111.0, 111.3, 211.0, 211.3. *Pinus* ***taeda, P. echinata, P. strobus, P. virginiana, Castanea*** *dentata,* ***Populus*** spp., ***Juniperus*** *virginiana, Juglans* ***nigra, Prunus serotina,*** *Quercus* spp., *Acer rubrum,* ***Betula verrucosa, Liriodendron tulipifera.***

OBJECT : To select and develop trees of most rapid growth, highest quality, and greatest economic usefulness for growing in the Tennessee Valley.

METHODS : An active search is being conducted for superior pine and hardwood trees—to date 136 superior selections of loblolly, shortleaf, Virginia, and white pine, 117 selections of black cherry, black walnut, yellow-poplar, and northern red, chestnut, and white oaks for pulpwood and timber production, and 8 selections of yellow-poplar, maple, and birch species with figured wood for veneer have been made. Twenty-seven selections of cottonwood are being compared for their form and growth qualities in four plantations in the Valley and response to nutrients. Four selections of American chestnut were propagated to test their blight resistance, and records are being kept on two timber-type Asiatic and hybrid chestnut plantings. A total of 2,400 pine super-seedlings at the Clinton Nursery have been selected and outplanted in order to determine whether nursery selection is a feasible method of discovering genetically superior strains of trees. Arboretums and other test plantings of forest species in the Norris, Tennessee, area total 21. A columnar redcedar progeny test has been established at three locations in the Valley and pine progeny tests at seven locations.

COOPERATORS: Hiwassee Land Company, Calhoun, Tennessee; Tennessee River Pulp and Paper Company, Counce, Tennessee; Tennessee Department of Conservation, Nashville, Tennessee; U. S. Forest Service, Southeastern Forest Experiment Station, Asheville, North Carolina, and Northeastern Forest Experiment Station, Laurel, Maryland; University of Tennessee Agricultural Experiment Station, Knoxville, Tennessee.

ASSIGNMENT : A. A. Foster, Supervisor, Forest Tree Improvement Section; T. G. Zarger, Staff Forester; K. A. Taft, Staff Forester; D. C. Forbes, Staff Forester.

11-2. **SEED ORCHARDS AND SEED PRODUCING AREA TESTS.** 122.0, 122.1. General.

OBJECT : To determine optimum practices for establishing and caring for seed orchards and seed production areas; to promote establishment of seed orchards and seed producing areas in the Tennessee Valley so that future reforestation programs can be carried out with trees of optimum growth and quality potential.

METHODS : Twelve pine seed orchards have been completed. Production of grafted planting stock is being continued to replace those which die. Experience in establishing and maintaining seed orchards is being noted to provide information on sound orchard management practices to assure an abundant, regular, and dependable seed supply.

COOPERATORS : Alabama Division of Forestry, Montgomery, Alabama; Carter Patten, Chattanooga, Tennessee; Georgia Forestry Commission, Macon, Georgia; Hassell and Hughes Lumber Company, Waynesboro, Tennessee; Hiwassee Land Company, Calhoun, Tennessee; Kentucky Division of Forestry, Frankfort, Kentucky; Tennessee River Pulp and Paper Company, Counce, Tennessee; Tom B. Swann, Dandridge, Tennessee.

ASSIGNMENT : A. A. Foster, Supervisor, Forest Tree Improvement Section; T. G. Zarger, Staff Forester.

11-3. **PROPAGATION TESTS.** 151.02, 251.02. General.

OBJECT : To develop and test vegetative and other methods of propagating and producing select plant material.

METHOD : Various vegetative propagation methods (grafting, budding, air layering, and rooting) have been adapted, developed and tested for the production of select hardwood and pine planting stock used in TVA's forest tree improvement, nut tree, and other tree crops research work.

COOPERATORS : University of Tennessee Agricultural Experiment Station, Knoxville, Tennessee.

ASSIGNMENT : A. A. Foster, Supervisor, Forest Tree Improvement Section; T. G. Zarger, Staff Forester; John F. Hatmaker, Propagator.

11-4. **SEED SOURCE TESTS.** 111.1, 211.1. *Pinus* taeda, ***P. echinata, P. virginiana, P. strobus, Juniperus virginiana,*** *Acer* ***saccharum.***

OBJECT: To determine the geographic limits within which seed should be collected for production of forest planting stock used within the Tennessee Valley.

METHODS : A total of 25 loblolly, shortleaf, and Virginia pine, redcedar and sugar maple seed source tests have been established. Significant differences in survival and height growth have been observed among some of the sources but delineation of provenance limits for collecting seed that will be used within the Valley is as yet premature. Criteria used in determining optimum provenance boundaries include growth rate, resistance to forest pests, response to environmental factors, and other tree or wood characteristics.

COOPERATORS: One or more of the following: Committee on Southern Forest Tree Improvement; Kimberly-Clark Corporation Coosa River Newsprint Division, Coosa Pines Alabama; Tennessee Fish and Game Commission, Nashville, Tennessee; Tennessee River Pulp and Paper Company, Counce, Tennessee: Tennessee State Division of Forestry, Nashville, Tennessee; U. S. Forest Service, six research centers of Central, Southern, and Southeastern Forest Experiment Stations; University of Maryland, Natural Resources Institute. College Park, Maryland; University of Tennessee Agricultural Experiment Station, Knoxville, Tennessee; and University of the South, Sewanee, Tennessee.

ASSIGNMENT : A. A. Foster, Supervisor, Forest Tree Improvement Section; T. G. Zarger, Staff Forester.

12. TEXAS FOREST SERVICE
College Station, Texas

12-1. DEVELOPMENT **OF DROUGHT-HARDY STRAINS OF LOBLOLLY PINE.** 111.2, 151.07. *Pinus* ***taeda.***

OBJECT : To develop a drought-hardy strain of loblolly pine for reforestation on severe sites.

METHODS : Five extremely severe sites and five or more individual trees on each site were selected along the westernmost fringe of the southern pine region. Progeny tests are made by individual mother trees from each site to determine (1) the most promising sites and (2) most drought-hardy selections on that site. Mother trees are tested by means of four pollen parents. Progeny are grown under uniform nursery conditions, then lifted as 1-O stock, morphologically graded, root pruned, and subjected to imposed and controlled drought in the field as l-l stock. After progeny testing, crosses between the most desirable parents will be placed in seedling seed orchards for the future production of drought-hardy seed.

LOCATION : East Texas. Deep sandy soils.

ASSIGNMENT : J. P. van Buijtenen, Silviculturist.

12-2. **SELECTION OF ONE-YEAR-OLD LOBLOLLY PINE NURSERY SEEDLINGS FOR OUTSTANDING GROWTH CHARACTERISTICS.** 111.3. *Pinus* ***taeda.***

OBJECT: To determine if outstanding 1-year-old loblolly pine seedlings continue to show height growth superiority following outplanting in the field.

METHODS : One-year-old loblolly pine seedlings possessing (1) superior height, (2) average height, and (3) inferior height were selected from standard nursery beds in the fall of 1953, 1954, and 1955. One hundred seedlings of each class were planted in rows at 6 x 8 spacing (25 plant rows, 4 replications) for 3 successive years. Observations on height growth are made yearly.

LOCATION : Cherokee County, T e x a s. Sandy soil.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

12-3. **ANATOMICAL FACTORS RESPONSIBLE FOR VARIATIONS IN WOOD SPECIFIC GRAVITY.** 111.3, 151.32. *Pinus* ***taeda, P.*** *elliottii.*

OBJECT : (1) To determine the contributions of various anatomical factors to changes in wood specific gravity, and (2) to determine whether it is possible to breed selectively for those factors which increase wood specific gravity without adversely affecting pulp and papermaking properties.

METHODS: Wood samples from selections for high and low wood specific gravity will be analyzed for the factors contributing to wood specific gravity. The factors will be examined for their effect on pulp and papermaking properties and the possibility of using them as criteria for selection.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

12-4. **GENETIC CONTROL OF WOOD DENSITY.** 112.02, 151.321. *Pinus* ***taeda.***

OBJECT: To determine the heritability of wood specific gravity in loblolly pine.

METHODS: On the basis of several thousand wood specific gravity determinations, 30 loblolly pine trees have been selected from 15 sites in East Texas. Two trees were selected from each site, one possessing high wood density, the other low wood density. These selected phenotypes formed the basis for making specific crosses involving high x high, low x low, and high x low wood densities. Controlled pollinated seed were grown at 4 x 6 spacing in replicated blocks in uniform nursery beds. The bole wood of 100 2-O and 1-O seedlings from each cross is being analyzed for wood density. The mean wood density values of each progeny are compared with the specific gravity of the core wood of the respective parents. From these determinations it will be possible to estimate the rigidity of genetic control over this important wood property. The same progenies were field planted at 6- x 8-foot spacing for further analysis at a more mature age. The study is part of the S-23 project.

LOCATION : Cherokee County, Texas.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

12-5. **SEED ORCHARD ESTABLISHMENT AND OPERATION.** 122.1. *Pinus* ***taeda.***

OBJECT : To determine the best way to handle a seed orchard to produce an early, heavy, and sustained yield of seed.

METHODS : In 1955-1956 grafted scions of loblolly pine were planted in blocks at 30 x 30 and 20 x 20 spacing. The blocks contain 12 and 16 grafts respectively. Total of 18 blocks at 30 x 30 and 24 blocks at 20 x 20. One-half of the area is disc cultivated, the other half is mowed. The blocks form the basic unit for fertilization studies. Three levels of fertilization are used in factorial design, with at least three replications (blocks) per treatment in both cultivated and non-cultivated sections. The levels of fertilizer are: (a) high-600 lbs. N, 500 lbs. P and K/acre; (b) intermediate—200 lbs. N, P, and K/acre; and (c) controls—none. Fertilizer applications are made in early spring. Soil analyses are made each fall to determine nutrient-supplying capacity under each treatment.

LOCATION : Cherokee County, T e x a s. Light sandy soil.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

12-6. **QUANTITATIVE GENETICS STUDY IN LOBLOLLY *PINE.*** 141. *Pinus* ***taeda.***

OBJECT: (1) To determine the mode of inheritance of characters of commercial im-

portance, and (2) to develop selection indices based on genetic information.

METHODS : Heritabilities and genetic correlations will be determined from existing plantations in the Texas Forest Service Cooperative Tree Improvement Program. These data will be used for the construction of selection indices and for the evaluation of various breeding systems.

LOCATION : Cherokee and Nacogdoches Counties, Texas.

ASSIGNMENT : J. P. van Buijtenen, Silviculturist.

12-7. **HERITABILITY STUDY IN LOBLOLLY PINE.** 141. *Pinus* ***taeda.***

OBJECT: To determine the heritability of a number of anatomical, morphological, and physiological characteristics of loblolly pine.

METHODS : Two loblolly pine populations in Texas will be sampled as part of a cooperative study of the Southern Institute of Forest Genetics and the Texas Forest Service. The sample trees will be evaluated by an incomplete series of diallel crosses. The seedlings produced will be tested on a number of sites in Texas and Louisiana. The heritability estimates will be obtained from parent progeny correlations and from an analysis of variance of the progeny data.

COOPERATORS : Institute of Forest Genetics at Gulfport.

ASSIGNMENT : J. P. van Buijtenen, Silviculturist.

12-8. **ATTEMPTS TO STIMULATE EARLY CONE PRODUCTION INPLANTED LOBLOLLY PINE SEEDLINGS.** 151.01, 151.03. *Pinus* ***taeda.***

OBJECT: To determine the length of time required to bring loblolly pine trees into flowering and cone production through the application of different cultural treatments and techniques.

METHODS : Three replicated plots approximately 2 acres in size were planted to l-year old seedlings in the fall of 1958 at 15 x 15 spacing. Each replication is divided into four blocks containing 90 seedlings each; these blocks constitute the basic amount for fertilization treamtents. Each block will receive different ratios of available nitrogen and phosphorus. Potassium will be maintained at a constant level. These levels in pounds per acre are :

Block	*Nitrogen*	*Phosphorus*	*Potassium*
I	***600***	***0***	***200***
II	0	***600***	***200***
III	***600***	***600***	***200***
IV	0	0	***200***

Soil analyses are made each fall following fertilizer application in spring.

LOCATION : Cherokee County, Texas.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

12-9. **STUDY OF CHEMICAL CHANGES ASSOCIATED WITH ROOTING IN PINES.** 151.02. *Pinus* ***taeda, P.*** *elliottii.*

OBJECT : (1) To study the metabolic changes which are associated with the initiation and development of roots, and (2) to determine if growth regulators are present which specifically influence rooting.

METHODS : Cuttings will be propagated in the greenhouse under an intermittent mist system. At regular intervals cuttings will be removed from the rooting bed. The basal inch of these stems of the cuttings will be analyzed for free amino-acids, sugars, and protein amino acids. In a separate study samples will be taken at regular intervals for the determination of the content of growth regulators.

LOCATION : Brazos County, Texas.

ASSIGNMENT : J. P. van Buijtenen, Silviculturist.

12-10. **THE INFLUENCE OF CROWN PRUNING ON PRODUCTION AND DISTRIBUTION OF CONESONLOBLOLLYPINE.** ***154.3.*** *Pinus* ***taeda.***

OBJECT : To determine best method for shaping trees in managed seed orchards.

METHODS : This study was established during the summer of 1958 in an area with deep sand soil. Pruning was done in 3- and

5-year-old planted stands and also in a natural old field stand about 25 years old which was already producing rather heavy cone crops. Treatments applied include severe (½ the total crown) and light (¼ of total crown) topping as well as trimming all lateral limbs on other individual trees. Retreatments will be applied over a period of several years to those trees that were lightly pruned and cone production of the treated versus the check trees will be recorded periodically. Two hundred and forty trees are involved in the study.

LOCATION: Cherokee County, Texas.

ASSIGNMENT: J. P. van Buijtenen, Silviculturist.

13. UNION BAG-CAMP PAPER CORPORATION
Savannah, Georgia

13-1. **SLASH PINE SEED PRODUCING AREA PROGENY TEST.** 111.3, 122.0. *Pinus elliottii.*

OBJECT: To establish relative, and if possible, absolute degrees of genetic improvement in progenies of three different slash pine seed producing areas.

METHODS: Five seed sources are tested: (1) Control, woods-run seed; (2) Ogeechee Forest seed producing area; (3) Altamaha Forest seed producing area; (4) Oconee Forest seed producing area; and (5) control-pollinated progeny (miscellaneous mixture including some polymix progeny as well as specific crosses.) All five seed sources are outplanted on each of three forests where seed producing areas are located. Each outplanting uses a Latin square design with individual plots consisting of 121 trees. Of the total number of seedlings in each plot, 49 are sample trees, others serve as isolation. All plantings are on a 6 x 10 spacing. Outplantings are established on cutover woods sites with a double disking for site preparation. The study was established in January 1963.

ASSIGNMENT: Barry F. Malac, Director.

13-2. **PROGENY TEST OF CROSSES FOR SPECIFIC CHARACTERISTICS.** 111.3, 153. *Pinus* spp.

OBJECT: To obtain early indications of heritability in clones available for testing, to aid in evaluating the phenotypic selection system, and to assess the value of row plot planting designs.

METHODS: A randomized block design was used with 10 blocks, each containing ten lo-tree row plots. Six specific crosses, one general seed orchard lot, and three lots of check material were used in the test. Outplantings were at 8- x 8-foot spacing with one row isolation strip between blocks.

ASSIGNMENT: Robert L. Koenig, Research Forester.

13-3. **HYBRIDIZATION FOR DIFFICULT SITES.** 112.01. *Pinus elliottii, P. clausa, P. palustris, P. serotina, P. glabra, P. virginiana,* and *P. rigida.*

OBJECT: To develop trees well adapted for outplanting on problem sites in coastal Georgia and South Carolina, and in eastern Virginia.

METHODS: Controlled pollinations are being made in various combinations using specific tree selections of the following pine species: slash, sand, longleaf, pond, spruce, Virginia, and pitch. Some crosses are first being made on a trial basis to determine the feasibility of continuing with them on a "pilot plant" approach.

COOPERATOR: North Carolina State University (Drs. L. C. Saylor and Bruce J. Zobel).

ASSIGNMENT: Robert L. Koenig, Research Forester.

13-4. **FERTILIZATION OF SLASH PINE SEED ORCHARDS.** 151.03. *Pinus elliottii.*

OBJECT: To test the effects of various levels of nitrogen (N) and potash (K_2O) on increment of grafted seed orchard trees.

METHODS: There are 6 different treatments imposed on 15 different clones. Treatments are as follows:

Elemental N	*Elemental K_2O*
- - - (ounces per tree) - - -	
0	*0*
36	0
72	0
0	21
36	21
72	21

COOPERATOR : University of Florida (Drs. W. L. Pritchett and R. E. Goddard).

ASSIGNMENT : Robert L. Koenig, Research Forester.

13-5. **FERTILIZATION OF SLASH PINE SEED ORCHARDS FOR CONE PRODUCTION.** 151.03. *Pinus elliottii.*

OBJECT : To determine the effects of various levels of nitrogen upon the flowering habits of young slash pine ramets.

METHODS : Four different treatments with four replications were applied to ten clones. Available nitrogen at rates of 9, 8, 16, and 32 ounces per tree was applied by surface application. All trees received base application of 6.8 lbs. of O-14-14.

COOPERATOR : University of Florida (Drs. W. B. Pritchett and R. E. Goddard).

ASSIGNMENT : Robert L. Koenig, Research Forester.

13-6. **FERTILIZATION OF SLASH PINE SEED ORCHARD FOR CONE PRODUCTION.** 151.03. *Pinus elliottii.*

OBJECT : To stimulate flower production in slash pine orchards through application of large dosages of inorganic fertilizers.

METHODS : Treatments of 0, 16, and 2- lbs. of 10-10-10 granular fertilizer were applied with one application to five clones. Thirty healthy 5-year-old ramets, six each of five clones, were randomly assigned the three treatments. Fertilizer was applied on the surface within the dripline of the tree crown. Tht study was established in 1961.

ASSIGNMENT : Robert L. Koenig, Research Forester.

13-7. **FERTILIZING AND SPRAYING SEED-PRODUCING AREAS FOR BETTER CONE PRODUCTION.** 151.03, 152.0. *Pinus* spp.

OBJECT : Determination of quantitative response in cone production to: (1) fertilize] application; (2) periodic spraying for cone insects; and (3) both treatments combined.

METHODS: Randomized block design includes six treatments, two variants of each treatment, and four replications of each. Treatments include controls, 30- and 50-lb. applications of 8-8-8, some applied once only, others every other year. Half of the trees will be sprayed with 3 percent BHC in fuel oil (Feb.. May-July), and half will remain unsprayed.

ASSIGNMENT : Barry F. Malac, Director

13.-8. **SEED ORCHARD MANAGEMENT.** 154.4 *Pinus elliottii.*

OBJECT: To test various spacing in slash pine seed orchards.

METHODS : Spacing under tests include 20x20, 30x30, and 40x40-foot spacings.

ASSIGNMENT: Robert L. Koenig, Research Forester.

14. UNITED STATES FOREST SERVICE, FOREST PRODUCTS LABORATORY
Madison, Wisconsin

14-1. **WOOD QUALITY EVALUATIONS FOR GENETICS STUDIES.** 151.32, 251.32. General.

OBJECT : To provide over-all evaluations of density and fiber characteristics in wide samplings such as Forest Surveys to assist in determining individual tree variations and outstanding or superior wood quality.

METHODS : Specific gravity, summerwood percentages, and fiber characteristics were determined in cooperation with genetics and silvicultural studies at various research projects of the Forest Experiment Station. Wood quality evaluations are being carried out in connection with the Forest Survey in many states in the south and southeastern United States.

COOPERATORS : Southern, Southeastern, Lake States, and Pacific Northwest Forest Experiment Stations, U. S. Forest Service.

ASSIGNMENT : M. Y. Pillow, Supervisory Technologist.

15. UNITED STATES FOREST SERVICE, REGION 8
Atlanta, Georgia

15-1. **IMPROVEMENT OF FOREST TREE SEED.** 122.0, 122.1. *Pinus.*

OBJECT: To provide sufficient seed for reforestation needs from the best geographic and parental sources.

METHODS: The tree improvement program will be divided into three phases of activity. The first phase will be the establishment of about 3,100 acres of seed production areas; the second phase will be the establishment of about 1,200 acres of seed orchards; and the third phase, the incorporation of tree improvement principles in silvicultural practices. Work on all three phases will be done concurrently.

ASSIGNMENT. Thomas F. Swofford, Forester.

16. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Asheville, North Carolina

16-l. **SPECIES TRIALS AND ARBORETA.** 111.0, 211.0. General.

OBJECT. To test the performance of several different species planted in arboreta or planting trials.

METHODS: Several different coniferous species were planted during the 1920's on a burned area on Mount Mitchell, North Carolina, and several species were planted in an arboretum on the Bent Creek Experimental Forest. Several hardwood species were planted in different locations in the Piedmont region of North Carolina. This project is now inactive.

ASSIGNMENT: Earl R. Sluder, Associate Silviculturist.

16-2. **RUST TESTS WITH PINES.** 111.0, 151.5. *Pinus.*

OBJECT: To determine response of *Pinus* species to fusiform rust infection.

METHODS: Eighteen species of hard pines, including several exotics, are being inoculated with specific, single-gall collections of *Cronartium* fusiforme. Pine seedlings are artificially inoculated and disease development is observed under greenhouse conditions. The two primary collections of rust used in the study were from the same loblolly pine plantation, but one gall was cerebroid, while the other was fusoid in shape. These rust collections were found to be distinct serologically, with the cerebroid type being more closely related to *C. quercuum* than to other *C. fusiforme* collections.

ASSIGNMENT: H. R. Powers, Jr., Plant Pathologist.

16-3. **EASTERN HEMLOCK SEED SOURCE STUDY.** 111.1. *Tsuga* canadensis.

OBJECT: To assist the Connecticut Agricultural Experiment Station in a large study.

METHODS: Twenty sources are represented in the outplanting, which consists of two blocks of 16 plots each. Fourteen of the plots in each block consist of a single seed source each, while two plots consist of several sources each. Each plot contains 16 trees planted 6 x 6. Plots are randomized within blocks. Twelve of the plots in each block are Latin squares of four seedlings from four mother trees of the source involved. Seedlings were planted in 1957 on the Pisgah Ranger District near Brevard, North Carolina.

COOPERATOR: Connecticut Agricultural Experiment Station.

ASSIGNMENT: Earl R. Sluder, Associate Silviculturist.

16-4. **WHITE PINE SEED SOURCE STUDY.** 111.1. *Pinus strobus.*

OBJECT: To determine type and extent of racial variation in white pine.

METHODS: This is a range-wide study being conducted by several Forest Experiment Stations and the Ontario Department of Lands and Forests. Sixteen seed sources are being used. The Asheville project's outplantings

were made in 1959, except one source, which was planted in 1960. Outplantings consist of four randomized blocks; each plot consists of 81 trees from a seed source planted '7 x 7 in nine rows of nine trees. There are three outplantings: one of all 16 sources in a river bottom (Davidson River) near Brevard, N. C.; one of six sources on old field sites near Nottely Lake near Blairsville, Georgia; and one of six sources in a stream bottom near Wytheville, Virginia. Initial survival counts were made in June 1959; survival was 95 percent for the North Carolina outplanting, 79 percent for the Georgia outplanting, and 85 percent for the Virginia outplanting.

COOPERATORS : Ontario Department of Lands and Forests; The Lake States, Central States, and Northeastern Forest Experiment Stations of the U. S. Forest Service.

ASSIGNMENT : Earl R. Sluder, Associate Silviculturist.

16-5. **WHITE PINE AS AN INDICATOR OF AIR POLLUTION.** 111.3. *Pinus strobus.*

OBJECT: To determine utility of individual white pine trees as indicators of kind and concentration of air pollutants.

METHOD : Grafts or open-pollinated seedlings of white pine from several locations in Tennessee, North Carolina, West Virginia, and Pennsylvania are exposed in areas where damage from air pollution is thought to occur. Seedlings or grafts or susceptible trees are exposed in different geographic locations and symptoms compared. Grafts of trees known to be good indicators have been planted on the Bent Creek Experimental Forest near Asheville, N. C., and at two locations along the Blue Ridge Parkway.

ASSIGNMENT : Charles R. Berry, Plant Pathologist,

16-6. **YELLOW-POPLAR SEED SOURCE STUDY.** 211.1. *Liriodendron tulipifera.*

OBJECT: To determine if geographical races of yellow-poplar exist and, if they do exist, which region is best suited as a source of seed for the Southern Appalachians.

METHOD : Trees from 16 seed sources were planted in 1954 in two randomized blocks on the Bent Creek Experimental Forest. Each plot consists of 64 trees from a source, planted 8 x 8. Height and survival were measured for the first 5 years. In 1958, frequent measurements were made to determine the pattern of seasonal height growth.

ASSIGNMENT : Earl R. Sluder, Associate Silviculturist.

16-7. **GEOGRAPHIC VARIATION OF NORTHERN RED OAK.** 211.1. *Quercus borealis.*

OBJECT : To study variation in northern red oak seedlings from six widely distributed geographic locations.

METHODS : The seedlings, which were furnished by the Cabot Foundation, were planted in 1953 on the Bent Creek Experimental Forest. They were cut off near the ground at the beginning of the 1954 and 1955 growing seasons. Regrowth was measured at weekly intervals during these two seasons and the data sent to the Cabot Foundation. The Foundation has since dropped the study. The planting at Bent Creek is being maintained and the study carried on an informal basis.

ASSIGNMENT : Earl R. Sluder, Associate Silviculturist.

16-8. **YELLOW-POPLAR 1-PARENT PROGENY TEST.** 211.3. *Liriodendron tulipifera.*

OBJECT: To obtain basic information on variation among l-parent progenies of yellow-poplar.

METHODS : Seeds were collected in western North Carolina from 8 trees selected for various phenotypic characteristics, kept separate by tree, and sown in a nursery. The 1-O seedlings were planted in spring 1961 on cleared forest land. Seedbed germination, percent of seedlings under plantable size, and outplanting survival varied by mother tree. Phenotypic observations will be made on the progeny groups to determine differences among them and variation within them. Progeny phenotypes will be compared with parent tree phenotypes.

COOPERATOR : Tennessee Valley Authority, Norris, Tennessee.

ASSIGNMENT : Earl R. Sluder, Associate Silviculturist.

16-9. **INHERITANCE OF STEM FORM.** 211.3. ***Prunus serotina.***

OBJECT: To determine whether stem form, particularly crook and sweep, is inherited in some black cherry trees.

METHODS: A l-parent progeny test was started in 1964. Seed was collected from five black cherry trees in each of three stem-form categories: (1) straight, (2) moderate crook and sweep, and (3) heavy crook and sweep. Stem crook and sweep were quantified by measuring the right-angle distance from a straight pole to the tree edge at the point of greatest departure from a straight line at each crook and sweep area. Clones of each tree will be propagated and grown with seedling progeny.

ASSIGNMENT: Earl R. Sluder, Associate Silviculturist.

16-10. **NORTHERN RED OAK SEEDLING GRADES.** 211.3. ***Quercus borealis.***

OBJECT: To determine the effect of seedling grade on survival and growth of northern red oak seedlings.

METHODS: Three seedling grades, determined by size at the root collar, are being tested in replicated plots on good, average, and poor sites. The overstory and competing brush was deadened during the summer prior to winter planting.

ASSIGNMENT: C. E. McGee, Project Leader.

16-11. VARIATION IN OAK TO NECTRIA CANKER. 211.3, 251.5. *Quercus* ***alba.***

OBJECT: To determine response to infection by ***Nectria*** *galligena* of clonal lines of ***Quercus*** *alba.*

METHODS: Clonal lines of ***Q.*** *alba* were developed from two parental trees, one showing extreme susceptibility, and the second apparent resistance, to Nectria canker. Artificial inoculations will be made to evaluate resistance of these clones as well as that of a group of white oak seedlings from randomly selected seed.

ASSIGNMENT: H. R. Powers, Jr., Plant Pathologist.

17. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Athens, Georgia

17-1. **PINE SPECIES COMPARISON TEST.** 111.0. *Pinus* spp.

OBJECT: To compare adaptability of the species for planting on Piedmont clay soils.

METHODS: Tests established in 1957 consist of plots of 121 trees, one plot of each species, replicated three times at different locations. Loblolly , shortleaf, longleaf, slash, white, and Virginia pine plantings are located at Calhoun Experimental Forest in Piedmont South Carolina.

ASSIGNMENT: R. G. McAlpine, Project Leader.

17-2. **SELECTION AND BREEDING OF LITTLE-LEAF-RESISTANT PINE.** 111.1, 111.3, 112.02. *Pinus* ***echinata.***

OBJECT: (1) The development of littleleaf-resistant strains of shortleaf pine, and (2) searching for littleleaf-resistant strains of shortleaf pine from within the natural geographic range of the species.

METHODS: Apparent littleleaf-resistant shortleaf pine are being selected on severe littleleaf sites. Scions collected from these selections have been grafted to shortleaf pine stock and outplanted in 1953 and 1954. Twenty-one clones, 10 to 20 individuals each, planted in rows, are represented in an outplanting area at Athens, Georgia. Open-pollinated progeny have been subjected to tests for resistance under experimentally intensified littleleaf conditions. Georgraphic seed source plantings include seed lots of 12 sources planted in 2 blocks of 12 plots each with 48 trees in each plot. The plantings are located in Athens, Georgia; the Calhoun Experimental Forest, Union, South Carolina; and the Lee Experimental Forest, Virginia.

COOPERATOR : School of Forestry, University of Georgia, Athens.

ASSIGNMENT : W. C. Bryan, Pathologist.

17-3. **TEST OF SONDEREGCER PINE IN THE PIEDMONT.** 112.01. *Pinus* × *sondereggeri.*

OBJECT. To test performance of a natural hybrid in the Piedmont.

METHOD : This is an informal study consisting of four plantings of 50 to 100 trees each of Sonderegger pine selected from seedbeds at the South Carolina State nursery at Wedgefield. Plantings located on Calhoun Experimental Forest in the Piedmont of South Carolina.

ASSIGNMENT : R. G. McAlpine, Project Leader.

17-4. **PROGENY TEST FOR RESISTANCE TO LITTLELEAF.** 112.02, 112.03. *Pinus echinata.*

OBJECT : To determine inheritance to littleleaf disease in shortleaf pine progeny from different parental matings.

METHODS : Seedlings obtained from selfing and crossing clones of shortleaf pine located at Athens, Georgia, were planted in April 1965 on a 6-acre area on the Calhoun Experimental Forest, Union, South Carolina. Thirty-four progeny group plus a check, or a total of 700 trees, were planted. The test design is five randomized blocks with four trees per plot. The isolation strip around the entire test area was planted with run-of-the-mill seedlings. The area is surrounded by shortleaf pine in all stages of the disease.

ASSIGNMENT : W. C. Bryan, Pathologist.

17-5. **SELECTION CATALOGUE FOR HARDWOODS.** 211.3. Hardwoods.

OBJECT : To locate, describe, and catalogue individual hardwood trees that exhibit characteristics useful in a forest genetics and tree improvement program.

METHODS : The selections will be based primarily on traits such as superior tree and wood quality, form, growth rate, and other desirable characteristics. Some trees with undesirable characteristics will be catalogued. A description and location form is given. A numbering system for trees is described and code numbers for 46 hardwood tree species assigned.

ASSIGNMENT : R. G. McAlpine, Project Leader; C. D. Webb, Plant Geneticist.

176-6. **PARENT AND SEEDLING GRADE EFFECTS IN SWEETGUM.** 211.3. *Liquidambar styraciflua.*

OBJECT : To determine (1) the relationship between morphological grades of seedlings and subsequent survival and early growth, and (2) if maternal parent has any effect on survival and growth, leaf coloration, branching habit, bud formation, and bark characteristics.

METHODS : Seedlings from a study at Macon, Georgia, of seedbed density effects were graded by root collar diameters into four classes. Seedlings from 10 open-pollinated parent trees were planted in spring of 1964 on a prepared bottomland site along the Oconee River in Greene County, Georgia. The experiment is a split-plot factorial in a randomized block design. Plots consist of 25 measurement trees at a spacing of 6 x 6 surrounded by a 24-tree isolation row of the same parentage and seedling grade.

ASSIGNMENT : R. G. McAlpine, Project Leader; C. D. Webb, Plant Geneticist.

17-7. **SYCAMORE SEEDLING GRADES.** 211.3. Platanus *occidentalis.*

OBJECT : To determine (1) the feasibility of underplanting seedlings with immediate and complete overstory control; (2) find an optimum size of seedling stock for underplanting; and (3) the necessity for cleanings to remove understory competition.

METHODS : Five grades of l-year sycamore seedlings will be underplanted in a hardwood stand of poor composition in a Piedmont creek bottom subject to periodic flooding. Grades of seedlings based on root collar diameters are 3/20, 4/20, 5/20, 6/20, and 7/20 inch. These will be planted at a spacing of 6 x 6 in 10 plots in each of two randomized complete blocks. One plot of each grade will be cleaned as necessary to release seedlings from understory competition.

ASSIGNMENT: R. G. McAlpine, Project Leader; C. D. Webb, Plant Geneticist.

17-8. VEGETATIVE PROPAGATION METHODS. 251.02. ***Liriodendron tulipijera,*** *Liquidambar styraciflua.*

OBJECT: (1) To develop techniques for year-around rooting of cuttings from hardwood trees, primarily yellow-poplar and sweetgum; (2) to determine the effect of tree age and time of taking cuttings on rooting ability; (3) to find if differences exist between rooting ability of cuttings taken from the tree crown, epicormic branches, and stump sprouts; and (4) to find if differences in rooting exist between hardwood and softwood cuttings.

METHODS: Greenhouse facilities will be used. Individual studies will be designed to attain various parts of the objectives. The most promising treatments with growth regulators and environments will be used initially.

ASSIGNMENT: R. G. McAlpine, Project Leader.

18. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Blacksburg, Virginia

18-1. SPECIES COMPARISON OF CERTAIN SOFTWOODS AND HARDWOODS. 111.0, ***211.0.*** *Pinus* ***taeda, P. echinata, P. virginiana, P. strobus, Juniperus virginiana,*** and ***Liriodendron tulipijera.***

OBJECT: To determine adaptability of certain species to planting in the Piedmont of Virginia.

METHODS: In 1945, Virginia, shortleaf, white, and loblolly pine plus redcedar were each planted on good and poor abandoned fields. There were five replications on each site with 242 trees per plot spaced 6 x 6. Only two plots of yellow-poplar were planted.

ASSIGNMENT: Jack Stubbs, Project Leader.

18-2. SEED SOURCE OF LOBLOLLY PINE. 111.1. *Pinus* ***taeda.***

OBJECT: To determine the effect of geographic seed source on the growth and development of loblolly pine in the Virginia Piedmont.

METHODS: Study was established in 1945. It is a replicated block experiment with five blocks of four plots each-one plot for each of four sources. Plots are 1.36 x 0.72 chains and contain 8 rows of 15 trees each, planted 6 x 6. Sources represented are Arkansas, Mississippi, South Carolina, and North Carolina. This installation is on the Lee Experimental Forest 4 miles south of Buckingham, Virginia. The plantings are on abandoned old fields.

ASSIGNMENT: Jack Stubbs, Project Leader.

18-3. SEEDSOURCEOFSHORTLEAFPINE. 111.1. *Pinus* ***echinata.***

OBJECT: To determine the effect of geographic seed source on the growth and development of shortleaf pine in the Virginia Piedmont.

METHODS: Study was established in 1945. It is a replicated block experiment with five blocks of six plots each-one plot for each of six sources. Plots are 1.36 x 0.72 chains, and contain 8 rows of 15 trees each, planted 6 x 6 feet. Sources are Arkansas, Mississippi, Alabama, Virginia (planted 1949), Ohio, and New Jersey. This installation is on the Lee Experimental Forest, 4 miles south of Buckingham, Virginia. The plantings are on abandoned old fields.

ASSIGNMENT: Jack Stubbs, Project Leader.

184. SELECTION AND TESTING OF VARIATION. 111.3. *Pinus* ***virginiana.***

OBJECT: To determine variation and inheritance of economically important traits and isolate superior types.

METHODS: A catalogue of superior phenotypes and a rating method have been set up. In 1962, selection and progeny testing began of 20 pairs of trees having similar ages, diameters, heights, and competition. One tree of each pair shows good pruning ability and the other one poor pruning ability. The studies are located on the Lee Experimental Forest near Buckingham, Virginia.

ASSIGNMENT : Jack Stubbs, Project Leader; D. L. Bramlett and J. G. Hutchinson, Research Foresters.

18-5. **FLOWERING CHARACTERISTICS IN CERTAIN PINES. 151.0** *Pinus* **echinata, *P. virginiana.***

OBJECT : To determine importance of environmental factors in flower induction, pollination, seed development, seed production, and seed predators in the Piedmont of Virginia.

METHODS : Annual variation in flower conelet, and seed production is being observed Development records are being kept from the strobilus to the mature cone. The effects of different soil moisture levels on the production of female flowers in shortleaf pine are being determined. The studies are located on the Lee Experimental Forest near Buckingham, Virginia.

ASSIGNMENT : Jack Stubbs, Project Leader; D. L. Bramlett, Research Forester.

19. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Charleston, South Carolina

19-1. A **TEST OF SPECIES SUITABLE FOR SANDHILLS PLANTING.** 111.0. *Pinus, Juniperus,* ***Cupressus.***

OBJECT : To test survival and early growth of various conifers native to adverse sites for planting in the Sandhills.

METHODS : Species tested are native of either very wet or very dry sites in about the same climatic region as the Sandhills. Plots of 50 trees of each species replicated three times were established for three consecutive years, 1955 through 1957, although species changed somewhat from year to year. Species planted are : loblolly, slash, longleaf, pond, shortleaf, Virginia, spruce, sand, lodgepole, and jack pines, eastern redcedar, Arizona cypress.

Plantings located on Manchester State Forest, South Carolina.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-2. **GROWTH OF PINES FROM SPAIN.** 111.0. ***P. halepensis, P. laricio, P. pinaster,*** and ***P.*** *pinea.*

OBJECT : To determine growth and other performance characteristics of four species of pine from Spain planted on sandhill soil.

METHODS : Twenty-five seedlings of each species were planted in five rows of five seedlings each on the Manchester State Forest in South Carolina. Location is in an old field.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-3. **COMPARISON OF PINE SPECIES.** 111.0. *Pinus* palustris, ***P.*** serotina, ***P. elliottii,*** and ***P. taeda.***

OBJECT : To compare survival and growth of four pine species planted on a wet, savannah site in South Carolina.

METHODS: The area was burned before planting. The planting design was two Latin squares with plots 60 feet square and tree spacing 6 x 6. No grade 3 seedlings were used. The innermost 7 x 7 rows of trees were measured.

COOPERATOR : South Carolina National Forest.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-4. **SPECIES COMPARISON ON BOTTOMLAND SITES.** 111.0, 211.0. *Pinus glabra,* ***P. taeda, Juniperus virginiana,*** *Quercus* ***falcata*** **var.** *pagodaefolia,* ***Q. prinus,*** *Q.* ***shumardii, Liriodendron*** *tulipifera,* and ***Liquidambar styraciflua.***

OBJECT : To compare survival and growth of certain hardwoods and conifers planted on representative good sites in typical rundown stands of bottomland hardwood in South Carolina.

METHODS : The variables are : (1) species, five hardwood and three conifers; (2) sites,

first bottom and terrace; (3) treatment, release and no release; (4) replication in space, each species, site and treatment combination replicated twice; and (5) replication in time, 3 years from 1953 through 1955. Each plot is 24 x 24 with 100 seedlings spaced 2 x 2. For growth comparisons plots are to be thinned to a 4 x 4-foot spacing. Each site subplot has a 25-foot isolation strip.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-5. **COMPARISON OF SAND PINE WITH OTHER PINES IN SANDHILL PLANTINGS.** 111.0, 111.1. *Pinus clausa,* ***P.*** *elliottii,* P. ***taeda, P. palustris.***

OBJECT: To determine survival and early growth of two sand pine races in comparison with other pines planted on sandhill soils in west Georgia and South Carolina.

METHODS : Seedlings of the Ocala and Choctawhatchee races of sand pine plus slash, longleaf, and loblolly seedlings were planted in Talbot County, Georgia, in February 1964. Spacing was 6 x 6 in plots 84 feet square in a split-plot Latin square. Oak sprouts on one of the subplots will be allowed to grow, those on the other will be eradicated. An additional planting was made during February 1964 in the Sandhills State Forest, Chesterfield County, South Carolina.

COOPERATORS : Georgia Kraft Company; South Carolina Commission of Forestry.

ASSIGNMENT : 0. Gordon Langdon, Proj ect Leader.

19-6. **TEST OF LOCAL LONGLEAF PINE SEED SOURCE.** 111.1. *Pinus* palustris.

OBJECT: To test growth and survival of longleaf seedlings from eight seed sources in north Georgia, South Carolina, and southern North Carolina when planted in the South Carolina Sandhills.

METHODS : Seedlings were planted in 1955 through 1957 at the Sandhills State Forest and the Manchester State Forest. Each location contains plots of 121 trees planted 6 x 6 for each seed source, replicated four times. Three annual replications were established with seed from the same general sources but from different trees. The seed sources: Augusta, Georgia; Aiken, Jasper, Horry, Berkeley, and Richland Counties, South Carolina; Francis Marion National Forest, Manchester and Sandhills State Forests, South Carolina; Bladen Lakes State Forest, North Carolina. Test, plantings are located on deep sand sites.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-7. **LONGLEAF PINE SEEDLING GRADES.** 111.3. *Pinus* ***palustris.***

OBJECT. To determine the effect of seedling grade, foliage clipping, root pruning, and season of planting on longleaf survival when planted on cleared sandhill sites.

METHODS : One-year-old longleaf pine seedlings from the Wedgefield, South Carolina, nursery were used. Plantings were made in the Manchester and Sandhills State Forest in South Carolina. Outplanting was done in the fall of 1953, the winter of 1954, and spring of 1954. Number 1 and number 2 grade stock were used. Treatment of seedlings consisted of needles clipped to 5 inches and roots pruned 3, 5, and 7 inches and needles not clipped and roots pruned to 3, 5, and 7 inches. Four blocks were laid out at each location. Each block was divided into three seasonal treatments and each seasonal treatment was further divided in 24 rows 100 feet long. Rows are 6 feet apart and trees are spaced 4 feet apart within rows.

COOPERATOR : South Carolina Commission of Forestry.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

19-8. **GROWTH OF SUPERIOR VERSUS AVERAGE NURSERY SELECTED PINE SEEDLINGS.** 111.3. *Pinus* palustris, P. ***taeda,*** and P. *elliottii.*

OBJECT: To determine whether the initial vigor of extra large seedlings selected from nursery beds is carried through subsequent years as a genetically controlled characteristic.

METHODS : Plots contain 12 trees, planted 6 x 6 feet. There is one plot of superior seedlings and one plot of average seedlings of each spe-

cies with two replicates planted each year for 4 years, 1952 to 1955. Plots are located on a flatwoods site at the Santee Experimental Forest.

ASSIGNMENT: 0. Gordon Langdon, Project Leader.

19-9. **TUPELO ECOTYPES.** 211.0, 211.1. Nyssa ***aquatica, Nyssa sylvatica*** var. *biflora.*

OBJECT: To determine effects of saturated and flooded soil conditions on the growth, anatomy, and morphology of swamp tupelo and water tupelo from three seed ecotypes.

METHODS : One-year-old seedlings are grown in tanks under six water regimes of flooded and saturated soils for one growing season. The experiment is laid out as a 6 x 6 Latin square and will be replicated twice in time (years). Water tupelo seedlings are being used from two seed sources in each of the three ecotypes: red river, black river, and nonalluvial swamp, and swamp tupelo seedlings from two seed sources in each of three ecotypes: pond, black river, and nonalluvia swamp. The soil tanks are on the Santee Experimental Forest in South Carolina.

ASSIGNMENT: 0. Gordon Langdon, Project Leader.

19-10. **HYBRID POPLARS.** 212.02. ***Populus.***

OBJECT: To determine growth of five hybrid poplar clones on the Santee Experimenta: Forest in South Carolina.

METHODS : Five cuttings of each clone were treated with rootone and placed in the soil so that only two buds were above the ground line. The area was a good hardwood site and the cuttings were cultivated during the first growing season. The cuttings were furnished by personnel of the Westvaco Experimental Forest in South Carolina.

COOPERATOR: West Virginia Pulp and Paper Company.

ASSIGNMENT : 0. Gordon Langdon, Project Leader.

20. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Cordele, Georgia

20-1. **EFFECT OF CLIMATIC AND ENVIRONMENTAL FACTORS ON WOOD PROPERTIES OF PLANTED SLASH PINE.** 111.2, 151.08, 151.32. *Pinus elliottii.*

OBJECT: To determine (1) factors for use in converting cubic-foot yields in slash pine plantations to pounds of usable woods, and (2) measurable factors which influence wood density, both climatic and environmental.

METHODS : Increment cores were obtained from slash pine trees over an area of 37 counties in southern Georgia. The stands were the same as those used for a study of yields in relation to age, site, and density. Increment cores were collected at d.b.h. from dominant and codominant trees. Broad specific gravity was determined by the maximum moisture content method. Increment cores were dissected into 5-year increments starting from the bark. Summerwood percent was obtained by means of a binocular instrument. All independent variables, (site index, stand density, age, growing-season rainfall, and summer rainfall) are being plotted individually and in pairs under the dependent variables specific gravity and percent summerwood in order to identify any independent variables that are not correlated with the dependent ones, and, also, to help in determining any trend toward curvilinearity and possible interactions. Multiple regressions are being used to determine the extent of correlation of the remaining variables.

ASSIGNMENT : Frank A. Bennett, Project Leader.

20-2. **CATALOGUE OF SELECTED TREES. 111.3.** *Pinus* ***elliottii.***

OBJECT: To locate, label, describe, and catalogue plus slash pine within plantations.

METHODS : Starting in 1953, outstanding trees on the George Walton Experimental Forest have been described on a standard form Volume growth is compared with adjacent trees. Summerwood proportion of the increment core is indicated on a diagram, based or ocular examination.

ASSIGNMENT: Frank A. Bennett, Project Leader.

20-3. INHERITANCE OF TRAITS IN SLASH PINE. 111.3. *Pinus elliottii.*

OBJECT : To determine the extent to which maternal parent trees with certain traits may transmit their qualities to progeny.

METHODS : Seedlings for the study were planted in February 1956 on an old field near Cordele, Georgia. Progeny were included of two trees in each of four form groups as follows: (1) good form, (2) pronounced crook, (3) forked, and (4) pronounced taper. Two rows of 25 trees each were planted at a spacing of 10 x 10. An additional row of 25 trees from each maternal parent was planted adjacent to the main planting.

ASSIGNMENT : Frank A. Bennett, Project Leader.

21. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Fort Myers, Florida

21-1. **COMPARATIVE GROWTH OF PINES IN SOUTH FLORIDA.** 111.0. *Pinus palustris,* ***P. elliottii*** var. ***elliottii, P. elliottii*** var. *densa,* ***P. taeda.***

OBJECT : To determine survival and growth of loblolly, longleaf, and two varieties of slash pine in south Florida.

METHOD : Seedlings of loblolly, longleaf, and typical slash pine were obtained from Olustee and Munson nurseries in Florida. South Florida slash pine seedlings were all from the Keri Nursery of the Alico Land Development Company, the only available source. Four outplantings were located on each of the east and west coasts of southern Florida. Each plot contained 7 x 7 rows of seedlings spaced 8 x 8. There are four replications.

COOPERATION : Alico Land Development Company; Florida Forest Service.

ASSIGNMENT : J. W. McMinn, Associate Silviculturist.

21-2. **SEED SOURCE OF SOUTH FLORIDA SLASH PINE.** 111.1. *Pinus* ***elliottii*** var. *densa.*

OBJECT : To determine the effects of seed source, seed size, and seedling size in South Florida slash pine.

METHODS : Seed from Hendry County, in the south-central portion of the variety's range, and Polk County, near the northern limit of the natural distribution, are compared. Seed was divided into medium and large, and seedlings into small, medium, and large. The outplanting area is in Charlotte County. The trees were planted with a spacing of 6 x 7 in a randomized block design with four replications. Each plot contained 7 x 7 rows of trees.

ASSIGNMENT : J. W. McMinn, Associate Silviculturist.

22. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Franklin, Virginia

22-l. **INHERITANCE OF FORM.** 111.3. *Pinus* ***taeda.***

OBJECT : To determine effect of cone characters and seed tree form on loblolly pine cone collections in coastal Virginia.

METHODS : Cones were collected from 29 loblolly pine trees in October 1952. Seed were extracted, stratified, and planted beneath Hot Caps March 23, 1953. Spacing was 8 x 8. The resulting planting contains 450 seed spots in a block with two rows of 8 x8-foot spaced trees as a margin. The planting was on the Camp Experimental Forest in Sussex County, Virginia. The soil is Atlee very fine, sandy loam. Previous to planting, the field was in corn. The plantation contains seedlings from each of six trees classed as one of five classes of parent trees. Tree classes are forked, good, upswept branches, rough, and residual trees left following clearcutting. The basic plot contains six rows of five seedlings. Each row was from a

single tree and the plot was of one class of trees. Each plot was replicated three times.

ASSIGNMENT: K. B. Trousdell, Silvicul turist.

23. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION

Macon, Georgia

23-1. **GROWTH AND TREE QUALITY CHARACTERISTICS OF MINOR SOUTHERN PINES AND CERTAIN EXOTICS.** 111.0. *Pinus.*

OBJECT : To determine some of the characteristics of minor species so they can be used effectively in hybridization programs.

METHODS : Seedlings of sand, spruce, pond, and Virginia pine were planted in middle Georgia. Other pines from eastern United States such as pitch and Table-Mountain pine are included. Rate of growth and other data related to tree form and resistance to pests will be recorded. The purpose is to obtain information now lacking about minor species so that they may be used, if feasible, for hybridization with major southern pines or other species.

COOPERATORS : Georgia Kraft Company; Georgia Forest Research Council.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-2. **RACIAL VARIATION IN LOBLOLLY PINE IN GEORGIA.** 111.1. *Pinus* taeda.

OBJECT : To determine the kind and amount of racial variation in loblolly pine throughout the State of Georgia and adjacent areas of Florida.

METHODS : Seed was obtained from 14 locations throughout Georgia and 3 in north Florida in 1955. Also, one seed lot from south Arkansas (Crossett) was obtained. Seedlings were outplanted at ten locations in Georgia and one in Florida. Six plantations in Georgia have all 18 seed lots represented, two have 15, and two have 13. Each plantation has four replications and 36 trees per plot. Survival and height measurements have been taken at 1, 2, 3, and 5 years. Fusiform rust and tipmoth damage were recorded at 3 and 5 years.

COOPERATORS : Georgia Forestry Commission; several pulp and paper companies; Georgia Forest Research Council.

ASSIGNMENT : John F. Kraus, Plant Geneticist; T. LaFarge, Research Forester.

23-3. **STAND VARIATION IN LOBLOLLY PINE** 111.1, 111.2, 111.3. *Pinus* ***taeda.***

OBJECT: To estimate the variation between trees in loblolly pine stands and the influence of number of trees on accuracy o stand samples in racial selection studies.

METHODS : From the seed collected i 1955 for project 23-2 above, seed was kep separate by 11 maternal parents on each o three acres. One area was in southeast Georgia one in middle Georgia, and one in northwes Georgia. All seedlings were outplanted in mid dle Georgia in 25-tree plots with 4 replica tions. Survival, growth, and disease and insec attack were recorded at 1, 2, 3, and 5 years o age.

COOPERATORS : Georgia Kraft Company Georgia Forestry Commission; Georgia Fores Research Council.

ASSIGNMENT : John F. Kraus, Plant Geneticist; T. LaFarge, Research Forester.

23-4. **SHOOT GROWTH PHENOLOGY OF LOBLOLLY PINE FROM SEVERAL GEOGRAPHIC SOURCES AND OPEN-POLLINATED PROGENIES WITHIN SOURCES.** 111.1, ***111.3.*** *Pinu* ***taeda.***

OBJECT : To determine patterns of heigh growth in loblolly pine from several geographi sources, and among progenies within sources

METHODS : In the Bleckley County plantation of the local loblolly racial test describe in project 23-2 above, five trees were randomly chosen from each of four replication of six seed sources. Weekly measurements o terminal shoot elongation were made durin the 1962 growing season. In the adjacent plantation of the loblolly stand variation study described in project 23-3 above, three tree were randomly chosen from each of four replications of three progenies of each of the thre

sources. Weekly measurements of terminal shoot elongation were made during the 1962 growing season. Correlations among growth pattern (date, rate, duration, etc.) and total height, height growth, and fusiform rust incidence will be examined.

COOPERATORS : Georgia Kraft Company; Georgia Forest Research Council; Georgia Forestry Commission.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-5. **CROWN FORM OF LOBLOLLY PINE FROM ARKANSAS.** 111.1, 111.3. *Pinus* taeda.

OBJECT : To compare crown form of open-pollinated loblolly pine progeny of plus trees growing in Arkansas with progeny of certain selected loblolly pines growing in Georgia.

METHODS : In the spring of 1960, progeny of three outstanding loblolly pine in Arkansas were planted with those of three Georgia trees in a 6 x 6 Latin square with 4 trees per plot at 10 x 10 spacing. Branch diameter and length will be measured to permit a more accurate comparison of form among trees than is possible to obtain in racial variation studies of the Crossett, Arkansas, race.

COOPERATOR : Southern Forest Experiment Station, Crossett, Arkansas.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-6. **SHORTLEAF RACES CROSSED WITH SLASH PINE.** 111.1, 112.01. *Pinus* ***echinata,*** *P.* ***elliottii.***

OBJECT : To compare various races of shortleaf pine crossed with one race of slash pine combinations with each other and with slash and shortleaf pine in terms of survival, cold resistance, drought resistance, growth rate, resistance to fusiform rust, recovery from tipmoth damage, and susceptibility to littleleaf disease, at suitable locations throughout the range of shortleaf pine and portions of the natural and artificially extended range of slash pine.

METHODS : In January 1964, an installation of the "Cooperative Study of Shortleaf Geographic Races X Slash Pine (IG-12.6)" was planted near Allentown, Georgia. The plantation was installed in accordance with the study plan, dated September 27, 1963, provided by the Institute of Forest Genetics at Gulfport, Mississippi. Six shortleaf x slash hybrids and five checks (two slash, three shortleaf) were planted in row plots of 15 trees in six randomized blocks. This plantation is being shown as a separate study because additional checks were included besides those called for in the study plan. Also, the plantation is adjacent to other progeny tests which may permit rough comparisons of performance of the hybrids. The planting site has a history of severe fusiform rust and tipmoth infections, and provides an especially good location to test the hybrids.

COOPERATORS : Institute of Forest Genetics at Gulfport; Georgia Kraft Company.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-7. **BREEDING SOUTHERN PINES FOR DESIRABLE TRAITS.** 111.3, 112.01, 112.02, 14, 153, 151.32. *Pinus* ***taeda, P. elliottii, P. echinata,*** and ***P.*** *palustris.*

OBJECT : To breed improved strains, for planting locally, of the major southern softwoods through intraspecific and interspecific hybridization.

METHODS : Selection of superior phenotypes with combinations of good traits was carried out in natural stands and plantations near Macon and Cordele. A few poor phenotypes were included for comparison. Germ plasm of most selected trees is preserved by grafting. One-parent progeny tests of slash, longleaf, shortleaf, and loblolly pine have been established. Row or rectangular plots replicated several times have been used. Progeny of more than 100 maternal parents were planted in 1956 and 1957. A three-phase program involving a "poly-cross" test, individual crosses, and selfing was developed for testing over 300 selections being used in the Georgia Forestry Commission seed orchards. In breeding, emphasis has been on growth rate, tree form, resistance to pests, and wood quality. Disease resistance work is in cooperation with the Division of Forest Protection Research.

COOPERATORS : Georgia Kraft Company; Continental Can Co.; Georgia Forestry Commission; Georgia Forestry Research Council.

ASSIGNMENT : John F. Kraus, Plant Gen-

eticist; T. Miller, Pathologist; T. LaFarge, Research Forester.

23-8. **TECHNICAL DIRECTION OF IDA CASON CALLAWAY FOUNDATION TREE BREEDING PROJECT.** 111.3, 112.01, 112.02. *Pinus* spp.

OBJECT : To assist the Foundation in the development of improved forest tree strains for planting in west central Georgia,

METHODS : Plans were prepared for overall operation of the tree breeding project. Progeny test data were obtained and analyzed. Recommendations were made for seed orchard establishment. A total of 1,405 plots has been established in 47 individual studies. Small plantings of southern pine species hybrids are included. The first plantings were made in 1951.

COOPERATOR : Ida Cason Callaway Foundation.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-9. **NURSERY SELECTION.** 111.3. *Pinus elliottii, P. taeda,* and *P. x sondereggeri.*

OBJECT : To apply nursery selection techniques in tree breeding and to learn something of the advantages as well as disadvantages of the method.

METHODS : Approximately 500 each of slash, loblolly, and Sonderegger pine seedlings averaging twice the height of average seedlings were selected in nursery beds of the Georgia Forestry Commission. They were outplanted in 1954 in a paired planting design. Annual measurements were taken for 4 years. Seedling selection was repeated in 1955 and approximately 100 seedlings each of slash and loblolly pine were planted. Comparisons of height growth, rust infection, survival, and form have been made.

COOPERATORS : Georgia Forest Research Council; Georgia Forestry Commission.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-10. **PROGENY TESTING SEED ORCHARD CLONES.** 111.3, 112.02. *Pinus elliottii, P. taeda.*

OBJECT : To determine the specific combining ability of about 308 clones represented in seed orchards of the Georgia Forestry Commission and to estimate the additive and dominance variation within the clones represented in the orchards.

METHODS : The first pollinations were made in 1958. A modified topcross is being used. In addition, certain individual clones will be crossed and selfed. Randomized blocks and row plantings are being used. Spacing is 8.5 x 8.5 feet.

COOPERATORS : Georgia Forestry Commission; Georgia Forest Research Council.

ASSIGNMENT: John F. Kraus, Plant Geneticist; T. LaFarge, Research Forester.

23-11. **SOUTHERN PINE SPECIES HYBRIDS** 112.01. *Pinus* spp.

OBJECT : To determine growth and other traits of hybrids planted in the Georgia Piedmont.

METHODS : Four lots of hybrid material from shortleaf and loblolly crosses and four lots of open-pollinated seedlings all from seed produced at the Institute of Forest Genetics at Placerville, California, were planted in 1951. There are three replications totaling 24 plots in the study.

COOPERATOR : Georgia Forest Research Council.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-12. **PERFORMANCE TESTS OF CONTROL-POLLINATED SLASH PINE PROGENY WITH IDA CASON CALLAWAY FOUNDATION.** 112.02. *Pinus elliottii.*

OBJECT: To determine inheritance of traits in progeny of slash pine selected for a combination of good traits.

METHODS : Thirty-one plots in a replicated design were established near Macon Georgia, with seedlings from crosses of slash pine trees that were rated highest on the basis of l-parent tests. A larger planting of similar material was made at the same time on property of the Callaway Foundation which lies some 90 miles west of Macon. Special emphasis is upon resistance to fusiform rust because 1-parent progeny of the parental stock had low percent infection.

COOPERATORS : Ida Cason Callaway Foundation; Georgia Kraft Company.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-13. **CONE PRODUCTION AND SEED QUALITY.** 154. *Pinus* ***taeda*** and ***P. elliottii.***

OBJECT: To determine accuracy with which cone crops in seed production areas can be estimated and obtain an estimate of seed quality when produced in a seed production area.

METHODS : Cones were counted with the aid of binoculars prior to ripening and compared with a count of cones after the trees were cut. Relationship between number and size of seed and characteristics of the cones and size of the cone crop were determined.

COOPERATORS : Continental Can Company; Georgia Forest Research Council; Georgia Forestry Commission.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

23-14. **NURSERY PRODUCTION OF SWEETGUM.** 211.3. *Liquidambar styraciflua.*

OBJECT : To determine the effect of nurserybed density and mother-tree on production of plantable seedlings.

METHODS : Seed were collected from 15 randomly chosen sweetgum trees in Oconee and Clarke Counties, Georgia. Seed was sown by individual mother-tree to grow seedlings at densities of 10, 20, 30, and 40 per square foot. Nursery data included height, coloration, branching, weight, root-top ratios and grade yield. Seedlings were outplanted in Bleckley County, Georgia.

COOPERATORS : Georgia Forestry Commission; Georgia Forest Research Council.

ASSIGNMENT : C. D. Webb and John F. Kraus, Plant Geneticists.

24. UNITED STATES FOREST SERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Marianna, Florida

24-l. **ST. JOE SPECIES TEST.** 111.0, *Pinus* ***elliottii, P. taeda, P. palustris, P.*** *echinata,* ***P. radiata, P. virginiana, P.*** *clausa.*

OBJECT : To compare early survival and subsequent growth of hand- and/or machine-planted slash, loblolly, longleaf, shortleaf, Monterey, Virginia, and Ocala and Choctawhatchee sand pine on a sandhill site prepared with rootrake, harrow, and undercut.

METHODS : In January 1954 loblolly, slash, shortleaf, longleaf, and Monterey pine were planted 7 feet apart in 18 rows of 125 seedlings. One plot was machine-planted and another bar-planted on a sandhill site in Liberty County, Florida, prepared by rootrake, harrow, and undercut. Virginia, Oeala sand, and Choctawhatchee sand pine were bar-planted in January 1955 on an adjacent, similarly prepared site. Square measurement plots of 49 trees were established in each planting. Annual measurements were taken of surviving species through age 10.

COOPERATOR : St. Joe Paper Co.; Florida Board of Forestry.

ASSIGNMENT : Russell M. Burns, Research Forester.

24-2. **CHIPOLA SPECIES TEST.** 111.0 *Pinus* elliottii, ***P. taeda, P. palustris, P.*** *clausa.*

OBJECT : To compare the survival, growth, and long-term performance of planted slash, loblolly, longleaf, and Choctawhatchee sand pine on a prepared sandhill site.

METHODS : In January 1959, 1-O stock of loblolly, slash, longleaf, and Choctawhatchee sand pine was machine-planted on a sandhill site prepared by burning and double chopping with a Marden Duplex Brush Cutter the previous summer. Each species was planted 6 x 8 (908/acre) on plots measuring 300 square feet (2.1 acres). Measurements of total height and survival are taken annually.

COOPERATORS : Florida Board of Forestry; Hardaway Contracting Co.; International Paper Co.

ASSIGNMENT : Russell M. Burns, Research Forester.

24-3. TAXON TRIALS. 111.0, 211.0. Softwoods, hardwoods.

OBJECT: A framework within which exploratory planting trials of available species, races, or hybrids (tree taxa) may be made.

METHODS : From 1960 until 1963 lineal plantings were made of promising and available native and exotic conifers and hardwoods. In 1964 a 7 x 7 grid of trees planted 8 feet apart was substituted. Seedlings have been 1-O stock hand-planted on sandhill sites cleared of scrub hardwoods and wiregrass by means of a Marden Duplex Brush Cutter.

COOPERATORS : Florida Board of Forestry; International Paper Co.; St. Joe Paper Co.

ASSIGNMENT: Russell M. Burns, Research Forester.

24-4. SAND PINE RACE COMPARISON. 111.1. *Pinus clausa.*

OBJECT: To compare survival, growth, adaptability to site, and resistance to insects and disease of Ocala and Choctawhatchee sand pine planted in the sandhills of northwest Florida.

METHODS : In 1955, and again in 1956, two 9 x 14-tree Choctawhatchee plots and two 9 x 14-tree Ocala sand pine plots (randomly arranged) were bar-planted on each of 4 root-raked sandhill sites on the Chipola Experimental Forest. Spacing approximated 6 x 6. Fail spots in both installations were replanted at the end of the first growing season. Survival, height, and d.b.h. measurements are taken on the center 50 trees.

COOPERATORS : Florida Board of Forestry; Hardaway Contracting Company; International Paper Company.

ASSIGNMENT: Russell M. Burns, Research Forester.

24-5. RESPONSE OF SLASH PINE SEEDLINGS FROM EIGHT SEED SOURCES TO FERTILIZATION. 111.1, 151.03. *Pinus elliottii*

OBJECT : To determine whether a racial or individual tree variation exists in the nutrient requirements of slash pine, specifically the nitrogen, phosphorus, and potassium requirements of this species.

METHODS : Seed obtained from eight seed sources, two individual trees per seed source! covering the major portion of the natural range of slash pine, was used for this study. Seedlings were grown under greenhouse conditions for one year and fertilized with N, P, K, and Mg. Measurements made of the study material include seedling weight and foliar N, P, K, and Mg by treatments.

COOPERATORS : Florida Board of Forestry.

ASSIGNMENT : R. H. Brendemuehl, Project Leader.

24-6. EVALUATION OF TIP-MOTH INJURY IN RELATION TOTREEGROWTH. 152.0. *Pinus taeda, P. echinata, P. clausa.*

OBJECT : To determine whether tip-moth injury during the early life of a plantation of susceptible species has an effect upon the final yield and quality of the stand.

METHODS: Paired, 81-tree plots of loblolly, shortleaf, and Choctawhatchee sand pine planted at a 7 x 9 spacing were established on cleared sandhill sites in 1960. Trees in one plot were chemically treated to prevent tip-moth damage.

COOPERATORS : Florida Board of Forestry; Hardaway Contracting Co.; Division of Forest Fire, Insects, and Disease Research.

ASSIGNMENT: Russell M. Burns, Research Forester.

25. UNITED STATES FORESTSERVICE, SOUTHEASTERN FOREST EXPERIMENT STATION
Olustee, Florida

25-l. ARBORETUM. 111 .0. General.

OBJECT : To develop a combination breeding-introduction garden.

METHODS. Two plantations are being maintained, both on flatwoods soil but one on a wet site and the other on a drier site. Plots of *Pinus* consist of 25 tree squares spaced at 12 x 12. Both plantations are located on the Olustee Experimental Forest (Florida) . The principal records being maintained are for seed source, plot establishment, growth rates, inci-

dence of insect or disease damage, and phenology of flowering.

ASSIGNMENT: A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-2. **COMPARISON OF FOUR PINE SPECIES ON A FLATWOOD SITE.** 111.0. *Pinus x sondereggeri, P. palustris, P. taeda,* and *P. elliottii.*

OBJECT : To compare the relative growth of Sonderegger pine with that of longleaf, loblolly, and slash pines.

METHODS : In December 1953, 100 seedlings each of the four pines were planted in four replications on Leon fine sandy soil on the Olustee Experimental Forest in Florida. Spacing was 8 x 8.

ASSIGNMENT: Frank A. Bennett, Project Leader; Lawrence P. Wilhite, Associate Silviculturist.

25-3. **SLASH PINE ECOTYPE STUDY.** 111.1. *Pinus elliottii.*

OBJECT : This study attempts to answer the question whether slash pine has split into a wet site and a dry site type. The study is designed to test an abrupt change from wet to dry site rather than a gradual one.

METHODS : Seed were collected in 1952 from a stand on a pond margin and a stand on a dry site. Seedlings from both collections were planted in 1953 on a wet site in Union County, Florida, owned by the Owens-Illinois Glass Company and a dry site on the Olustee Experimental Forest (Florida). Each plantation consists of 4 randomized blocks containing two plots of 50 seedlings each. Spacing between rows is 8 feet and within the row 10 feet. Seedlings of both seed sources are also planted on wet and dry sites in the Corkscrew Experimental Forest in south Florida. The same design was used except that 5 blocks instead of 4 were planted. Early height measurements showed no distinct differences between trees from the two ecotypic sources.

COOPERATORS : Owens - Illinois Glass Company; Atlantic Land and Improvement Company.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist; J. E. Bethune, Associate Silviculturist.

254. **SLASH PINE SEED SOURCE STUDY.** 111.1. *Pinus elliottii.*

OBJECT : To prepare precise maps of slash pine seed collection zones for Florida and Georgia.

METHODS : Fourteen seed source collections were made in 1953. They covered the range *of Pinus elliottii* var. *elliottii* in Georgia and Florida. Outplantings of all seed sources were made in 1954 in Lake, Baker, and Liberty Counties (Florida), and Dooly and Effingham Counties (Georgia). Partial plantings were also made in Collier County, Florida, and Emanuel County, Georgia. Complete plantings consist of 4 blocks with the seed sources in randomized plots. Each plot contains 10 rows of 10 seedlings spaced at 8 x 8. Sources from the extreme south and extreme north of the slash pine range seem to be growing the slowest. Strong planting site effects have been noted.

COOPERATORS : Atlantic Land and Improvement Company; Owens-Illinois Glass Company; Continental Can Corporation; Union Bag-Camp Paper Corporation; U. S. Forest Service, Southern Forest Experiment Station; Florida National Forests.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-5. **RACIALVARIATIONINSLASHPINE.** 111.1. *Pinus elliottii.*

OBJECT : To determine the patterns of geographic and racial variation in slash pine for various juvenile and mature tree characteristics and to search for possible correlations with environmental factors.

METHODS : In 1960 seed and foliar samples were collected from five randomly chosen trees at each of 54 collection points scattered throughout the natural range of both typical and South Florida slash pine. Seed were sown in the spring of 1961 and seedlings outplanted at four locations in 1962: Lake City, Florida; Fort Myers, Florida; Macon, Georgia; and Gulfport, Mississippi. Early results, including varia-

tion in seed and cone characteristics of the parents, foliar characters of both parents and progenies, and germination and early growth of progenies, are now being prepared for publication.

COOPERATORS : U. S. Forest Service, Institute of Forest Genetics at Gulfport; Southeastern Forest Experiment Station, of the U. S. Forest Service, at Macon, Ga., and Fort Myers, Fla.

ASSIGNMENT : A. E. Squillace, Project Leader; John F. Kraus, Plant Geneticist; E. Bayne Snyder, Plant Geneticist; and James W. McMinn, Associate Silviculturist.

25-6. **PHYSIOLOGICAL RACES IN SLASH PINE.** 111.1, 151.03. *Pinus elliottii.*

OBJECT : To determine whether; (1) seedlings from the geographic location where highest foliage-phosphorus concentrations were noted will make more rapid growth and/or accumulate more phosphorus than seedlings from outside this area when planted in phosphorus-poor flatwoods soil; (2) the nature and magnitude of the growth response to applied phosphate on flatwoods soil is uniform among various seed sources, and (3) foliage-phosphorus concentrations indicative of deficiency and sufficiency of phosphate in the soil vary with geographic seed source.

METHODS : The soil to be used is a poorly drained flatwoods type of Bladen-Weston series on which slash pine has responded strongly to phosphate fertilization. Slash pine seedlings of 1-O nursery-grown stock from four sources within and six sources outside the zone of high foliage phosphate content will be tested with 0-, 5-, and 50-pounds per acre supplements of P supplied as concentrated (and highly soluble) superphosphate. Chemical analyses of the soil and seedling tissue will be made at the beginning of the experiment and 1 and 2 years after fertilizer treatment, to permit evaluation of treatment and seed source effects and their interaction on assimilation and nutrient accumulation by the trees.

COOPERATORS : Buckeye Cellulose Corporation; American Agricultural Chemical Company.

ASSIGNMENT : T. A. Harrington, Project Leader.

25-7. **CLONAL ORCHARDS.** 111.3. *Pinus elliottii.*

OBJECT : (1) To preserve the parent trees used in selecting and breeding slash pine; (2) to compare gum yields, growth rates, and form of the selected trees on the same site; and (3) to have a source of propagules for seed orchards.

METHODS : Three plantations are involved, all planted on flatwoods sites. They contain a total of 110 clones, each represented by from 1 to 15 ramets. The oldest of these plantations contains grafts made in January 1954. The youngest is still being added to.

COOPERATOR : Owens-Illinois Glass Company.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-8. **SINGLE PARENT PROGENY TEST OF POOR FORM.** 111.3, 13. *Pinus elliottii.*

OBJECT : To test progeny of 7 slash pine selected for their poor form.

METHODS : Progenies were grown from open-pollinated seed collected in 1952 and outplanted in 1953. The plantation is on a flatwoods site in the Olustee Experimental Forest (Florida) and consists of four blocks, each containing from 6 to 42 individual trees of each progeny planted as plots with the plots randomized within the blocks. Photographs of the parents are on file and comparisons of the progeny with the parents will be made when the progeny are large enough.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-9. **OUTPLANTING OF ROOTED CUTTINGS OF HIGHGUM-YIELDINGPHENOTYPES.** 111.3, 141. *Pinus elliottii.*

OBJECT : (1) To preserve the parent trees used in selecting and breeding high gum-yielding slash pine; (2) to compare gum yields of the selected trees on the same site; and (3) to have a source of propagules for seed orchards.

METHODS : The plantation is located on a flatwoods site in the Olustee Experimental Forest (Florida) and contains from 1 to 8

ramets of 16 selected trees. Most of the cuttings were outplanted in 1943. Trees were used with those in other studies to demonstrate the inheritance of several traits. Male and female flowers are being used in controlled crosses with new selections.

ASSIGNMENT: A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25—10. **NURSERY SELECTION FOR SUPERIOR HEIGHT GROWTH.** 111.3. *Pinus elliottii*.

OBJECT: To establish a plantation of outstanding slash pine seedlings to be used for future breeding work and as a possible future seed supply source.

METHODS : The plantation was established in 1953 on a flatwoods site in Union County, Florida, owned by the Owens-Illinois Glass Company. It consists of 1,060 superior seedlings selected from the Olustee State Nursery planted in rows of 25 seedlings each. Four alternate rows in the center of the plantation are planted with average seedlings as a check. Spacing between rows, and trees in the row, is 12 feet. Eighth-year measurements showed the selected trees had an average height superiority of 23 percent over controls. Survival of the select seedlings was 35 percent versus 66 percent for controls. None of the select trees was superior to the best of the controls.

COOPERATOR : Owens-Illinois Glass Company.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-11. **INHERITANCE OF SPECIFIC GRAVITY IN SLASH PINE.** 111.3, 112.02, 141, 151.321. *Pinus elliottii.*

OBJECT. To obtain information on the variation and inheritance of specific gravity in slash pine.

METHODS : 10-mm. increment cores were taken from 4 groups of trees as follows: 500 progenies, 14 years old, wind and controlled pollinated; 47 rooted cuttings, 14 years old, from seven clones; 47 trees, 25 years old, in a plantation; and 25 trees, varying from 20 to 40 years in age and located in natural stands in north-central Florida and south-central Georgia. Specific gravity and summerwood percent were determined. Narrow-sense heritability estimated from the progeny data was 21 percent for wind pollinations and 56 percent for control pollinations. Summerwood percent heritabilities were about one-half as large as for specific gravity. Specific gravity was also found to be inversely related to d.b.h. and directly related to total height, to a moderately strong degree, in the older groups of trees.

COOPERATOR: U. S. Forest Service, Institute of Forest Genetics at Gulfport.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-12. **BREEDING AND PROGENY TESTING FOR SELECTIONOFHIGHGUM-YIELDING GENOTYPES OF SLASH PINE.** 112.02. *Pinus elliottii.*

OBJECT : To obtain for future seed orchard establishment at least 12 more proven superior gum-yielding genotypes of slash pine.

METHODS : Selected superior phenotypes are being control bred with three already proven genotypes. The seed produced will be outplanted in progeny testing plantations. Work will continue until the desired new proven genotypes have been obtained. Fifteen progenies were outplanted in 1962 in P-tree plots replicated 10 times.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-13. **POLYCROSSING AND PROGENY TESTS OF SELECTED SLASH PINES.** 112.02. *Pinus elliottii.*

OBJECT : (1) To produce a population of trees which will possess superiority in two or more desired characteristics to be used for further selection and breeding, and (2) to progeny test available selected phenotypes.

METHODS : (1) Controlled pollination of selected trees for 3 years using a mixture of pollens from genotypes and phenotypes selected for high oleoresin yield, high wood specific gravity, and fast growth; (2) progeny testing

of selections through use of wind-pollinated seed; (3) progeny testing through use of control-pollinated seed produced in (1). Forty-five progenies were planted in 1961 in row plots of 4 trees each, replicated 10 times.

COOPERATORS : I. J. Langdale; Southern Resin and Chemical Company; Union Bag-Camp Paper Corp.; Georgia Coastal Plain Experiment Station; Mrs. Elizabeth Davis; Florida National Forests; Florida Forest Service; State Armory Board.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-14. **PROGENY TEST OF HIGH GUM YIELDERS.** 112.02, 112.03, 141. *Pinus* elliottii.

OBJECT : (1) to test the progeny from controlled crosses between four high gum-yielding slash pine, and (2) to determine which of these are high gum-yielding genotypes.

METHODS : Controlled breeding was done in 1947 and 1948. Progenies were outplanted in 1951. The plantation is located on a `flatwoods site in the Olustee Experimental Forest (Florida) and consists of four blocks each containing 11 crosses including trees rated as high x high, high x self, high x wind, and average x wind. The crosses are arranged in plots varying in size from 2 to 18 trees. The plots are randomly situated within the blocks. Three extra blocks contain crosses represented by a few individuals. The depression of growth rate by selfing has been shown in this plantation. The trees were microchipped in 1961. The results substantiated those found in other studies, but no new high-yielding genotypes were found.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-15. **PROGENY TEST OF HIGH GUM-YIELDERS.** 112.02,141. *Pinus* elliottii.

OBJECT : To test the progeny from controlled crosses between six high gum-yielding slash pine and to determine which of these are high gum-yielding genotypes.

METHODS: Controlled breeding was done in 1943 and 1944. Progenies were outplanted in 1945. The plantation is located on a typical flatwoods site in the Olustee Experimental Forest (Florida) and consists of 7 blocks each containing 14 crosses including trees rated as high x high, high x wind, average x average, and average x wind. Each cross is represented by two to five individual trees in each block. Three extra blocks contain crosses represented by a few individuals. Microchipping in 1954 and in 1956 indicates that three trees are high-yielding genotypes. Inheritance of gum viscosity, gum exudation pressure, stem crook, tracheid length, bark thickness, specific gravity, summerwood percent, crown width, d.b.h., height, volume, needle length, needle bundle volume, fasciele sheath length, needle divergence, and bud scale length have also been shown in this plantation.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-16. **SELECTION, BREEDING, AND PROGENY TESTING OF F_1 TREES IN PLANTATION** O-116. 112.02, 141. *Pinus* elliottii.

OBJECT : To evaluate the best nine F_1 phenotypes in a progeny test plantation for inherent high gum yield.

METHOD : These nine clones are currently being used in seed orchards. Crosses made included full-sibs, half-sibs, backcrosses, and selfs. The seed produced were outplanted in a progeny testing plantation in 1962. Eighteen progenies were planted in 2-tree plots replicated 10 times.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-17. **HIGH GUM-YIELD SEED PRODUCTION AREA.** 122.0, 13. *Pinus* elliottii.

OBJECT: To determine the feasibility of establishing a seed-production area to produce seed having moderately superior gum-yielding ability, growth rate, and timber quality.

METHODS : The area covers 10 acres in a 19-year-old plantation on the Osceola National Forest in Florida. Original spacing was about 8 x 8 feet and there are 400 to 500 trees per acre. About 200 trees per acre are to be microchipped to indicate gum-yield capacity. After chipping, the final selection of trees to be left in the seed-production area will be made. Twenty-five trees per acre will be left, on a basis of good gum yield, volume growth, and tree form.

ASSIGNMENT: A. E. Squillace, Project Leader.

25—18. **SEEDORCHARDFORHICHGUMYIELDERS.** 122.1. *Pinus* elliottii.

OBJECT: Intended as an experimental planting to facilitate study of seed orchard management, the study will also furnish slash pine seed of high quality for gum production.

METHODS : Planting is on a 5-acre area of the Osceola National Forest. Irrigation is being provided as needed through ditches between the rows. Clonal material is being supplied by nine of the best trees in a progeny testing plantation with most of the propagation by airlayering. Spacing between rows and trees is 30 x 30.

COOPERATOR: Florida National Forests.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-19. **INTENSIVE PLANTATION MANAGEMENT.** 13. *Pinus* elliottii.

OBJECT : (1) To develop optimum rotations for slash pine plantations of varying site indices and stand densities and with varying market values for pulpwood and naval stores, and (2) to determine the optimum planting density in slash pine plantations managed for joint production of pulpwood and naval stores.

METHODS: The study will be divided in two phases: (1) development of the necessary mensurational information, and (2) the development of optimum management techniques. Much data already in the files will be used in conducting the study.

COOPERATOR : University of Georgia.

ASSIGNMENT : Frank A. Bennett, Project Leader; Jerome L. Clutter, Professor.

25-20. **THE INHERITANCE OF SEED AND SEEDWING CHARACTERS IN SLASH PINE.** 141. *Pinus elliottii.*

OBJECT : (1) To measure the parent-progeny relationships of seed and seed-wing characters of a selected population of slash pine, and (2) to determine if possible the mode of inheritance of one or more of the characters studied.

METHODS: Cones were collected from trees in test plantings made in 1957, 1961, and 1962. Measurements are being made of seed shape, seed coat thickness, seed color, seed weight, wing shape, and wing color. Heritabilities will be estimated from variance components and parent progeny relationships determined by regression and correlation.

ASSIGNMENT : John F. Kraus, Plant Geneticist.

25-21. **EXPLORATION OF MICROCHIPPING AT JUVENILE AGE TO EVALUATE GUM-YIELDING POTENTIAL IN SLASH PINE.** 151.0. *Pinus elliottii.*

OBJECT: To explore a technique for determining the gum-yielding potential of trees at a very early age.

METHODS: Progenies of proven high- and low-oleoresin-yielding trees plus suitable controls were grown at wide spacing (18 inches x 18 inches) in the nursery for 2 years. The resulting saplings were microchipped during the late summer of their second year in the nursery.

ASSIGNMENT : A. E. Squillace, Project Leader.

25-22. **TOPOPHYSIS AS RELATED TO GROWTH AND FORM OF SLASH PINE AIRLAYERS.** 151.0. *Pinus elliottii.*

OBJECT : (1) To determine whether topophysis exists in slash pine and if so the extremes in variation in growth or form which can be expected; (2) to determine the relative root-ability of branches from the extremes of the crown and of first order and second order branches; and (3) to establish possible leads as to the physiological factors controlling growth rate and growth habit in slash pine.

METHODS : Airlayers were installed on terminal, first-order, and second-order branches in the upper and lower crown of four open-grown, 25-year-old slash pine in August. 1960. The rooted airlayers available in June 1961 were planted in two blocks of eight airlayers each. Height will be measured annually for 5 years and observations made on stem development.

ASSIGNMENT : T. A. Harrington, Project Leader.

25-23. **STIMULATION OF FLOWERING.** 151.01. *Pinus palustris.*

OBJECT : To determine effects of branch girdling on female flowering in longleaf pine.

METHODS : Five pairs of primary branches on each of 15 trees will be used and one branch of each pair will be girdled. Branch elongation will be observed as well as flower production.

ASSIGNMENT : Frank A. Bennett, Project Leader.

25-24. **STIMULATION OF FLOWERING.** 151.01. *Pinus elliottii.*

OBJECT : To determine feasibility of increasing female flowering in slash pine by girdling branches.

METHODS : Seven, open - grown, well-formed, cone-bearing trees about 15 years old are being used. Ten large, first-order branches were selected in the upper portion of the crown of each tree. Five branches were girdled and five left as checks. The study was designed for analysis as a randomized complete-block experiment.

ASSIGNMENT : Frank A. Bennett, Project Leader; Ray J. Varnell, Associate Silviculturist.

25-25. **AIRLAYER AND GRAFT GROWTH RESPONSE AND SUCCESS BY TREE AGE.** 151.02. *Pinus elliottii.*

OBJECT : (1) To determine the differential growth response of slash pine airlayers and graft scions taken from 5-, 10-, 20-, and 40-year-old trees, and (2) to compare the growth of air-layers from lo-year-old trees and lo-year-old cuttings that originally came from 30-year-old trees.

METHODS : The outplanting was completed in 1958 on a flatwoods site in the Olustee Experimental Forest, and consists of five replicated blocks each containing two propagules from each of the five age classes and for each propagation method, a total of 20 trees per block. Spacing is 12 x 12 feet.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

25-26. **SURVIVAL AND GROWTH OF PINES ON VARIOUS SITES.** *151.09. Pinus elliottii, P. palustris, P. taeda,* and *P. clausa.*

OBJECT : To compare the survival and growth of planted pines on four soil types on the lower Coastal Plains.

METHODS : In January 1958, 64 seedlings each of longleaf, loblolly, slash, and sand pine were planted in two replications on Blanton fine sand, Leon fine sand (hardpan phase), Leon fine sand (softpan phase), and Plummer fine sand on the Olustee Experimental Forest in Florida. For the survival phase of the study, two seedlings were planted 12 inches apart at each spot and plantation spacing was 6 x 8.

ASSIGNMENT : Frank A. Bennett, Project Leader; Lawrence P. Wilhite, Associate Silviculturist.

25-27. **STUDIES OF THE IDENTIFICATION, BIOLOGY, ECOLOGY, AND CONTROL OF INSECTSAFFECTINGTHESEEDPRODUCTION OF SLASH AND LONGLEAF PINES.** *152.0. Pinus elliottii, P. palustris.*

OBJECT : (1) To identify the major insects destructive to flowers, cones, and seeds; (2) to study the life histories, behavior, and ecological insect-host tree relationships of the important insects; and (3) to develop chemical and biological methods for the control of economically destructive cone and seed insects.

METHODS : This project initiated in 1957 embraces many laboratory and field studies, the ultimate goals of which are to develop economically and entomologically sound methods for controlling insects affecting seed production in seed orchards, natural seed production stands, and high-value tree improvement plantings.

ASSIGNMENT : C. W. Fatzinger and E. P. Merkel, Research Entomologists.

25-28. **PRUNING OF SLASH PINE SEED ORCHARDS.** 154.3. *Pinus elliottii.*

OBJECT : To develop a seed orchard pruning technique which will produce the maxi-

mum cone producing crown area while limiting the tree to a manageable height.

METHODS : Established in 1957 in a plantation on a flatwoods site. The study tests four pruning treatments on trees in three height classes, treatments to begin as the trees attain their assigned height. Records are kept of time spent pruning, time consumed in cone collection, and number of cones produced. Field layout consists of four blocks, each containing 12 trees. Spacing is approximately 32 x 32. Cultural treatments include cultivation, fertilization, and protection from severe insect and disease damage.

COOPERATOR : Owens-Illinois Glass Company.

ASSIGNMENT : A. E. Squillace, Project Leader; C. R. Gansel, Associate Plant Geneticist.

26. UNITED STATES FOREST SERVICE, SOUTHERN FOREST EXPERIMENT STATION
Alexandria, Louisiana

26-1. SPECIES-SITE ADAPTATIONS. 111.0. *Pinus elliottii, P. palustris, P. taeda, P. echinata.*

OBJECT : To determine the different sites in south Mississippi and Louisiana and to determine which is the correct species for each of these sites. While this study was not designed as a tree improvement study, a knowledge of the forest sites is necessary in properly evaluating genetic material.

METHODS : One hundred twenty plots were established over a 4-year period (1954-1957) throughout south Mississippi and Louisiana. Each plot contained longleaf, slash, and loblolly pine planted in square subplots of 121 or 144 seedlings each at 6 x 6 spacing. These subplots were arranged in a randomized complete block design with three replications. About one-third of the plots contained shortleaf subplots. Growth measurements of the trees are being made at 5-year intervals. Soils analyses are being made on the plots.

COOPERATOR : L. N. Dantzler Lumber Company; Gaylord Container Corporation; Division of Crown-Zellerbach Corporation; International Paper Company; University of Mississippi, University Lands; Mississippi Forestry Commission; U. S. Forest Service, Mississippi National Forest; U. S. Forest Service, Kisatchie National Forest; Bodcaw Company; Continental Can Corporation; A. J. and Nona Trigg Hodges Gardens, Inc.; Tremont Lumber Company; Olin Mathieson Chemical Corporation; Lutcher-Moore Lumber Company; T. C. James and Company; Edgewood Land and Logging Company; Urania Lumber Company; Rice Land and Logging Company; Union Producing Company; Humble Oil Company; Hillyer Duetsch Edwards, Inc.

ASSIGNMENT : Eugene Shoulders, Research Forester.

26-2. **GEOGRAPHIC SOURCES OF LONGLEAF, SLASH, LOBLOLLY, AND SHORTLEAF PINE SEEDS,** 1935 **CROP.** 111.1. *Pinus* ***taeda, P. palustris, P. echinata, P.*** *elliottii.*

OBJECT : To study (geographic) racial variation of four major southern pines.

METHODS : The study was established in 1936-37 (with a few follow-up plots a year later) by planting 11 geographic sources of longleaf pine, 7 of slash pine, 12 of loblolly pine, and 13 of shortleaf pine, each species in 3 balanced, randomized-block replications (less a few missing plots because of shortages of stock) in square plots, 400 trees per plot, at 6 x 6-foot spacing; total area, approximately 56 acres. This was the largest installation of a regionwide study that failed because of establishment deficiencies and other mishaps. Inroads of fire and hogs during World War II have precluded any meaningful measurements of survival and growth to date, except for a wood-specific-gravity determination of the slash pine component by Echols, a comparison of basal area, merchantable volume, and fusiform rust infection in the slash pine at age 22 by Derr and Enghardt, and a study of gum yield in the slash pine by Barrett. The plantations are, however, an invaluable source of racial breeding material, and the Crossett Research Center has made and outplanted (at Crossett, Arkansas) about 10 interracial crosses with pollen from the loblolly component. The

plantations at Alexandria are being preserved for future observation and breeding. Study is located at Alexandria, Rapides Parish, Louisiana (J. K. Johnson Tract), on upper coastal plain site. Surplus seed was donated to the Union of South Africa and results were published by S. P. Sherry in 1947.

COOPERATOR : Institute of Forest Genetics at Gulfport.

ASSIGNMENT : William F. Mann, Jr., Project Leader.

26-3. **HYBRIDIZATION OF SOUTHERN PINES.** 112.01. *Pinus* ***elliottii, P. palustris, P. echinata.***

OBJECT : To explore (1) the crossability of southern pine species, and (2) the possibility of mass-producing *Pinus* ***palustris*** × ***P. elliottii*** without bagging.

METHODS : ***P. echinata*** × ***P. elliottii*** was made under control in 1951; ***P.*** palustris × ***P. elliottii*** has been made extensively since, including some by method (2) above. Progenies are outplanted, largely arboretum-style but with some provision for t tests, at Millard, Mississippi, on the Crossett Experiment Forest, Crossett, Arkansas, and on the Palustris Experimental Forest. Some data are also available on natural crosses of ***P.*** × ***sondereggeri*** × ***P.*** × ***sondereggeri, P.*** × ***sondereggeri*** × ***P. palustris,*** and ***P.*** × ***sondereggeri*** × ***P. taeda*** from a 7-acre Sonderegger pine plantation on the Kisatchie National Forest and from isolated Sonderegger pines on the Palustris Experimental Forest. Crosses were made at Alexandria, Rapides Parish, Louisiana, on and near the J. K. Johnson Tract, on upper coastal plain sites.

COOPERATORS : Crossett Research Center; Southern Timber Operations, Crown-Zellerbach Corp.; Louisiana Forestry Commission.

ASSIGNMENT : Harold J. Derr, Hoy C. Grigsby, Research Foresters.

26-4. **HYBRIDIZATION OF SOUTHERN PINES.** 112.01. *Pinus* ***palustris,*** *P.* ***elliottii.***

OBJECT : To study the growth rate and disease resistance of longleaf × slash hybrids. Emphasis will be on brown-spot resistance of this hybrid, although its susceptibility to fusiform rust will also be evaluated.

METHODS : Since 1954, approximately 3,000 hybrid seedlings have been produced on 20-25 female parent trees using pollen from local planted stands. Outplantings on both the Johnson Tract and the Longleaf Tract of the Palustris Experimental Forest include wind-pollinated half-sibs and slash pines obtained from State nurseries. Most outplantings are randomized block (3 to 4 replications) with either a 20- or 25-tree row serving as a treatment plot. Spacings are either 6 x 8 or 8 x 8. All crosses have been made on or near the Johnson Tract, Palustris Experimental Forest, in Rapides Parish, Louisiana, on upper coastal plain sites.

COOPERATOR: U. S. Forest Service, Institute of Forest Genetics at Gulfport.

ASSIGNMENT : Harold J. Derr, Research Forester.

26-5. **HYBRIDIZATION OF SOUTHERN PINES.** 112.01. *Pinus* spp.

OBJECT: To explore (1) the crossability of southern pine species and the performance of 2-, 3-, and 4-species hybrids, F_2 progenies of Sonderegger pine and back-crosses of this hybrid to both its parents, the performance of progenies of members of a longleaf-loblolly hybrid swarm, and the results of selfing, and (2) the possibility of mass-producing longleaf x slash and shortleaf x slash hybrids without bagging.

METHODS: Beginning in 1954, proved or putative hybrids have been produced on upwards of 100 female parent trees of longleaf (predominating), Sonderegger, loblolly, shortleaf, and slash pines, using pollen from local and Mississippi sources and from the Eddy Arboretum at Placerville, California. Arboretum-type, t test, and pilot-plant outplantings, including supplementary outplantings on the Crossett and Harrison Experimental Forests, total several acres. Majority of crosses and main outplantings on A. J. Hodges Experimental Area, Many, Sabine Parish, Louisiana; some supplementary crosses at DeRidder, Beauregard Parish, Louisiana; all on upper coastal plain sites.

COOPERATORS : Crossett Research Center; Institute of Forest Genetics at Gulfport; Long Bell Lumber Company.

ASSIGNMENT : Hoy C. Grigsby, Research Forester.

26-6. **INHERITANCE OF INDIVIDUAL-TREE CHARACTERS.** 141. *Pinus palustris.*

OBJECT: To study the inheritance of (1) black seed coat, and (2) brown-spot resistance in longleaf pine.

METHODS : Beginning about 1953, collections of wind-pollinated cones have been made from, and a variety of controlled pollinations have been made on, three longleaf pines having the rare character "black-seed," and on one longleaf pine nursery-selected about 1937 and having unusual resistance to brown-spot ("Father Abraham, the mother of a new race!"), and suitable check trees. Outplantings of resulting progenies have been made at various places in Louisiana and Mississippi. The collections and controlled crosses have been made in Rapides and Grant Parishes, near Alexandria, Louisiana, on upper coastal plain sites.

COOPERATORS : A. J. Hodges Forest Products Co., Inc.; U. S. Forest Service, Institute of Forest Genetics at Gulfport.

ASSIGNMENT : Harold J. Derr, Research Forester.

26-7. **SOUTHERN PINE POLLINATION TECHNIQUES.** 154.0. *Pinus* palustris, ***P.*** *elliottii,* P. taeda.

OBJECT : To improve the reliability and efficiency, and to clarify some of the basic relationships, of controlled pollination of the southern pines, particularly longleaf.

METHODS : Work mostly on longleaf pine female parents, with longleaf, slash, and loblolly pine pollens. Preliminary work in 1954 on pollen extraction, on bagging techniques, on pollinizers, and on mass pollination (hybridization) without bagging. Beginning in 1958, rigorously designed studies of stages at which to bag and to pollinate, of duration of flower receptivity, of competitive ability of pollen of alien species, and of diagnostic value of laboratory germination tests of fresh and stored pollen. Designs typically multifactorial, with two or three trees either as blocks or as treatments, depending on superimposed pollen or pollination-treatment combinations; 12 to 36 or more observations per experiment, each consisting of five to ten bags per treatment-combination per tree. Results in terms of cones maturing, seeds filled, and, in some phases, hybrid seedlings produced. Controlled pollinations on A. J. Hodges Experimental Area, Many, Sabine Parish, Louisiana, on upper coastal plain sites.

COOPERATOR: U. S. Forest Service, Institute of Forest Genetics at Gulfport.

ASSIGNMENT : E. B. Snyder, Research Forester.

27. UNITED STATES FOREST SERVICE, SOUTHERN FOREST EXPERIMENT STATION
Crossett, Arkansas

27-l. **EXOTIC TRIALS IN SOUTHWESTERN ARKANSAS.** 111.0, General.

OBJECT : To discover exotic species, varieties, strains, or hybrids which will thrive in this area and which have traits that make them desirable for forestry purposes. They will also be used in the breeding and hybridization program to combine certain desirable characters with those of native species.

METHODS : Various species of trees not native to the south Arkansas-north Louisiana area were planted over a period of 5 years beginning in the spring of 1954. These plantings are made on 18 plots in five test areas. Two demonstration plots were planted in 1955 involving 25 and 26 species each. Five seedlings were planted per row with rows being replicated from two to five times where the seedlings were available. In 1956, twelve additional plantations were made on various site conditions. The number of species varied from 12 to 25 at each site. Each species was planted in plots of 25 at a spacing of 8 x 8. A total of 29 coniferous species (including two native species) was planted. In 1957, another plantation

involving 50 species was planted with 8 by 8 foot spacing. Plantations are on Ozan Lumber Company land, Nevada, Hempstead, Clark, and Pike Counties, Arkansas, and the Crossett Experimental Forest, Ashley County, Arkansas.

COOPERATOR : Ozan Lumber Company.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-2. A **PERFORMANCE AND PROGENY TEST FOR SEVEN PINE SEED LOTS FROM ARKANSAS, LOUISIANA, AND MISSISSIPPI.** 111.0, 111.1. *Pinus* ***taeda, P. × sondereggeri, P. glabra,*** and ***P. echinata.***

OBJECT: To compare further the performance of two sources of Mississippi loblolly pine with loblolly from southeastern Arkansas; to test the progeny of a Mississippi loblolly pine plus tree candidate and a Louisiana Sondereg-ger hybrid backcross, to compare the growth of spruce pine and shortleaf pine with the above sources, and to compare informally the survival and growth of the seedlings on these plots with the seedlings on the adjacent direct seeding plots of another study.

METHODS : Seedlings from the seven sources were planted 8 by 8 feet on tenth-acre plots and replicated three times. The plantation is on Bradley-Southern Division land, Bradley County, Arkansas.

COOPERATOR : Bradley-Southern Division of Potlatch Forests, Inc.

ASSIGNMENT: Hoy C. Grigsby, Associate Plant Geneticist.

27-3. A **TEST OF *36* GEOGRAPHIC SOURCES OF LOBLOLLY PINE SEED IN SOUTHERN ARKANSAS.** 111.1. *Pinus* ***taeda.***

OBJECT: To determine what sources, if any, will grow as well or possibly better than the native loblolly on its own site so that the information can be used to determine the areas from which seed can be secured in case of failure in the local seed crop. Also, to obtain information in regard to wood quality and density and resistance to disease and insects.

METHODS : The experiment is set up on the same design and work plan as the Southwide pine seed source study sponsored by the Committee on Southern Forest Tree Improvement and involves a total of 35.5 acres. All seed sources are replicated from 4 to 12 times This test involves 36 sources of loblolly pint from 13 states or throughout its natural range from Maryland to Texas. Plantings are on Ozan Lumber Company land, Hempstead County, Arkansas, and Georgia-Pacific Corp. land Cleveland County, Arkansas.

COOPERATORS : Ozan Lumber Company Georgia-Pacific Corporation.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27—4. **LOCAL TEST OF CROSSETT PINE SEED** 111.1. *Pinus* ***taeda.***

OBJECT: To test the performance of Crossett seedlings with stock from other seed sources in the South in their local environment : (1) to determine if Crossett seed and seedling stock are equal to-or possibly superior to-local seed within carefully defined areas, and (2) to locate seed source provenances which are as satisfactory as-or possibly better than-that of Crossett for planting in the Crossett area.

METHODS : Cooperators consisting principally of industries, public forestry agencies. and schools have installed a total of 19 successful plantations involving 88 seed sources on 35 acres of land in nine southern states. Series I plots were established in 1954, Series II in 1955, and Series III in 1956. The plantings were made in randomized block design according to the "Standardized Working Plan for Local Tests of Seed Source" prepared by the Committee on Southern Forest Tree Improvement, Subcommittee on Geographic Source of Seed, under the direction of Philip C. Wakeley. Plantations are located in Bienville, Rapides, Washington, and Lincoln Parishes, Louisiana; Pike and Tishomingo Counties, Mississippi; Anderson and Franklin Counties, Tennessee; Ashley and Hempstead Counties, Arkansas; Shelby County, Texas; Lauderdale and Autauga Counties, Alabama; Columbia County, Florida; and Georgetown County, South Carolina.

COOPERATORS : Continental Can Company; Louisiana Forestry Commission; School of Forestry, Louisiana State University; Mississippi Forestry Commission; Tennessee Val-

ley Authority; Georgia-Pacific Corp.; University of Arkansas; S. C. Kardell; Department of Forestry, Louisiana Polytechnic Institute; School of Forestry, Auburn University; Florida Ranger School, University of Florida; West Virginia Pulp and Paper Company.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-5. **MORPHOLOGICAL SEEDLING TYPES AS POSSIBLE INDICATORS OF GENOTYPES IN LOBLOLLY PINE.** 111.3. *Pinus taeda.*

OBJECT : This study tests the possibility that different morphological loblolly pine seedling types in nursery beds can result in trees with distinctive genetic traits.

METHODS : Six distinctive seedling types were selected and planted in randomized row design in four blocks : (Type 1) Seedlings with a terminal bud. No side branches. Secondary needles of normal length. (Type 2) Seedlings with a terminal bud and at least one whorl of side branches. Secondary needles normal length. (Type 3) Seedlings with terminal bud and no side branches. Secondary needles very long. (Type 4) Seedlings with no terminal bud. Have candle present. No side branches. Secondary needles normal length. (Type 5) Seedlings with no terminal bud. Candles recently opened to reveal primary needles. No side branches. Secondary needles normal. (Type 6) Seedlings with no terminal bud and no side branches. All needles primary. This plantation was established in 1958. It contains 21 trees of each of the six types replicated four times. Plantations are in the Crossett Experimental Forest on loess over coastal plain soil.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-6. **PLUS TREE SELECTION PROGRAM.** *111.3. Pinus* echinatn, *Pinus taeda.*

OBJECT : To set up specifications for the selection of superior tree phenotypes and to list the superior trees selected to date giving the traits of the individual trees in detail.

METHODS : One hundred ten carefully selected trees are included in the program at present. The number varies. Some trees are being dropped as testing progresses and others added as better trees are found. The normal procedure in testing these superior tree candidates is: (1) collect cuttings for vegetative propagation (rooting or grafting) as soon as possible, (2) collect open-pollinated cones for one-parent progeny test the first cone harvest, and (3) control-breed the tree to other trees with desirable traits for testing the heritability of traits from both parents. Offspring produced by one or more of these methods have been obtained from most of these 110 trees and are now growing in test areas. The study is located in southeast Arkansas on loess over coastal plain soil.

COOPERATOR: Georgia-Pacific Corp.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-7. **PHENOTYPIC VARIATION IN THE PROGENY OF OPEN-POLLINATED, SELECTED LOBLOLLY PINE PARENT TREES.** 111.3. *Pinus taeda.*

OBJECT: To determine the variation existing among the progeny of an open-pollinated parent and general differences between the performance of progeny from one parent to another.

METHODS : Seed was collected from 16 parent trees with special characteristics such as large crowns, black seed, or large cones. The seedling stock was planted in 4 blocks of 15 randomized rows of 10 seedlings each. Insufficient seedlings did not allow four replications of all sources. The outplantings were made in 1955 on the Crossett Experimental Forest area on loess over coastal plain soil.

COOPERATOR : Georgia-Pacific Corp.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-8. **AN OPEN-POLLINATED PROGENY TEST OF SEED COLLECTED FROM BULL PINES.** 111.3. *Pinus taeda.*

OBJECT: To determine whether the undesirable features of the bull pine are controlled by heredity or whether they are due entirely to environment.

METHODS : The progeny of eight heavily limbed, poorly pruned bull loblolly pine trees were planted in six blocks in randomized paired

row design with bed-run nursery seedlings. Ten seedlings were planted per row. The outplantings were made in 1957 on Ozan Lumber Company land, Hempstead County, Arkansas.

COOPERATOR: Ozan Lumber Company.

ASSIGNMENT: Hoy C. Grigsby, Associate Plant Geneticist.

27-9. **THE SELECTION OF SUPER SEEDLINGS FROMNURSERYBEDS.** 111.3. *Pinus taeda, P.* echinata.

OBJECT: To determine whether the super seedlings found in nursery beds will develop into super trees.

METHODS : Selections were made on the basis of height. A seedling of average height and one considered to be a runt were selected from the immediate vicinity of each super seedling and planted along with it in the test plots as checks. These seedlings were planted adjacent to one another in randomized rows and blocks, each size class falling in a separate row. Plantings were made in 1954, 1955, and 1956. A total of 166 plots has been planted in 23 plantations. All of these plantations involve 8.8 acres in south Arkansas and north Louisiana Coastal Plain.

COOPERATORS : Georgia - Pacific Corp.; Ozan Lumber Company; Louisiana Polytechnic Institute; Continental Can Company; Union Producing Company; Deltic Farm and Timber Company.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-10. **EFFECT OF INTENSITY OF SELECTION ON LOBLOLLY PINE IMPROVEMENT.** 111.3. *Pinus* taeda.

OBJECT: To test the degree of genetic improvement obtainable from the progeny of wind-pollinated pole and piling quality trees compared to that obtained from the progeny of wind- and control-pollinated plus trees.

METHODS : Seed from 13 loblolly pine geographic sources are replicated four times in randomized plots of 121 trees each. Test includes progenies from ten wind-pollinated plus tree selections, a controlled cross of two of these, a mix from pole and piling quality trees, and a mix from unselected trees for control.

COOPERATOR : Georgia-Pacific Corp.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-11. **FIRST HYBRID PINE PLANTATIONS AT CROSSETT.** 112.01, 112.02. *Pinus* spp

OBJECT : (1) To obtain information on relative growth and form of the various hybrids of the major southern pines and their varieties; (2) to supply pollen and cuttings; and (3) to provide parent trees for breeding work.

METHODS : Plantation 1 was established in 1954, and consisted of 19 hybrid lots from control-pollinations made at the Alexandria Branch Station and at the Harrison Experimental Forest in 1951. Seedlings from one natural hybrid were also used. The seedlings are all in one plot. The original planting was in randomized rows of five trees each. Much inter-planting altered this design somewhat. Plantations 2 and 3, established in 1956, consist of 19 hybrid and control lots derived chiefly from crosses made at the Crossett Branch in 1953, and at Placerville, California, in 1952. These seedlings are contained in two plots and are planted in randomized rows, 10 trees per row. Each row is replicated two to three times. Plantations are in the Crossett Experimental Forest, Ashley County, Arkansas on loess over coastal plain soil. Hybrids planted were : *Pinus* elliottii elliottii x ***P.*** echinata and reciprocal, ***P. echinata x P. taeda, P. elliottii*** *elliottii* ***x P. elliottii*** *densa,* ***P. taeda. x P. elliottii*** *densa,* and ***P. taeda x P. palustris.***

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-12. **THE TREATMENT OF PINE SEED WITH ULTRASONICS TO INDUCE POSSIBLE CYTOGENETIC EFFECTS.** 112.11. *Pinus* ***taeda.***

OBJECT : To produce chromosomal aberrations and mutations.

METHODS : The ultrasonic (sound radiation above the normal audible limit) treatments were made at a frequency of 400 kilocycles and at an intensity of 200 watts. Four seed lots were immersed in water (which served as a carrier for the sound waves) and

treated with the ultra-sonorator for periods of 2, 4, 8, and 16 minutes, respectively. The resultant seedlings were planted in 1955 in four blocks. Each block contained eight plots, four from treated and four from untreated seed. Each plot contained 49 seedlings and all are in the Crossett Experimental Forest, on loess over coastal plain soil.

COOPERATORS : Georgia-Pacific Corp.; Agricultural Research Center, Beltsville, Maryland.

ASSIGNMENT: Hoy C. Grigsby, Associate Plant Geneticist.

27-13. THE USE OF GAMMA IRRADIATION TREATMENTS ON LOBLOLLY PINE SEED TO INDUCE POSSIBLE CYTOGENETIC EFFECTS. 112.11. *Pinus* ***taeda.***

OBJECT : To produce new and more useful trees through chromosomal aberrations and mutations.

METHODS : Seven seed lots were treated with seven dosage levels of gamma irradiation in a cobalt irradiator at Oak Ridge, Tennessee. The dosages were 500r (roentgen units), 1,000r, 1,500r, 2,000r, 2,500r, 3,000r, and 3,500r. The treatments above 1,500r were apparently too heavy and no seedlings were produced. Seedlings from the three lightest dosages and a check were planted in four blocks at each of two locations. Individual plots contained 49 trees each. The plantations were made in 1955 in the Crossett Experimental Forest area on loess over coastal plain soil.

COOPERATOR : Georgia-Pacific Corp.

ASSIGNMENT: Hoy C. Grigsby, Associate Plant Geneticist.

27-14. THE TREATMENT OF PINE SEED WITH X-RAYS TO INDUCE POSSIBLE CYTOGENETIC EFFECTS. 112.11. *Pinus* ***taeda.***

OBJECT : To produce chromosomal aberrations and mutations.

METHODS : The five levels of X-ray treatment are 200r (roentgen units), 400r, 600r, 800r, and 1,000r. The first outplanting was made in 1955 in three blocks. Ten trees from each of the five treatments plus a control were planted in each block. The second outplantings were made in 1956 in two plantations. The larger plantation contained 40 trees from each of the five treatments plus the control divided into four blocks of 10 trees each. The smaller plot containing five trees from each treatment was established as a demonstration plot. The plantations are in the Crossett Experimental Forest on loess over coastal plain soil.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-15. THE EFFECT OF COLCHICINE SOLUTIONS ON LOBLOLLY PINE SEED. 112.12. *Pinus* ***taeda.***

OBJECT: To develop new and more useful trees by attempting to induce changes in the genetic makeup of the cell.

METHODS : Stratified and unstratified lots of seed were treated from one to seven days in a 0.455 percent aqueous solution of amorphous colchicine. The seedlings were outplanted in 1954 in a single plot. Trees resulting from various treatments were randomized. Additional lots of seed were treated in the same solution the following year for periods of 1, 3, and 7 days. Seedlings from these treatments were planted in one plot in randomized rows, 10 seedlings per row. The plantations are in the Crossett Experimental Forest on loess over coastal plain soil.

COOPERATOR: Georgia-Pacific Corp.

ASSIGNMENT: Hoy C. Grigsby, Associate Plant Geneticist.

27-16. ROOTING OF LOBLOLLY PINE CUTTINGS. 151.02. *Pinus* ***taeda.***

OBJECT : A series of short-term studies to find the optimum environmental conditions for rooting cuttings.

METHODS : Cuttings are placed in greenhouse benches and the following factors are varied to determine optimum rooting conditions: misting cycle and duration of mist, air and rooting medium temperatures, and rooting medium materials. Indolebutyric acid in various concentrations is used as the principal rooting stimulant.

COOPERATOR : Georgia-Pacific Corp.

ASSIGNMENT : Hoy C. Grigsby, Associate Plant Geneticist.

27-17. **TIP MOTH INJURY IN RELATION TO TREE GROWTH.** 152.0. *Pinus* ***taeda, P. echinata, P. echinata x P.*** *elliottii.*

OBJECT: To determine what effect the Nantucket tip moth ***(Rhyacionia frustrana*** Comstock) has on the growth and form of loblolly shortleaf, and shortleaf x slash hybrid pines.

METHODS : Tip-moth-free plots and tip-moth-infested plots are each replicated three times for all sources. The insect-free plots are sprayed twice monthly with insecticides. Installed in spring of 1959. Examinations an made yearly. This is a part of a larger study (FS-2-i16-5-SS) conducted by the U. S. Fores Service, Insect Laboratory, Gulfport, Mississippi.

COOPERATORS : Bradley-Southern Division, Potlatch Forest, Inc., and U. S. Fores' Service, Forest Insect Research Project, Gulfport, Mississippi.

ASSIGNMENT: Charles X. Grano, Research Forester; Hoy C. Grigsby, Associate Plant Geneticist.

28. UNITED STATES FOREST SERVICE, SOUTHERN FOREST EXPERIMENT STATION, INSTITUTE OF FOREST GENETICS
Gulfport, Mississippi

28-l. **NON-NATIVE TAXON TRIALS.** 111.0, 114. *Pinus* spp.

OBJECT : To establish a source of materials for study of character variations for phylogenetic and breeding purposes, and for producing readily available germ plasms.

METHODS : Unreplicated plots of 25 seedlings spaced at 10 x 10 have been established on the Harrison Experimental Forest since 1954 with new plots being added as seedlings become available. Efforts are being made to obtain the most likely suitable sources of seed from as many *Pinus* species as possible. Any promising species or races are to be tested more extensively in separate areas. Thus far, 39 species and non-native taxa have been planted.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester; J. C. Barber, Project Leader.

28-2. **SELECTION, TESTING, AND BREEDING SOUTHERN PINES RESISTANT TO THE SOUTHERN PINE BEETLE.** 111.0, 111.3, 152.0. *Pinus* spp.

OBJECT: (1) To select from severe beetle-outbreak areas pines that have resisted beetle attack and survived; (2) to examine components of oleoresin for possible resistance factors; and (3) to establish both open- and controlled-pollinated progeny tests to study resistance mechanisms.

METHODS : Trees that have been attacked by southern pine beetle and successfully resisted the attack are being selected throughout the South and are propagated in Mississippi and Texas by grafting. Oleoresin samples are collected from the trees for analysis, and cones harvested for open-pollinated seed. Samples are also taken from nearby trees, presumed beetle-susceptible, for controls. Oleoresin samples are analyzed by gas chromatography for either qualitative or quantitative differences in composition. Samples from open-pollinated progenies will be analyzed for estimating inheritance. Controlled crosses will be made on grafts as soon as flowers are available. Toxicity and attractiveness of whole-gum and gum component samples will be evaluated with caged populations of southern pine beetle.

COOPERATOR: J. P. van Buijtenen, Forest Geneticist, Texas Forest Service.

ASSIGNMENT: J. F. Coyne, Associate Entomologist; J. C. Barber, Project Leader.

28-3. **GAS EXCHANGE IN EXCISED PINE NEEDLES.** 111.0, 111.1, 111.3, 151.0. *Pinus* ***echinata, P. taeda, P.*** *palustris,* ***P.*** *elliottii.*

OBJECT : (1) To correlate the response patterns of gas exchange with tree development and growth, and (2) to determine how different genetic material may differ in its response to environmental change.

METHODS : The response patterns of gas

exchange (primarily 0_2 production) of excised pine needles, measured manometrically, are being followed throughout the year in three series of experiments: (1) geographic source series (plant material is from Texas and New Jersey shortleaf pines growing in a 'I-year-old seed-source plantation) ; (2) species series (plant material is from loblolly, slash, longleaf, and shortleaf pine saplings) ; (3) individual trees (plant material will be from fast- and slow-growing slash or longleaf pines). In addition, a series of experiments is being conducted to determine physiological mechanisms responsible for the observed response patterns.

ASSIGNMENT : R. M. Allen, Plant Physiologist.

28-4. LOBLOLLY PINE SEED SOURCE STUDY. 111.1. *Pinus* taeda.

OBJECT : To establish a planting of loblolly pine for sampling and breeding materials that represent different geographic regions throughout its natural range.

METHODS : Thirteen sources of seed are represented in three randomized blocks in this 6-acre planting on the Mississippi Gulf Coastal Plain. The plots are 11 x 11 trees spaced at 6 x 8, the internal 49 trees serving as the sampling plot, and were planted in spring, 1960. A row of demonstration plots was planted in the spring, 1959.

ASSIGNMENT : 0. 0. Wells, Associate Geneticist.

28-5. RACIAL VARIATION IN ROOT TYPES OF LONGLEAF PINE. 111.1. *Pinus palustris.*

OBJECT: (1) To determine the extent and types of root form variations; (2) to determine if a reported diffuse-rooted Georgia type could be identified; and (3) to measure effects of differences in root form on subsquent growth and other characters.

METHODS : About 1100 trees were outplanted on the Harrison Experimental Forest in 1959. The trees are from seed of 72 wind-pollinated parents collected from 21 Georgia locations, Birmingham, Alabama, and other locations in the South. The planting is a 5-tree-row plot, 3-replicate, rectangular lattice design spaced 6 x 12. The trees are sprayed with Bordeaux mixture to control brown spot.

ASSIGNMENT: 0. 0. Wells, Associate Geneticist.

28-6. SOUTHWIDE PINE SEED SOURCE STUDY. 111.1. *Pinus* taeda, P. *elliottii,* P. *palustris,* ***P.*** echinatu.

OBJECT : To map, for longleaf, slash, loblolly, and shortleaf pines, the zones within which seed may be moved freely from collecting ground to planting site, but across the boundaries of which it should not be moved.

METHODS : The Southwide Pine Seed Source Study was initiated in 1951 by the Committee on Southern Forest Tree Improvement. State, industrial, federal, school, and private individual cooperators in 16 states have established 128 plantations in connection with the study. Of these, 108 are being maintained, and include 2,780 plots, 136,220 measurement trees, and 336,380 trees in all-less mortality. In addition to having installed them, the cooperators maintain, protect, and periodically remeasure the plantations, in selected instances with supplementary insect and disease re-examinations by Forest Experiment Station specialists. In addition to the cooperating planters, many agencies, particularly the State Forest Nurseries, cooperated in the production of the planting stock, and many more, including several private individuals, contributed seed for the study. Several cooperators have included extra plantations, or taken additional measurement data in their standard plantations to get further information from the study. Such activities are encouraged. Although a member of the Southern Forest Experiment Station staff is Chairman of the Subcommittee coordinating the study, and devotes 50 to 75 percent of his time, plus clerical help, to the undertaking, it must be emphasized that this is not a U.S. Forest Service study. It is an enterprise of the Committee on Southern Forest Tree Improvement, in which the Forest Service (through the Northeastern, Southeastern, Southern, and Central States Forest Experiment Stations and their Research Projects, and Region 8 through two of its National Forests) is merely one of many cooperators. Individual cooperators have the privilege of publishing independently the results from plantations or groups of plantations under their own care and jurisdiction, but the Committee on Southern

Forest Tree Improvement reserves review and publication rights on combinations of plantations of two or more cooperators.

COOPERATORS : Individuals and agencies in 16 states.

ASSIGNMENT : Subcommittee on Geographic Source of Seed, 0. 0. Wells, Chairman, Gulfport, Mississippi.

28-7. **CROSSES OF SLASH PINE ON VARIOUS SHORTLEAF RACES.** 111.1, ***112.01.*** *Pinus* elliottii, ***P. echinata.***

OBJECT: This study is designed to test, through most of the range of shortleaf pine, hybrids between slash pine of a single provenance and shortleaf pine of eight different provenances. The various shortleaf x slash combinations and their checks will be compared in terms of survival, cold resistance, drought resistance, growth rate, resistance to fusiform rust, recovery from tip-moth damage, and susceptibility to littleleaf disease to see whether the hybrids can be specifically tailored to the requirements of different planting localities by choosing shortleaf parents of appropriate provenances.

METHODS : The hybrid seed was produced from controlled pollinations made by the Southern Station and Hodges Land and Timber Company, Inc., in 1960 and 1961. Seed has been shared among the Northeastern, Southeastern, Central States, and Southern Forest Experiment Stations and the Tennessee Valley Authority. Seedlings grown by these cooperating agencies during 1963 were planted during the 1963-64 planting season in six replications of 15-tree row-plots in New Jersey, Pennsylvania, Ohio, Arkansas, Louisiana, Mississippi, and Georgia, and in four replications of 7-row × 'I-tree plots on a littleleaf site in Alabama. Slash pine of the same provenance as the pollen parents of the hybrids, and shortleaf pine local to each planting site, were included as checks. A second large-plot planting was established in Georgia in December 1964 on a littleleaf site.

COOPERATORS : A. J. Hodges Forest Products Co., Inc.; Northeastern Forest Experiment Station; Central States Forest Experiment Station; Southeastern Forest Experiment Station; Southern Forest Experiment Station; Tennessee Valley Authority.

ASSIGNMENT: Coordinated by 0. (Wells, Associate Geneticist.

28-8. **THE NATURE OF SLASH PINE ON TH MISSISSIPPI AND ALABAMA OFFSHOR ISLANDS.** 111.1 *Pinus elliottii.*

OBJECT : To study morphological varia tions between island, coastal, and inland popu lations.

METHODS : Trees on Cat, Horn, and Daup hin Islands were sampled for needle, buc twig, and cone characters. Samples were als taken from trees on the mainland beaches op posite each island, trees along a transect run ning north from the coast, and from a coasta progeny growing on the experimental fores1

COOPERATOR : Francois Mergen, Profes sor, Yale University.

ASSIGNMENT : E. B. Snyder, Geneticist

28-9. **GEOGRAPHICVARIATIONINNEEDLECHAR ACTERISTICS OF LOBLOLLY AND SHORT LEAF PINE.** 111.1. *Pinus* ***taeda, P. ech inata.***

OBJECT : To determine the geographic pattern of genetic variation in needle charact eristics of loblolly and shortleaf pines.

METHODS: Needles from 44 widely dis tributed seed sources will be studied using Southwide Pine Seed Source Study materia growing in Harrison and Pearl River Counties Mississippi, and in Washington Parish, Louis. iana. Twenty-two anatomical and morphologi cal characters are being examined.

COOPERATOR : Francois Mergen, Profes sor, Yale University.

ASSIGNMENT : 0. 0. Wells, Associate Geneticist.

28-10. **BREEDING IN SLASH PINE PLANTATIONS OF NON-LOCAL SEED SOURCE.** 111.1 111.3. *Pinus* ***elliottii.***

OBJECT : To compare progeny from local natural sources to those from a Florida seed source plantation. The information is needed to evaluate the feasibility of further genetic and breeding research within such plantations which are widespread in the south.

METHODS : Wind-pollinated progeny from 64 trees from the two sources, were outplanted in 1956. About 1900 trees were planted on each of two 3-acre sites: the Harrison Experimental Forest and the McNeil1 Experimental Forest. At each location a 3-replicate, lo-tree-row plot, triple lattice design was used with 6 x 12 spacing.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-11. SLASH × SHORTLEAF F_1 HYBRID. 111.1, 111.3, 112.01. *Pinus* ***elliottii, P.*** *echinata.*

OBJECT : (1) To estimate the influence of pollen source and individual seed parent upon the frequency of nanophytes in the F_1 hybrid populations of slash x shortleaf, and (2) to compare variation patterns in mortality and height growth of the hybrid progenies with those of open-pollinated progenies from the same seed parents.

METHODS : Shortleaf pollen sources of different geographic origin have been used to control-pollinate selected Florida slash pine trees. Control-pollinated and open-pollinated seed will be collected to provide the progenies required. Single-tree replicated plots, 6-foot triangular spacing, in compact family block design will constitute the outplanting. Nanophytes will be statistically defined and the appropriate frequency distributions compared. Height growth, its variance, and mortality comparisons will also be made.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-12. *Pinus rigida* TESTS. 111.1, 112.01. *Pinus rigida.*

OBJECT: To test the local adaptability of ***P.*** *rigida* and ***P.*** *rigida* hybrids when crossed and compared with ***P. echinata, P. serotina, P. taeda,*** and ***P.*** *glabra.*

METHODS : Two hundred and sixty-five trees representing various ***P.*** *rigida* and test crosses are to be planted on each of two harsh sites, very wet and very dry, on the Harrison Experimental Forest. Due to the extremely variable number of seedlings representing the various crosses, complete randomization of single tree plots, spaced at 8 x 8 will be used.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-13. RECIPROCAL SPECIES EFFECTS IN SHORTLEAF X SLASH AND SLASH X SHORTLEAF HYBRIDS. 111.1, 112.01. *Pinus* elliottii, ***P. echinata.***

OBJECT: To test, in two locations, hybrids between slash pine and shortleaf pine from eight widely distributed seed sources. The assumption that each species of the cross contributes equally to the genetic constitution of the hybrid will be tested by this study.

METHODS: Hybrids were produced by controlled pollination with both slash pine and shortleaf pine used first as male and then as female parents. Plantings were established in Jasper County, Georgia, and Harrison County, Mississippi, during the 1963-1964 planting season.

COOPERATOR: Southeastern Forest Experiment Station.

ASSIGNMENT : 0. 0. Wells, Associate Geneticist.

28-14. EFFECT OF THE ROOTS ON THE HEIGHT GROWTH OF PINES. 111.1, 151.0. *Pinus* ***taeda, P. elliottii, P. echinata.***

OBJECT : To measure the variation in height growth which can be attributed to differences in root efficiency and vigor.

METHODS : In two studies the tops and roots of young loblolly, slash, and shortleaf seedlings were interchanged in all combinations by grafting. The outplantings have 8 single-tree replications of each combination in one study and 10 in the other. Double-root systems were made by inarching in a thrid study. Here again all three species are represented in all combinations and there are 10 single-tree replicates in the outplanting. In a fourth study there are four treatments: (1) Scions from seven geographic sources of shortleaf grafted on the local shortleaf rootstock, (2) shortleaf source scions grafted on slash rootstock, (3) scions from the local shortleaf source grafted on the rootstocks of the other sources, and (4) shortleaf scions grafted on rootstocks of their own source. There are 10 single-tree replicates in the outplanting. An-

nual measurements will be made for at least five years.

ASSIGNMENT : R. M. Allen, Plant Physiologist.

28-15. **SELECTION OF FAST-GROWING SLASH AND LOBLOLLY SEEDLINGS FROM THE ASHE NURSERY.** 111.3. *Pinus taeda, P. elliottii.*

OBJECT: To obtain a future source of valuable variants for physiological and genetic studies and for tree improvement research.

METHODS: Annual selections for a 10-year period ending in 1971 are outplanted with controls. Selection intensity is approximately one per nursery bed (1: 50,000).

ASSIGNMENT : E. B. Snyder, Geneticist.

28-16. **PROGENY TESTING LONGLEAF PINE FOR BROWN-SPOT RESISTANCE.** *111.3. Pinus* palustris.

OBJECT : To identify brown-spot-resistant longleaf pines.

METHODS : Open-pollinated seed from 543 longleaf trees were collected and seedlings grown at Alexandria, Louisiana, and Gulfport, Mississippi. Bulk longleaf seedlings were planted 1 year earlier in Mississippi than selected progenies to build up a heavy inoculum on the area. Progenies were planted in single-tree plots with 10 replicates at three locations (Alexandria, La., and two in Harrison County, Miss.) ; one location in Mississippi will be sprayed to control the disease for a comparison of growth. Brown-spot infection and heights will be recorded up to 4 years.

COOPERATOR : Crown-Zellerbach Corp.; International Paper Company; Southeastern Forest Experiment Station.

ASSIGNMENT : Harold J. Derr, Research Forester, Alexandria, La.; F. F. Jewell, Plant Pathologist.

28-17. **PROGENY OF INDIVIDUAL LONGLEAF PINE TREES.** 111.3. *Pinus* palustris.

OBJECT: To determine if there is any variation in the length of the grass stage period between the progeny of individual, wind-pollinated longleaf trees in south Mississippi.

METHODS : Wind-pollinated longleaf see was collected from 35 different trees each ye: for 4 years. Part of the trees in the last 3 year collection were located in Pearl River Count Mississippi, part in Harrison County, Mississil pi, and part in Stone, Forrest, or Perry Cour ties, Mississippi. The first year's collection wa all from Harrison County. The stock was un formly treated in the nursery. Field planting have used 25-seedling row plots and a rar domized complete block design. Each year collection was a separate experiment. Survive measurements were made after 1 year in th field and survival and growth measuremenl each year thereafter for 2-4 years. Final fiel measurements have been made.

ASSIGNMENT : R. M. Allen, Plant Phy siologist.

28-18. **BREEDING AND PROGENY TESTIN SOUTHERN PINES FOR RESISTANCE T TIP MOTHS. 111.3, 112.02,** 141. *Pinu* **spp.**

OBJECT : (1) To determine whether ther is inherent resistance to tip moths in suscep tible native species, and (2) whether resistanc can be developed in susceptible native specie by breeding with resistant individuals or b hybridization with resistant species.

METHODS : Individual trees indicatin possible resistance to or tolerance of tip mot attack will be selected in the Southwide Pin Geographic Seed Source Study plantation o Crown-Zellerbach Corporation land near Mil lard, Mississippi. Other resistant trees whic are reported will be investigated for possibl selection. These trees will be used as paren trees in a breeding program. Hybrids develop ed at the Institute of Forest Genetics will b subjected to tip moth attack in the field an an evaluation made of their resistance.

ASSIGNMENT: J. F. Coyne, Associate En tomologist.

28-19. **HYPOCOTYL AND COTYLEDON COLO VARIANTS IN CROSSES OF SLASH PINE** 111.3, 112.02, 112.03, 141. *Pinus elliot tii.*

OBJECT : To determine inheritance of pig mentation mutants for use in studying th genetic stand structure, inbreeding in seed or

chards, ploidy and mutation breeding, species hybrids, and population genetics.

METHODS : Fourteen known carriers were intercrossed and selfed. In 1965, seedlings were studied in the nursery and in the laboratory for incidence of pink or green hypocotyls and their intergrades, and for xantha or other variants in the cotyledons. These supplement earlier studies with wind-pollinated material.

COOPERATOR : Francois Mergen, Professor, Yale University.

ASSIGNMENT: E. B. Snyder, Geneticist.

28—20. **ERAMBERT'S HYBRID.** 111.3, 141. *Pinus x sondereggeri.*

OBJECT : (1) To determine the species from which the natural hybrid originated, and (2) to test the significance of the extreme variability known to exist in its progeny.

METHODS : Samples from the parent tree and its progeny will reveal the species nature of the hybrid, and the use of variance as a variable will determine the possible existence of a significantly greater degree of progeny variability. The tree is at present considered to be a Sonderegger and as such is planted with the other Sonderegger pines.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-21. **VARIATION IN SHADE TOLERANCE AND WATER EFFICIENCY OF PROGENIES OF INDIVIDUAL SLASH PINES.** 111.3, 141, 151.0. *Pinus elliottii.*

OBJECT : (1) To determine if there is demonstrable genetic variation in the shade tolerance of slash pine seedlings; (2) to determine if there is demonstrable genetic variation in the water efficiency of slash pine seedlings; and (3) to determine how some of the more obvious physiological mechanisms are correlated with the variations in shade tolerance and water efficiency.

METHODS : One-parent progeny from over 200 mother trees in 13 locations were tested in the nursery bed for 2 years under different levels of light intensity and soil moisture. A factorial experiment in a randomized block design with four replications was used in comparing the following treatment effects on the progeny: (1) full sunlight-high moisture; (2) full sunlight-low moisture; (3) shade-high moisture; and (4) shade-low moisture. Height measurements were made at the end of the first growing season. In the second growing season the length of the spring flush was measured. At the end of the second growing season total heights and groundline diameter were taken on all seedlings; dry weights of foliage and dry weights of stem tissue were measured on selected progeny groups. Physiological studies concerning chlorophyll content, photosynthetic and respiration rates, and measurements of relative turgidity were made. Field and laboratory work have been completed and the data are being analyzed.

ASSIGNMENT : R. M. Allen, Plant Physiologist; E. B. Snyder, Geneticist.

28-22. **SELECTION AND CARE OF FUSIFORM-RUST-FREE SLASH PINES FROM CERTAIN HIGH-RUST-INCIDENCE PLOTS.** 111.3, 151.01, 151.5. *Pinus elliottii.*

OBJECT : To select and maintain rust-free slash pines in plots in the Chickasawhay Ranger District of the DeSoto National Forest. A secondary object is to observe effect of certain cultural treatments on the flower production of the selected trees.

METHODS : An examination of all living plot trees was made for rust infection and the infection percent calculated. The trees were 12-18 years of age and the plot size was 1/10 acre. Four of 7 plots were selected for use having an average of 93 percent rust-infected trees present. Where possible, all rust-free trees were released by removal of adjoining trees in a 25 foot radius from each selection. Included on each plot were two selections badly rust-infected. A total of 23 rust-free and 8 rust-infected trees were selected. Following release, 20-25 pounds of 5-10-5 commercial fertilizer was applied around the base of each residual tree for two consecutive years. It is to be repeated periodically. Brush control by herbicides has been started. When the trees are of sufficient size and have adequate flowers, controlled breeding will be done.

ASSIGNMENT: F. F. Jewell, Plant Pathologist.

28-23. **HISTOCHEMICAL AND BIOCHEMICAL DIFFERENCES ASSOCIATED WITH RESISTANCE TO THE FUSIFORM RUST FUNGUS IN SLASH AND SHORTLEAF PINES.** 111.3, 151.5. *Pinus elliottii,* ***P. echinata.***

OBJECT : (1) To make biochemical analyses of rust-susceptible and resistant slash pine and resistant shortleaf pine; (2) to identify by biochemical and histochemical analyses the response of pine hosts to inoculation and subsequent infection by fusiform rust; and (3) to isolate and identify chemical differences associated with resistance.

METHODS : Primary and secondary tissues of resistant and susceptible slash pines and resistant shortleaf pines will be inoculated by hypodermic injection of spores. Tissues will be sampled periodically and analyzed for biochemical differences. Determinations will be made for compounds such as gibberellins, auxins, auxinase, phenolics, and phenoloxidase. Tissue samples also will be quick-frozen, sectioned, and stained with vital stains to determine changes at the cellular level and locate response mechanisms to infection.

ASSIGNMENT : R. C. Hare, Associate Plant Physiologist.

28-24. **CONVERSION OF EARLY BOGALUSA PINE PLANTATIONS TO BREEDING BLOCKS, WITH ANALYSIS OF RELATIONSHIP BETWEEN JUVENILE AND MATURE PHENOTYPIC CHARACTERS.** 111.3, 153. *Pinus* ***taeda, P.*** *elliottii,* ***P. palustris, P.*** *echinata.*

OBJECT : (1) To utilize individual-tree measurements and descriptions at ages of 1, 2, 3, 4, 5, 10, 15, and 30 years in plantations of four species on two to six soil types each, for study of the variation in height and diameter at different ages; (2) to establish juvenile-mature correlations; and (3) to estimate predictive value of juvenile traits for use in early selection.

METHODS : Individual-tree measurements and descriptions had been made at various ages from 1 to 30 years on the survivors of 23,000 trees planted 1922-26. Four species on several sites are included. At age 30 final selection of more than 200 trees (plus corresponding checks) were made on a basis of "mature" performance and prior juvenile selections at ages 3-5. Data will be analyzed to determine variation at different ages, changes in stand structure, juvenile-mature correlations, species-soil interactions, etc. The value of various juvenile selection criteria will be examined. Selected trees have been released to increase flower production. These trees will be used in other genetic studies.

COOPERATOR : Crown-Zellerbach Corporation and predecessors have assisted in all phases of the study since its establishment.

ASSIGNMENT : Philip C. Wakeley, Principal Research Forester.

28-35. **HALF-SIB PROGENY TESTS WITH MISSISSIPPI FOREST TREES.** 111.3, 211.3 *Pinus* ***taeda, Liquidambar*** *styraciflua*

OBJECT: To determine genetic variation attributable to range-wide, state-wide, stand and individual tree effects in loblolly pine and sweetgum.

METHODS : Range-wide collections of loblolly pine seed have been grown under controlled environmental conditions. Morphological characters of seed and seedlings, and responses of seedlings to various environmental conditions are being studied. In a second phase of the study seed collected from five trees in each of 137 sweetgum and 118 loblolly stands along 20 latitudinal transects will be outplanted on several sites in Mississippi. Sources are from western Alabama to west of the. Mississippi River, and north from the Gulf to the limit of the natural range of loblolly pine. The study is part of the S-23 project.

COOPERATOR : Mississippi State University.

ASSIGNMENT : George L. Switzer, Professor, Mississippi State University; 0. 0. Wells Associate Plant Geneticist; J. R. Wilcox, Associate Plant Geneticist.

28-26. **SONDEREGGER PINE PLANTATION, 1926-27.** 112.01. *Pinus* ***x sondereggeri.***

OBJECT: To observe the normal development of putative F_1 *Pinus* ***palustris*** $\times$ ***P. taeda*** (Sonderegger pine) from longleaf pine seedbeds.

METHODS : Some 330 hybrid seedlings were selected from longleaf seedbeds sown with local seed, outplanted 6 x 8 in 1926-27, and remeasured periodically. Initial survival approximated 95 percent. Site was adverse, survival at age 30 approximately 16 percent. Growth, form, and infection by fusiform rust were highly variable. The plantation was supplemented by one control-pollinated backcross of ***P. palustris*** on putative F, ***P. palustris x P. taeda.*** Study is located at Bogalusa, Washington Parish, Louisiana ("Coburn's Creek"), on upper coastal plain site.

COOPERATOR: Crown-Zellerbach Corporation.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-27. **BREEDING AND PROGENY TESTING FOR RESISTANCE TO FUSIFORM RUST IN SOUTHERN PINES.** 112.01, 112.02, 151.5. *Pinus* ***elliottii, P. taeda, P. palustris, P. echinata.***

OBJECT : (1) Through control-breeding, both intra- and interspecific, among slash, loblolly, longleaf, and shortleaf pines to develop fusiform rust-resistant progeny lines; (2) through intensive testing by artificial rust inoculation methods, determine the reaction of l-parent and hybrid progenies arising from objective 1; and (3) establish field plots of selected progeny lines to determine their reaction to rust infection under natural conditions.

METHODS : Selected parents of slash and loblolly are crossed intra- and interspecifically, not only among and between these two species but also with shortleaf. Slash and longleaf pine have been crossed by controlled means. Progenies are tested in the nursery using a randomized block design. Examination of the seedlings is made 8-9 months following inoculation, and those free of rust are potted, held till the following spring, and reinoculated. Suitable statistical analysis is made of the results.

ASSIGNMENT : F. F. Jewell, Plant Pathologist.

28-28. **EFFECTS OF PHENOTYPIC VARIATION OF PARENTS UPON HYBRID PROGENIES.** 112.01, 141. *Pinus* ***elliottii, P.*** *palustris,* ***P. taeda.***

OBJECT : To investigate the components of variation attributable to individual parent trees in the over-all species hybrid variation.

METHODS : Three trees exhibiting gross morphological differences among themselves were selected from each of the three species, ***P. elliottii*** var. ***elliottii, P. palustris,*** and ***P. taeda*** for interspecies breeding. Hybrids were among all species. Several characters, particularly form and vigor, are to be followed in the nursery and field. The planting design will be in 5 to lo-tree row plots in compact family blocks, replicated 6 times.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-29. **SONDEREGGER PINE.** 112.01, 141. *Pinus* × ***Sondereggeri.***

OBJECT : (1) To determine the inheritance of characters of discriminatory and economic value in natural and artificially produced populations of ***P.*** × ***Sondereggeri,*** and (2) to determine the extent of introgression.

METHODS : Samples have been taken from two hybrid swarm areas in east Texas and west Louisiana, two planted populations in Louisiana, several plots of F_1 ***P.*** × ***sondereggeri*** in Mississippi, and from isolated trees throughout the South. A 3,600-tree planting of various Sonderegger back crosses has been established at the Harrison Experimental Forest at a 6 x 12 spacing, using 20-tree row plots arranged in compact family blocks and replicated 6 times. Further samplings and controlled pollinations are being made.

ASSIGNMENT: D. M. Schmitt, Associate Research Forester.

28-30. **INTERSPECIESHYBRIDARBORETA.** 112.01, 141. *Pinus* spp.

OBJECT : (1) To explore interspecies and self-compatibilities, (2) to study inheritance patterns of the southern pine hybrids.

METHODS : The following hybrids resulting from 1954 pollinations have been planted in Harrison County, Mississippi: ***P.*** palustris x ***P. elliottii elliottii, P. palustris x P. x*** *sondereggeri,* ***P. palustris x P. taeda, P. palustris x (P. echinata x P. elliottii elliottii), P. palustris x (P. palustris x P. taeda), P. elliottii elliottii x***

P. taeda, P. taeda* x *P. elliottii elliottii, P. taeda x P.* x *sondereggeri, P. echinata x P. elliottii elliottii, P. echinata x P. taeda, P. echinata* x *(P. echinata x P. elliottii elliottii), P. x sondereggeri x P. taeda, and ***P. x sondereggeri x (P. echinata x P. elliottii elliottii).*** One thousand two hundred and fifty-two seedlings were originally planted 12 x 12 in three replications with up to 16 trees per row plot, of which 1069 survived their second year in the field. This material has been measured for early height and diameter growth and pest occurrence and is being used for sample materials in studies of hybrid inheritance. Since flowering has started, various backcross combinations are being made on a small scale. A second hybrid test area was established in 1959 with 1120 trees at 6 x 10 in lo-tree row plots in 7 randomized blocks.

ASSIGNMENT : D. M. Schmitt, Associate Research Forester.

28-31. **BREEDING WITH A HIGH SPECIFIC GRAVITY LONGLEAF PINE.** 112.02. *Pinus palustris.*

OBJECT : (1) To determine to what degree the high specific gravity of the selected tree (Wayne l-l) is heritable and how much regression toward the mean will occur; (2) to determine to what type of parents this tree should be mated to capitalize on this outstanding trait, i. e., can it be combined with a tree of outstanding form, etc. to get better progeny; and (3) to determine how soon superior combinations can be recognized and whether there are correlated traits such as straightness and form.

METHODS : Wayne l-l was mated with four other trees selected for specific characteristics such as form, growth rate, crown, limbiness, etc. Parent tree measurements will be recorded, fiber lengths will be determined, and the trees will be vegetatively propagated. The 400 progeny were outplanted at 12 x 12 triangular spacing in 1963. There were 10 replicates of lo-tree row plots in a randomized block design. Progeny first-year field survivals will be recorded, as will the 3, 5, 10, etc. year heights. D.b.h. and form estimates will be recorded as soon as measurable. Wood quality tests will begin in the juvenile state for comparisons with mature measurements.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-32. **CONTROLLED POLLINATIONS FOR STUDYING INHERITANCE OF VIGOR, FORM, AND SEXUALITY IN SLASH PINE.** 112.02, 141 *Pinus elliottii.*

OBJECT : To study the inheritance of certain phenotypic variants occurring in a 4-acre slash pine plantation.

METHODS : About 2000 trees from controlled crosses among eight parents were planted in 1959. A compact family block design was used with three replications, and lo-tree row plots (multiple plots per entry per replication were used for some depending on the number of seedlings available). Spacing was 6 x 12

ASSIGNMENT : E. B. Snyder, Geneticist.

28-33. **PARENT HALF-SIB RELATIONS WITH RESPECT TO VIGOR, SEED SIZE, AND OTHER CHARACTERISTICS IN LONGLEAF PINE** 112.02, 141. *Pinus palustris.*

OBJECT : To obtain information on heritability of growth rate, seed size, variation in brown spot reaction, and other characters, and to show how such information can be used for genetic models and development of selection methods.

METHODS : Two plantings have been made on the Harrison Experimental Forest: (1) About 3000 seedlings survived from a 1957 outplanting of 8 acres. They are progeny from the wind-pollinated seed of 100 randomly selected trees. The planting is an 8-tree row plot 6-replicate, triple lattice design. The planting was 6 x 12. It was sprayed with Bordeaux mixture. (2) The planting was repeated in 1958 on 1 acre of land but the spacing was 1% x 12 and the planting was an 8-tree row plot 2-replicate, simple lattice. It is left unsprayed to determine the brown spot reaction of the progeny.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-34. **VARIATION AND INHERITANCE OF SEED CHARACTERS OF LONGLEAF-LIKE PINES** 112.02, 141. *Pinus palustris.*

OBJECT : (1) To study the inheritance of the black seed-coat and loose-wing characters in longleaf (?) pine; (2) to study the possible use of these characters as chromosome markers; and (3) to test the hypothesis of homologous variation against that of introgression as an explanation of these characters.

METHODS : About 2500 seedlings, mostly backcrosses, were outplanted in 1964 in five randomized blocks of lo-tree plots. About 500 F_1's are available from earlier plantings. Cultural measures will be taken to hasten flowering.

COOPERATORS : West Louisiana Land and Timber Co., Inc., Many, La.; Southern Forest Experiment Station, Alexandria, La.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-35. **CONTROL POLLINATING AND PROGENY TESTING PLUS SLASH PINE SELECTION,** 1958. 112.02, 141. *Pinus elliottii.*

OBJECT : (1) To verify phenotypic characteristics of plus trees and to obtain and evaluate certain F_1 combinations by 2-parent progeny tests; (2) to try a progeny test method which is simple and yet produces a knowledge of specific combining ability as well as the usual general combining ability; and (3) to study the inheritance of characters such as specific gravity, growth, and form.

METHODS : Twelve plus parent trees were pollinated to give 51 different crosses, excluding reciprocals. Sources for the selections of plus trees are as follows: (1) Harrison Experimental Forest-six trees selected for form, specific gravity, progeny size, volume, cone-bearing ability, and accessibility; (2) Crown-Zellerbach plantation, Bogalusa, La.-four trees selected for form, specific gravity, and growth rate; (3) International Paper Co. lands in Mississippi-two trees selected for specific gravity and growth rate. Parent trees will be as fully characterized as possible by measurements of branch characters, stem form, specific gravity, growth rate, phenology, etc. Amount of competition will be considered. The 3,300 trees of crosses and controls constituting 54 entries were outplanted on two sites at 12 x 12 triangular spacing in 1965. To accommodate variable seed yields, they were divided into (1) an 8-replicate, simple lattice of 36 entries in 9-tree rows, and (2) an 18-entry, 6-replicate, 'I-tree plot randomized block. Progeny characters measured will include nursery heights, 2-year survival, and 6-year heights. The same characters measured on the parent trees will be measured on the progenies at 5-year or suitable intervals for parent-progeny regressions, among other analyses.

COOPERATORS : Crown-Zellerbach Corp.; International Paper Co.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-36. **COMPATIBILITY, GROWTH RATE, AND MUTANT CHARACTERS IN SELFED SLASH PINE.** 112.03, 141. *Pinus elliottii.*

OBJECT : To obtain seed from enough parents to obtain valid estimates of the effects from selfing.

METHODS : Fifty pollination bags on each of 35 parents received self pollen. Selfed and wind-pollinated seedlings of each were compared in the nursery. The 800 selfed seedlings were outplanted with 800 wind-pollinated control seedlings in two 3-acre sites at 12 x 12 triangular spacing in 1965. To accommodate variable seed yields, 12 of the paired entries were divided into a 9-tree row plot, 6-replicate split-plot design, while 19 were outplanted in a a-tree, 4-replicate split-plot.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-37. **X-IRRADIATION AND AGING OF SOUTHERNPINE SEED FOR RETEROTIC AND MUTAGENIC EFFECTS.** 112.11. *Pinus* taeda, *P. echinata, P. elliottii.*

OBJECT: To study the nature of X_2 mutations.

METHODS : Results from early phases have been published. Slash, shortleaf, and loblolly planted in 1951 and 1955 from irradiated or 23-year-old seed were thinned in 1964 to induce flowering. Some of the 150 trees will be intercrossed when they flower.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-38. **DIALLELCROSSESWITHLOBLOLLYPINE.** 141. *Pinus taeda.*

OBJECT : To study genetic variances intensively in the southwestern range of loblolly pine.

METHODS : Within selected stands, 10 random trees are intercrossed in all combinations, excluding selfs and reciprocals. One of three stands within Mississippi has been completed and will be outplanted both in Mississippi and Texas in 1967. Crosses from other stands, including several in Texas, will be subsequently planted in both states.

COOPERATION : J. P. van Buijtenen, Texas Forest Service.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-39. **POLYGENIC INHERITANCE IN DIALLEL CROSSESOFLONGLEAFPINE.** 141. *Pinus* palustris.

OBJECT: To determine types and relative effects of gene and environmental action, combining ability, effects from selfing, differences in reciprocals, etc. in longleaf pine,

METHODS : About 6000 seedlings from controlled pollinations among 13 trees were outplanted in 1960 on 2 sites of the Harrison Experimental Forest. There are approximately 1,500, 4-tree row plots. Whole plots contain paired reciprocal crosses and are in a 9 x 9 rectangular lattice design with eight replications. Spacing is 12 x 12 in an equilateral triangle system. The plots were sprayed semiannually with Bordeaux mixture until height growth had been initiated.

ASSIGNMENT : E. B. Snyder, Geneticist.

28-40. **QUANTITATIVE GENETICS OF FOREST TREES.** 141, 241. General.

OBJECT : (1) To apply theories of quantitative genetics to the special problems of breeding forest trees; (2) to relate the concepts of character development and correlations to economically oriented selection and to the genetic variability structure of natural stands of forest trees; and (3) to analyze, on the basis of present theories, proposed methods for producing genetically improved seed.

METHODS : Using data from all possible sources, examine the application of present genetics theory and plant breeding methods to the problems of forest tree breeding and genetics. Presently used methods will be critically examined in the light of their underlying assumptions and of new genetic knowledge as it becomes available. Experimental designs and study plans will be developed to test new hypotheses and to produce genetic information with maximum efficiency.

COOPERATOR : Department of Genetics, North Carolina State University.

ASSIGNMENT : Gene Namkoong, Plant Geneticist.

28-41. **STUDY OF THE GROWTH SUBSTANCES II PINE.** 151.0. *Pinus* taeda, P. *palustris* *P.* elliottii.

OBJECT : To determine the nature an role of the growth substances present in pin buds.

METHODS : Extracts of the buds of lob lolly, longleaf, and slash in various stages o growth are being examined by chromatographi and bioassay procedures. The qualitative an quantitative changes in growth substances arc being studied during different stages of growth Work is also under way to identify these sub stances.

ASSIGNMENT : R. M. Allen, Plant Phy siologist.

28-42. **SOME ASPECTS OF HEIGHT GROWTH IN THE SOUTHERNPINES.** 151.0. *Pinus* spp

OBJECT : To quantify and determine hou height growth and variation in height growtl occur in the southern pines.

METHODS : A summary of observation and analyses, mainly by auto-correlation, o: detailed height growth measurements of the southern pines made over a period of years.

ASSIGNMENT : R. M. Allen, Plant Physiologist.

28-43. **FUSIFORM RUST INOCULATION OF PINE** 151.5. *Pinus elliottii.*

OBJECT : To develop techniques of rus inoculation of pine applicable to large-scale testing of hybrid progeny for resistance to fusiform rust.

METHODS : At the Harrison Experimenta Forest, moist-chambers were constructed fo inoculating young (30-50-day-old) slash pines *(Pinus elliottii* var. *elliottii)* in 4 x 4 nurser3 bed sections, and for inoculating one year o older potted plants under environmental con ditions favorable for rust infection. Improve. ment of methods and facilities is continuing.

ASSIGNMENT : F. F. Jewell, Plant Path. ologist.

28-44. **OBSERVATIONS ON THE PENETRATION O THE PINE HOST BY THE SPORIDIA 01** *Cronartium fusiforme* **AND THE ASSO CIATED HOST RESPONSES.** 151.5. *Pinu.* spp.

OBJECT : To determine through histological methods the method of penetration used by C. ***fusiforme*** on its pine hosts, and to study the anatomical changes resulting from successful establishment of the parasite in the host tissue, as compared with the normal anatomy of the host.

METHODS : Pine material from nursery or other artificial rust inoculations is killed, fixed, and paraffin embedded for serial sectioning. Uninoculated pine is handled in a similar manner. Microscopic examinations of the stained sections are made and details of the normal and pathological anatomy of the tissue are studied along with the morphology and developmental changes of the parasite.

COOPERATOR: R. P. True, Pathologist, West Virginia University.

ASSIGNMENT: F. F. Jewell, Plant Pathologist.

28-45. **THE RELATIONSHIP OF SUSCEPTIBILITY OF PINES TO** Ceratocystis ***Minor*** (Hedge.) **HUNT TO SUCCESSFUL ATTACK BY THE SOUTHERN PINE BEETLE.** 152.0. *Pinus* spp.

OBJECT: To determine if resistance to the southern pine beetle may be related to the rate of spread of the blue stain fungus ***Ceratocystis minor.***

METHODS: The blue stain fungus C. min***or*** is specific to southern pine beetle. Mortality of trees is usually attributed to the interruption of water movement by the fungus rather than the girdling effect .of the beetle. Trees of shortleaf, loblolly, and slash pine will be inoculated with the fungus to determine rate of spread and subsequent mortality of the trees. Progenies of beetle-resistant selections will be compared as soon as available. The effects of the fungus on oleoresin flow, pressure, and composition will be measured. An attempt will be made to relate any differences to resistance or susceptibility to beetle attack.

ASSIGNMENT: R. C. Hare, Associate Plant Physiologist.

28-46. **EVALUATIONOFNON-NATIVE** *Liquidambar* spp. 211.0. ***Liquidambar*** spp.

OBJECT: To evaluate the performance of ***L. formosana*** and a Mexican source of ***L.*** *styraciflua* in relation to local ***L.*** *styraciflua.*

METHODS : Fifty sources of ***Liquidambar,*** seven of ***L.*** *styraciflua* from the United States, one from Mexico, and 42 sources of *L. formosana* have been outplanted at the Harrison Experimental Forest. There are 200 8-tree row plots at 8 x 8 spacing in a randomized block design of four replications. Thirty of the sources have also been outplanted near Greenville, Mississippi.

ASSIGNMENT : James R. Wilcox, Associate Geneticist.

28-47. **GERMINATIONRESPONSEOFSWEETGUM PROVENANCES TO STRATIFICATION TIME.** 211.1. ***Liquidambar*** *styraciflua* L.

OBJECT : To determine the variation in stratification requirements of sweetgum seed collected throughout Mississippi and adjacent portions of adjoining states.

METHODS : Sweetgum seed was collected from three stands along each of six lines of latitude, 30-35°N, in Mississippi and adjacent portions of Alabama and Louisiana. Seed from five trees were bulked to represent each stand. Following stratification for 0, 4, 8, 16, 32, and 64 days, seed were placed in an incubator at alternating temperatures of 20°C for 16 hours and 30°C with light for eight hours. Daily germination counts were made for three weeks to study rate and total germination.

COOPERATOR: George Switzer, Professor, Mississippi State University.

ASSIGNMENT: James R. Wilcox, Associate Geneticist.

28-48. **BROAD SENSE HERITABILITY ESTIMATES IN COTTONWOOD.** 211.3, 241. *Populus deltoides.*

OBJECT : To obtain broad sense heritability estimates and expected gains at various selection intensities for growth and wood quality characters.

METHODS : Forty-nine randomly selected run-of-the-bar seedlings from a S-year-old cottonwood stand were subdivided into 20-inch cuttings for inclusion in the study. Clones were field-planted in a randomized block design with six replications of single-tree plots. The site was a sharkey clay. Following first-year growth, 6-inch cuttings were taken from each clone and placed in containers of soil in a split-plot design in the lath-house to evaluate root-

ing ability of the clones and the effect of two soil types, sharkey clay and a standard potting mixture, on root development.

ASSIGNMENT : James R. Wilcox, Associate Geneticist; Robert E. Farmer, Jr., Associate Research Forester.

28-49. **SWEETGUM HALF-SIB PROGENY EVALUATION.** 211.3, 251.09. *Liquidambar* styraciflua.

OBJECT : To study the variability and inheritance of various phenological, growth, form, and wood quality characteristics of sweetgum and the influence of location on their expression.

METHODS : Progenies from 40 wind-pollinated trees selected to represent a range of phenotypes and sites were outplanted at the Harrison Experimental Forest near Gulfport and the Delta Experimental Forest near Stoneville, Mississippi. Each outplanting consists of five replications of 4-tree row plots per parent tree on a 12 x 12 equilateral spacing.

ASSIGNMENT : James R. Wilcox, Associate Geneticist; Robert E. Farmer, Jr., Associate Research Forester.

28-50. **CONTROL-POLLINATION OF SWEETGUM.** *254.0. Liquidambar styraciflua.*

OBJECT : To define the period of receptivity of female flowers and to assess the amount of self-pollination in sweetgum.

METHODS : Controlled pollinations were made on emasculated, bagged sweetgum flowers on each of 3 trees at 2-day intervals from March 16-30, 1963, and from March ll-April 8, 1964. Protective bags were also placed over both male and female flowers on each tree to insure self-pollination. Seed heads were collected from controlled-pollinations, self-pollinations, unpollinated checks, and wind-pollinated flowers. Data were recorded and compared on seeds per head and seed weight for the various pollinations. Observations are continuing.

ASSIGNMENT : James R. Wilcox, Associate Geneticist.

28-51. **EFFECT OF COLLECTION TIME ON SWEETGUM SEED QUALITY AND SEEDLING HEIGHT.** *254.0. Liquidambar styraciflua.*

OBJECT : To determine the effect of tim of collection on sweetgum seed quality and sub sequent seedling height.

METHODS : Seed heads were collecte from 6 sweetgum trees in south Mississipp at 2-week intervals from September 5 to No vember 28, 1962. Data were recorded on speci fic gravity of the seed head, seed weight, an percent and rate of germination for each tre on each collection date. Percent germinatio and seedling height were also evaluated in replicated nursery test.

ASSIGNMENT : James R. Wilcox, Asso ciate Geneticist.

28-52. **FORCING SWEETGUM FLOWERS.** 254.(Liquidambar styraciflua.

OBJECT : To evaluate the effects of sev eral environmental factors on sweetgum flow er-bud dormancy and development.

METHODS : Flower-bud-bearing sweetgun branches from each of 3 trees were collectec at 3-week intervals from early January to mid February. Collected branches were subjectec to two temperature treatments, two day-length treatments, and to various nutrient and growth, promoting substances to study their effects or flower-bud break and subsequent development Additional studies will further define optimun conditions of forcing.

ASSIGNMENT : James R. Wilcox, Associate Geneticist.

28-53. **FREEZE-DRYING OF SWEETGUM AN YELLOW-POPLARPOLLEN.** 254.0. *Liquidambar styruciflua, Liriodendron tu*lipifera.

OBJECT : To develop optimum technique5 for freeze-drying, storage, and recovery o sweetgum and yellow-poplar pollen.

METHODS : Samples of sweetgum and yellow-poplar pollen were freeze-dried under high vacuum for 0 and 30 minutes, 1, 2, 4, and 8 hours. Prior to freeze-drying, moisture conten and germination percentage were determined Treated samples were stored under vacuum a room temperature. Samples were opened immediately, after 45 days, and after 3, 6, and 1% months' storage. Pollen was checked for moisture content, then subjected to recovery treatments of 25, 50, and 100 percent relative hu-

midity at room temperature and at 5" C. Samples from the various recovery treatments were checked at 24-hour intervals to determine germination percentage. Pollen samples will be used in pollinations to determine their effectiveness in setting seed.

ASSIGNMENT: James R. Wilcox, Associate Geneticist.

29. UNITED STATES FOREST SERVICE, SOUTHERN FOREST EXPERIMENT STATION
Harrison, Arkansas

29-1. **VIRGINIA PINE PLANTATION ON SHALLOW SOILS SITES IN ARKANSAS OZARKS.** 111.0 *Pinus* ***virginiana.***

OBJECT : (1) To test the feasibility of this species as a supplement to eastern redcedar ***(Juniperus virginiana*** L.) on shallow limestone soils, and (2) to determine when to thin this species to achieve maximum clear growth.

METHODS : Six completely randomized blocks of two O.l-acre plots each were planted with 1-O Virginia pine seedlings from a northwest Pennsylvania seed source at 3 x 3 spacing in February 1957. Measurement plots of 100 seedlings were established within each of the individual plots. Should this planting be successful it is planned to thin one plot from each pair to 6 x 6 spacing 5 years after establishment. All Virginia pine crop trees on the thinned plots will be pruned leaving one-third the total height in live crown. The remaining plots will be thinned 10 years after establishment and crop trees pruned as before. Measurements will be taken after first, second, third, fifth, and every fifth growing season thereafter. The plantations are in the Henry R. Koen Experimental Forest.

ASSIGNMENT : W. R. Maple, Research Forester.

29-2. **COOPERATIVE STUDY OF GEOGRAPHIC SOURCE OF LOBLOLLY PINE SEED.** 111.1. *Pinus* ***taeda.***

OBJECT : (1) To make exploratory test plantings of loblolly pine from seed lots of varied geographic source and crop years; (2) to test significant differences between sources; and (3) to demonstrate contrasting development in one planting near Norris, Tennessee.

METHOD : Three completely randomized blocks of 9 plots were established in March 1959. Four rows of four loblolly test seedlings were planted on each plot with a spacing of 8 x 8. Each plot had one row of loblolly buffer stock planted around the test stock. One row of buffer stock was planted around the three contiguous blocks, making two rows of buffer stock between all test plots. The plantation is in the Henry R. Koen Experimental Forest.

COOPERATOR : Tennessee Valley Authority.

ASSIGNMENT: W. R. Maple, Research Forester.

29-3. **TEST OF HYBRID PINES.** 112.01. *Pinus* ***echinata, P. taeda.***

OBJECT : To test survival and growth of crosses ***of*** *Pinus* ***echinata*** and ***P. taeda*** developed by Institute of Forest Genetics, Placerville, California, within the natural range of ***P. echinata*** and to compare the development of the hybrids with that of the parents.

METHODS : One randomized block of twelve, 56-foot square plots was established in February 1949. Nine center trees in each plot were test trees surrounded by at least two rows of ***P. echinata*** buffer stock. The study was further confounded by a spacing test of 5 x 5, 6 x 6, and 8 x 8. The study plan called for three replications, but poor germination of hybrid seeds (approximately 10 pereent) allowed the installation of but one block. Species and hybrids under test are: Shortleaf pine (*Pinus* ***echinata);*** loblolly pine ***(P. taeda);*** and shortleaf x loblolly pine hybrids, (1) 5001-1947 F_2 hybrid ***x P. echinata,*** (2) 5002-1947 F_2 hybrid x ***P.*** taeda. The plantation is on the Henry R. Koen Experimental Forest

COOPERATOR: U. S. Forest Service, Institute of Forest Genetics, Placerville, Calif.

ASSIGNMENT: W. R. Maple, Research Forester.

29-4. TEST OF CHINESE CHESTNUT, P. I. 58602. 212.01. ***Castanea*** *mollissima.*

OBJECT : To determine blight resistance, survival, growth, and adaptability to two of

the better hardwood sites in the Arkansas Ozarks.

METHODS : Two ¼-acre demonstration plots of 1-O Chinese chestnut seedlings were established on north-facing slopes derived from Boone chert and Newton sandstone. Both plots are square and contain 49 seedlings planted at 10 x 10 spacing. The plantation is on the Henr R. Koen Experimental Forest.

COOPERATOR : Crops Research Divisior Agricultural Research Service, Washingtor D. C.

ASSIGNMENT : W. R. Maple, Researcl Forester.

30. UNITED STATES FOREST SERVICE, SOUTHERN FOREST EXPERIMENT STATION
Stoneville, Mississippi

30-1. **SELECTED COTTONWOOD AND HYBRID POPLAR CLONAL TRIALS,** 1962 211.0, 211.3. ***Populus*** spp.

OBJECT : To determine if any of the new cultivars, selected for their apparent superiority over average planting stock in rooting ability, height growth, and disease resistance, are significantly better than the others and likewise better than similar material previously selected.

METHODS : There are 50 plots in a randomized block design with 5 replications. Each plot consists of one row of 10 cuttings from a single cultivar spaced 2 feet apart in the row. Rows are 3 feet apart. Basic data will consist of survival and height records taken at the end of the first growing season. Cuttings will be scored for Melampsora rust severity twice during the year. The cultivars planted and the source of stock are: I-154 (CV)(377), Hybrid, Italy; I-262 (CV) (378), Hybrid, Italy; I-214 (CV) (330), Hybrid, Italy; I-455 (CV) (331), Hybrid, Italy; Siouxland (CV) , Rust resistant clone from South Dakota State College; Texas select #1 (clone), Fort Worth, Texas; Arkansas select #1 (clone), Pine Bluff, Arkansas; Alton #1 (clone), Alton, Illinois; Carbondale #1 (clone), Carbondale Research Center, Carbondale, Illinois; Run-of-the-bar (CV) , Batture Experimental Forest, Chicot County, Arkansas.

ASSIGNMENT : L. C. Maisenhelder, Research Forester.

30-2. **CLONAL PLANTING TEST OF SELECTED CLONES OF EUROPEAN HYBRID POPLAR ANDEASTERNCOTTONWOOD.** 211.0, 211.3. ***Populus*** spp.

OBJECT : (1) To detect the presence of any elite clones of European hybrid poplar or eastern cottonwood that may be present among the planting stock selected from superior trees and now available at the Stoneville Research Center, and (2) to obtain documented survival and growth rate data for good growing stock on one of the best cottonwood-growing soils and site when given intensive cultivation and care over a 20- to 30-year period.

METHODS : There are 44 plots in a randomized block design with two replications Each plot contains 36 trees on a 10 x 10-foo spacing. Periodic examinations will be made to observe survival, height growth, tree form and resistance to insect and disease attack Thinnings will be made as needed to maintain good growth throughout the life of the planta tion. The European hybrids or varieties o ***Populus euramericana*** planted are : bacchet ***ierii,*** var. *erecta* serotina, eugeneii (England) ***gelrica,*** *marilandica,* ***mussolinii,*** *regenerata* (*necroetereh*), ***serotina,*** I ***214, eugeneii*** (Holland), *robusta* (Holland, and ***Populus nigra*** is included in the planting, also. In addition, there are eight selected clones of eastern cottonwood ***(Populus*** *deltoides*). The control planting is average cottonwood planting stock., An analysis of variance will determine the presence of any elite material. This study is located on Archer Island in Chicot County, Arkansas, near the city of Greenville in Washington County, Mississippi.

ASSIGNMENT : L. C. Maisenhelder, Research Forester.

30-3. **TEST PLANTING, 1960, OF HYBRID POPLAR AND SELECTED CLONES OF EASTERN COTTONWOOD.** 211.0, 211.3, 252.0. *Populus* ***euramericana, P. nigra, P.*** *deltoides.*

OBJECT : (1) To determine, over a period of 20 to 30 years, the presence of any elite clones of hybrid poplars or cottonwood among the clones now available at the Stoneville Re

search Center; (2) to test the use of Thimet, a systemic poison, in controlling insects; and (3) to test reduction of multiple sprouting by reducing the length of cutting exposed above the ground from 5 inches to 2 inches.

METHODS : Plots are laid out in a randomized block design with three replications. Measurements of height and diameter and records of insect and disease attacks will be made annually for the first 5 years and at 5-year intervals, thereafter. Planting stock is as follows : ***Populus*** *euramericana,* 11 varieties or hybrids; ***P. nigra;*** and ***P.*** *deltoides,* Catfish 1 through 5, and Rosedale 6, 7, and 8. Planting stock was obtained from l-year-old sprouts grown in the Stoneville Research Center nursery.

ASSIGNMENT: L. C. Maisenhelder, Research Forester; J. L. Gammage, Research Technician.

30-4. **YELLOW-POPLAR GEOGRAPHIC SEED SOURCE STUDY.** 211.1. *Liriodendron* ***tulipifera.***

OBJECT : To determine the extent of yellow-poplar racial variation among several different locations in the territory of the Southern Forest Experiment Station.

METHODS : Seed will be collected from the following sources: (1) A sandy site from a bay head or stream of south Mississippi; (2) a deep brown loam site in the Bluff Hills near Vicksburg; (3) a thin brown loam site near Oxford; (4) a brown loam site north of Memphis; (5) an upland brown loam site on Crowley's Ridge near Helena, Arkansas; (6) a poplar site near Sewanee, Tennessee; and (7) a poplar site near Birmingham, Alabama. The plan will generally follow those outlined in "Standardized Working Plan for Local Tests of Seed Source," October 25, 1951; and "Working Plan for Cooperative Study of Geographic Sources of Southern Pine Seed," September 12, 1952, both prepared by the Committee on Southern Forest Tree Improvement, Subcommittee of Geographic Source of Seed.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

30-5. **COLD REQUIREMENTS FOR BREAKING SWEETGUM DORMANCY.** 211.1, 251.05. ***Liquidambar*** *styraciflua.*

OBJECT : (1) To determine the relationship between length of cold exposure and rapidity of subsequent foliation under an optimum greenhouse environment; (2) to determine whether sweetgum from the northern and southern portions of its commercial range differs in cold requirement; and (3) to determine whether periods of high temperature alternating with cold exposure will cause a reinduction of dormancy.

METHODS : In November 1964, 110 plants from each seed source were lifted from nursery beds and potted. Fifty plants from each source were placed in continuous cold storage (4°C.) and another 50 in cold storage broken by a 24-hour exposure to high temperatures every 10 days. At intervals of 20 days, 10 seedlings from each source were removed from each storage treatment and "forced" in a greenhouse. Ten seedlings from each source were "forced" immediately after potting in November. Number of days from date they are placed in the greenhouse to foliation date were observed. Data will be analyzed as for a factorial design.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

30-6. **SEX RATIO IN NATURAL COTTONWOOD POPULATIONS.** 211.2, 211.3, 251.31, 251.321. ***Populus*** spp.

OBJECT : Originally designed to determine cottonwood sex ratio in the lower Mississippi Valley, this test has been expanded to study phenotypic variation in cottonwood specific gravity and phenology.

METHODS : Natural stands in the Mississippi Delta region will be sampled with a nested design. Field observations will be used to determine sex ratio and dates of flowering and seed dispersal on individual trees. Specific gravity will be sampled from individual trees using large diameter increment cores.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

30-7. **FIELD SELECTION OF SUPERIOR COTTONWOOD PHENOTYPES.** 211.3. *Populus deltoides.*

OBJECT : (1) To select superior cottonwood phenotypes for use in breeding, and (2) to develop and improve selection techniques.

METHODS : Preliminary selection will include an aerial or ground reconnaissance followed by a survey of selected stands. Superior phenotypes subjectively selected in this survey will be graded using a previously developed system in which the selected tree is compared with five adjacent dominant or codominant check trees for relative growth rate, straightness, apparent pruning capability, crown forkedness, crown area, and disease and insect resistance. Final selection will be based upon phenotypic grades.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

30-8. **FIELD SELECTION OF SUPERIOR SWEETGUM PHENOTYPES.** *211.3. Liquidambar* styraciflua.

OBJECT: Selection of phenotypically superior sweetgum from natural stands for use in a breeding program.

METHODS : Selections will be made on the basis of growth rate, straightness, pruning ability, resistance to epicormic sprouting, wood properties, and pest resistance. Seed and vegetative material will be collected for use in further breeding.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

30—9. **TESTING AND SELECTION OF PROGENY FROM OPEN-POLLINATED COTTONWOOD MOTHER-TREES.** *211.3. Populus* spp.

OBJECT : (1) To provide a population for selection purposes; and (2) to provide information on variation and inheritance of juvenile characters important in improvement.

METHODS : Half-sib families (60 trees each) from 81 parent trees are being grown under nursery conditions in a balanced 9 x 9 lattice design. Growth parameters and Melampsora rust resistance will be measured after one and two seasons' growth. Individual tree selections will be made from the best families for clonal testing. This study is located at the Stoneville nursery.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester; James R. Wilcox, Geneticist.

30-10. A **PRELIMINARY TEST OF COTTONWOOD CLONES.** 211.3, 221. *Populus* spp.

OBJECT: To test early clonal performanc on two sites of cottonwood selected for rapi juvenile growth in a progeny test.

METHODS : One hundred clones will b planted on two sites (Commerce loam an Sharkey clay) in triple lattice designs. Three ramet row-plots will be used with 10 x 1 square spacing. At the end of one season' growth, clones will be evaluated on the basis o growth, wood properties, and pest resistance Study areas are on Huntington Point, north o Greenville, Mississippi, and on the Delta Ex perimental Forest.

ASSIGNMENT : Robert E. Farmer, Jr., Re search Forester; James R. Wilcox, Geneticist

30-11. **BROAD SENSE HERITABILITY ESTIMATE: IN COTTONWOOD CLONES.** 211.3, 241 *Populus deltoides.*

OBJECT : To obtain heritability estimate, for several phenological and wood quality characters in cottonwood saplings and to es timate the gain from selection at various in tensities. The characters of interest are: heigh growth, diameter growth, extent of branching time of leaf emergence and leaf fall, specific gravity, and fiber length. Other characters wil be studied if clonal differences are apparent

METHODS : Forty-nine individual selec tions will be made from run-of-the-bar seed lings in a natural stand of cottonwood in tht Mississippi River valley near Greenville, Mis sissippi. Cuttings will be planted in a random, ized block design with six replications. Single tree plots will be used with 9-foot spacing be tween trees in both directions. Cuttings from individual selections will be assigned to repli cations on the basis of their relative positior in the seedling stem.

ASSIGNMENT : James R. Wilcox, Gene, ticist; Robert E. Farmer, Jr., Research For ester.

30-12. **SWEETGUM HALF-SIB PROGENY TEST** 211.3, 241. *Liquidambar styraciflua*

OBJECT : (1) To study the variability among selected trees and their progenies; (2) to obtain estimates of heritability for selected characters; and (3) to compare performance of progenies at two locations.

METHODS: Sixty-four trees were selected to represent a range of phenotypes and sites in south Mississippi. The following measurements will be taken on the parent trees for use in the parent-progeny regression for heritability estimates : height, diameter, age, straightness, height to crown, specific gravity, and fiber length. Stratified seed from the trees will be sown in plots. After germination and establishment, the young seedlings will be transplanted to nursery beds in a triple lattice design with three replications. Spacing will be 3 inches x 3 inches with a single plot consisting of 16 seedlings. In the spring the seedlings will be transplanted to the field in a design which duplicates, at two locations, the nursery design. A field plot will consist of 8 trees from a single parent. Spacing will be 8 x 8. Height growth will be measured at the end of the nursery growing season. Field measurements to be taken over a period of a year include: survival, date of leafing out, date of full leaf, date of leaf fall, height growth, branching habit, diameter, wood specific gravity, fiber length, proportion of summerwood, extent of natural pruning, minimum flowering age, and date of flowering.

ASSIGNMENT : James R. Wilcox, Geneticist.

30-13. A **LONG-TERM COTTONWOOD CLONAL TEST.** 211.3, 241, 251.09. *Populus* spp.

OBJECT : (1) To test preliminary clonal selections over a short rotation period (20-30 years) ; (2) to compare a randomly selected clonal population with one selected on the basis of outstanding juvenile performance; (3) to obtain broad-sense heritability estimates for characters important to improve; and (4) to test the effect of two radically different sites on patterns of variation.

METHODS : Forty clones selected from preliminary tests and 40 randomly selected clones will be grown on two sites (Commerce silt loam and Sharkey clay) in randomized block designs with five replications. Four-ramet row-plots and 10 x 10 square spacing will be used. Study areas are located on Huntington Point north of Greenville, Mississippi, and on the Delta Experimental Forest.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester; James R. Wilcox, Geneticist.

30-14. **A ONE-PARENT PROGENY TEST IN SWEETGUM.** 211.3, 251.09. ***Liquidambar*** *styraciflua.*

OBJECT : (1) To determine patterns of variation within and between half-sib families from six geographical locations in the lower Mississippi Valley; (2) to determine the relative performance of progeny from superior and randomly selected phenotypes; and (3) to test the effect of two major site types upon patterns of variation.

METHODS : One hundred tree families from 81 parent trees will be grown on each of two sites (Commerce silt loam and Sharkey clay) in 9 x 9 balanced lattice designs. Growth parameter, wood properties, and pest resistance will be measured and evaluated periodically. Study areas are located on Huntington Point, north of Greenville, Mississippi, and on the Delta Experimental Forest.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester; James R. Wilcox, Geneticist.

30-15. **TESTING AND SELECTION OF PROGENY FROM OPEN-POLLINATED COTTONWOOD MOTHER TREES.** 212.02, 241. *Populus* ***deltoides.***

OBJECT : (1) To provide an artificial population of cottonwood seedlings from which selections can be made; (2) to provide quantitative information on variation within and between families from open-pollinated mother trees; (3) to make an evaluation of the breeding potential of mother trees based on a nursery progeny test; and (4) to develop techniques suitable for large-scale implementation of the mother-tree approach in cottonwood breeding.

METHODS : Two hundred seedlings from each of 25 phenotypically superior female trees selected in the east batture of the Mississippi River between Clarksdale and Vicksburg, Mississippi, will be grown for 2 years under nursery conditions in 10 replications of 20 seedlings each. Seedlings will be spaced 2 feet apart in rows (3 feet apart) located randomly within replications. The following measurements will be made after 2 years' growth: (1) Total height; (2) diameter 4 inches above root collar or d.b.h., depending on average size of plants; (3) number of branches; and (4) ap-

parent resistance to Melampsora rust. Specific gravity and fiber length determinations will also be made.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester; James R. Wilcox, Geneticist.

30-16. **VEGETATIVE PROPAGATION OF HARDWOODS: ROOTING OF GREENWOOD CUTTINGS.** 251.02. *Liquidambar styraciflua, Quercus* spp.

OBJECT : To develop vegetative propagation techniques for hardwoods in the tree improvement program.

METHODS : Greenwood stem cuttings from sweetgum and several oak species will be propagated under mist after various root-inducing treatments. Various experimental designs will be used.

ASSIGNMENT: Robert E. Farmer, Jr., Research Forester.

30—17. **EFFECTS OF MOISTURE STRESS ON NATURALVARIATIONINGROWTHOFCOTTONWOOD CLONES.** 251.07. *Populus* spp.

OBJECT : To determine the influence of moisture stress upon variation in early growth of cottonwood clones.

METHODS : Cuttings from 30 randomly selected clones will be grown in the greenhouse under two soil moisture regimes (optimum and stressful). A split-plot design with five replications will be used. After a pre-determined growth period, the following parameter will be recorded and analyzed: total height, leaf area, dry weight of roots and shoots.

ASSIGNMENT : Robert E. Farmer, Jr., Research Forester.

31. UNIVERSITY OF FLORIDA, SCHOOL OF FORESTRY
Gainesville, Florida

31-1. **CYTOGENETIC STUDIES OF SOUTHERN PINE.** 111.0, 111.3, 112.01. *Pinus* spp.

OBJECT : To study variation in chromosome morphology within pine species, between pine species and between pine hybrids.

METHODS : Plant tissues are collected from known and suspected pine hybrids and from representatives of the parent species. Major emphasis is placed upon meiotic divisions in immature staminate strobili. Morphological details of chromosomes are noted to determine differences between species. Meiotic irregularities are critically examined, classified as to type, and their frequency recorded. The study is part of the S-23 project.

ASSIGNMENT : R. E. Goddard, Associate Professor.

31-2. **BREEDING SUPERIOR STRAINS OF SOUTHERN PINES.** 111.1, 111.3, 112.02. *Pinus elliottii, P. palustris.*

OBJECT : To assess variation pattern of Southern pine species indigenous to Florida, and, with the use of data collected from genetic studies of individuals and populations, develop superior strains.

METHODS: Variation in natural populations of slash and longleaf pine is determined by observation of select and comparison trees from throughout the species range. Inherent variability in growth performance and other important characteristics and possible selection gains are studied through breeding studies involving specific crosses between individuals exhibiting various characteristics. Breeding is done both in a breeding orchard and on selected individuals in natural stands. First genetic screening of the several hundred selections will be l-parent progeny tests conducted by the various cooperators with guidance of the University of Florida staff.

COOPERATOR : Brunswick Pulp and Paper Company; Buckeye Cellulose Corporation Container Corporation of America; Continental Can Company; Scott Paper Company; International Paper Company; Rayonier, Incorporated; St. Regis Paper Company; Union Bag Camp Paper Corporation.

ASSIGNMENT : R. E. Goddard, Associate Professor; R. K. Strickland, Research Associate

31-3. **NITROGEN NUTRITION AND METABOLISM IN RELATION TO PINE REPRODUCTIVE RESPONSES. 151.01, 151.03.** *Pinus* spp.

OBJECT: To determine some aspects of nitrogen nutrition and metabolism in relation

to pine reproduction and cone and seed development.

METHODS : Trees in a seed orchard for which past flowering records are available are selected for detailed study. Nitrogen composition of reproductive and vegetative tissues during several stages of cone development is analysed including measurement of total nitrogen and various protein fractions. By appropriate statistical techniques, the nitrogen analyses will be related to flowering and cone production. The sites and biosynthetic pathways of the utilization of nitrogen in pine reproduction will be investigated.

ASSIGNMENT : R. E. Goddard, Associate Professor; W. H. Smith, Assistant Professor.

31-4. **FERTILIZATION OF SOILS FOR SOUTHERN PINES.** 151.01, 151.03. *Pinus* spp.

OBJECT: To determine the growth and reproductive response of southern pine to applications of plant nutrients and to relate the response to the fertility status of principal forest soils in Florida.

METHODS : A series of replicated experiments were established in slash pine seed orchards. Treatments consisted of two or more rates of primary plant nutrients or of secondary nutrients. In areas of low pH, lime was applied in split-plots in which lime treatments make up the main plots. A factorial design was used in all experiments where practical. In most experiments, treatments have been applied annually since establishment. Height, diameter and occurrence of conelets are recorded annually. Trials were initiated in 1961 and 1962 to determine the extent of differential response of select tree progeny to major plant nutrients and other cultural treatments on flatwoods sites.

ASSIGNMENT : R. E. Goddard, Associate Professor; W. L. Pritchett, Soils Technologist; C. M. Kaufman, Professor.

31-5. **EXPERIMENTAL PLOT-SIZE TRIALS FOR SOUTHERN PINE PROGENY TESTS.** 153. *Pinus* elliottii.

OBJECT : To determine most adequate plot size for progeny testing southern pines.

METHODS : Slash pine seedlings from 24 geographic sources representing most of the species range were obtained in December 1959. Four separate test plantings involving these sources were established on adjacent areas employing l-, 4-, 16-, and 36-tree plots. One hundred to 112 seedlings from each source were used in the various tests. Data from each test will be subjected to analysis of variance. Comparison of the tests will be made on basis of sensitivity in detection of source differences, and, through analysis of sequential measurements, any accentuation of differences in later measurements will be determined.

ASSIGNMENT : R. E. Goddard, Associate Professor.

31-6. **EFFECTS OF TOP-PRUNING SEED ORCHARD TREES.** 154.3. *Pinus* taeda, P. elliottii.

OBJECT : To determine the effect of several intensities of pruning upon development and flower production of grafted and seedling pines.

METHODS : Three degrees of pruning and a tree-bending treatment have been applied in loblolly and slash pine seed orchards and in nearby open-grown natural stands of comparable tree size. The most intensive pruning was removal of 2-years' bole growth. All treatments are replicated on several clones in both orchards. Annually, height, diameter, crown spread and flower production are tallied for all treated trees and untreated controls of each clone.

COOPERATOR : International Paper Company, Southlands Experiment Forest.

ASSIGNMENT : R. E. Goddard, Associate Professor; Roy W. Stonecypher, Silviculturist, International Paper Company.

32. UNIVERSITY OF GEORGIA, GEORGE FOSTER PEABODY SCHOOL OF FORESTRY

Athens, Georgia

32-1. **PATTERN OF INHERITANCE STUDIES IN** *Pinus*. 111.0, 111.3, 141. *Pinus* taeda, P. elliotti, P. echinata.

OBJECT : (1) Study the pattern of inheritance in vigor (height and diameter growth), form and disease resistance among open- and

control-pollinated progeny; (2) determine the nature of parent-progeny correlations for certain characteristics of form and growth; (3) ascertain the method best suited to estimating heritability; and (4) gather native and exotic pines to be used in studies of inheritance.

METHODS : The selection of trees to provide the basic materials for the study of inherent characteristics now totals approximately 500. Some of these trees are being and will be controlled pollinated in all possible combinations. Progenies from these selected trees will be measured for short-term and long-term evaluation of growth, form and disease resistance. Heritability will be determined. Appropriate techniques are being utilized to gain a knowledge of the physical bases of inheritance of specific characteristics. The arboretum will provide germ plasm for a new gene pool which can be utilized for the creation of new trees.

COOPERATORS : College Experiment Station; Georgia Forest Research Council; Department of Botany.

ASSIGNMENT : James T. Greene, Assistant Professor; H. D. Porterfield, Forest Technician; C. L. Brown, Professor; L. W. R. Jackson, Professor; Mervin Reines, Associate Professor.

32-2. **HERITABILITY STUDIES IN** *Cupressus.* 111.0, 111.3, 141, 151.02. Cupressus spp., *Pinus* spp., *Juniperus virginiana.*

OBJECT : (1) To determine if there are differences in phenotypic expression within the genus *Cupressus;* (2) develop a control-pollination technique for the genus *Cupressus; (3)* determine if parent-progeny correlation exists for certain characters of form and growth; and (4) develop methods of vegetative propagation.

METHODS : (1) Select individual phenotypes for the following characteristics : (a) narrow crown, (b) well-formed pyramidal crown, (c) color of foliage, (d) horizontal branching, (e) stem form, and (f) those which are apparently resistant to Phomopsis blight; (2) develop methods of control-pollination and vegetative propagation; and (3) test different species of *Cupressus,* sources of Scotch pine, Japanese black pine, white pine, redcedar, and Virginia pine for possible advocation as Christmas trees.

COOPERATORS : College Experiment Station; Georgia Forest Research Council; Department of Botany; U. S. Forest Service.

ASSIGNMENT : James T. Greene, Assistant Professor; H. D. Porterfield, Forest Technician; Claud L. Brown, Professor.

32-3. **SELECTION FOR EARLY STROBILI PRODUCTION.** 111.3. *Pinus elliottii, P. taeda.*

OBJECT : To continually search for individuals which are producing male and female strobili at an early age, particularly slash and loblolly pine under 6 years of age.

METHODS : (1) Seedlings from open- and control-pollinations will be closely observed (2) the young "seedlings" will be crossed with each other in all possible combinations where possible; and (3) the known parents which bear seed yielding the early "flowering" "seedlings" will also be control-pollinated and vegetatively propagated.

COOPERATORS : College Experiment Station; Georgia Forest Research Council.

ASSIGNMENT : James T. Greene, Assistant Professor; H. D. Porterfield, Forest Technician.

32-4. **VARIATION AND INHERITANCE OF PHOTOSYNTHETIC EFFICIENCY AND VIGOR IN LOBLOLLY PINE.** 111.3, 141. *Pinus taeda.*

OBJECT : To study and define variation and heritability of photosynthetic efficiency and its relationship to vigor.

METHODS : (1) Needles and seedlings from wind- and control-pollinated trees will be scanned with an infra-red analyzer to measure CO_2 absorption, as a measure of apparent photosynthetic activity. Seedlings will be grown under the uniform conditions of a growth chamber in sufficient numbers to permit a valid statistical analysis. Seedlings will be compared to determine variation within lots as well as between lots. Subsequently, these seedlings will be transplanted to the field to observe their growth performance. Here, a possible relationship between measured photosynthesis in young seedlings and subsequent growth may be demonstrated. (2) To start with, five trees representative of each of two vigor classes will be selected and reciprocally cross-pollinal

ed. If more trees can be found to make up a minimum total of 10 per vigor class, we will proceed with a breeding program using bulked pollen. Resultant progeny will be tested as above in (1) and then will be outplanted in randomized blocks of six replications, 25 seedlings per plot with isolation strips provided. Annual height, diameter, and crown measurements will be made and analyzed statistically based on least squares. Inheritance of photosynthetic efficiency will be estimated using analysis of variance. The studies are part of the S-23 project.

COOPERATORS : College Agricultural Experiment Station; Georgia Forest Research Council.

ASSIGNMENT : Mervin Reines, Associate Professor.

32-5. **CYTOLOGY AND ANATOMY.** 111.3, 151.32. *Pinus elliottii, P. taeda.*

OBJECT : Variation of fibril angle in wood of parents and progeny of slash pine and loblolly pine.

METHODS : (1) Determine the correlation of the fibril angle of the branch wood with that of the adjoining stem wood; (2) determine the variation in the fibril angle of first and second ring from the pith with height in the stem of the tree; (3) determine the variation in the fibril angle of the parents and their open- and cross-pollinated progeny of slash pine and loblolly pine; and (4) determine variation in fibril angle of stem wood at breast height of trees with identical age and diameter.

COOPERATORS : Georgia Forest Research Council; College Experiment Station.

ASSIGNMENT : L. W. R. Jackson, Professor; William Morse, Graduate Assistant.

32-6. **THE INHERITANCE OF TRACHEID LENGTH AND SPECIFIC GRAVITYINSLASHAND LOBLOLLY PINE.** 141, 151.321, 151.322. *Pinus elliottii, P. taeda.*

OBJECT : (1) To determine the effect of selection and controlled crosses and selfings as a means of altering tracheid length and specific gravity in slash and loblolly pine, and (2) to compute heritability and genetic gain estimates for the populations studied.

METHODS : (1) The first-order branches of slash and loblolly pine parents will be analyzed for tracheid length and specific gravity. (2) The first-order branches from the control-pollinated seedlings of the slash and loblolly pine parents will be analyzed for tracheid length and specific gravity. The specific gravity will be determined by the maximum moisture method. The tracheids will be measured by the use of a Micro-projector. (3) Extreme parents with tracheid length and specific gravity will be crossed, selfed, and reciprocally crossed within and between the species. (4) Control-pollinated F_1 "seedlings" which have extremes of tracheid length and specific gravity will be crossed in all possible combinations. The inclusion of the interspecific crosses as well as the shortleaf is necessary to complete the possible pattern of inheritance in tracheid length and specific gravity for the populations studied. Heritability will be determined.

COOPERATORS : College Experiment Station; Georgia Forest Research Council; University of Minnesota.

ASSIGNMENT : James T. Greene, Assistant Professor; H. D. Porterfield, Forest Technician.

32-7. **AGING IN TREES.** 151.0, 151.02. *Pinus elliottii.*

OBJECT: This project is intended to be the first in a program for the study of the chronological aging in trees. Aims are to characterize the structural and physiological bases for aging in relation to problems of vegetative propagation. The specific objective of this project is to characterize structural aging of meristematic tissues; the living cells and its contents, Such studies of cells located in tissues or regions of active cell division in the cambium and tips of stems are presumably related to the functional aspects of plant parts of aging trees and to their manifestation in propagation.

METHODS : (1) Meristematic tissues, stem tips, and cambial cells will be removed from five slash pine trees, representing each of several age classes (germinating seed, seedlings in the cotyledon stage, seedlings 1 year old, and trees 2, 5, 10, 15, and 20 years of age). From each tree in each age class five samples of stem and cambial meristems will be collected for examination. (2) These tissues will be sec-

tioned, mounted on slides and appropriately stained for comparative studies of inter- and intracellular structure with the light microscope. (3) Living tissues of the above will be viewed with the phase microscope for comparative studies of structure and behavior. (4) Tissue culture of above materials will be made to provide suitable material for further microscopic examination and study of their relation to callus formation and consequently, vegetative propagation. (5) Appropriately prepared tissue will be examined by electron microscopy. Particular attention will be paid to the particulate structure of the cytoplasm and nucleus (mitochondria, microsomes, endoplastic reticulum, cytosomes, and nuclear inclusions) in the search for changes which might transpire with age. Particular attention will also be paid to the structural aspects of membranes and interfaces for subtle changes which may influence the transport, within the cell, of physiologically active substances.

COOPERATORS : College Experiment Station; Georgia Forest Research Council.

ASSIGNMENT : Mervin Reines, Associate Professor.

32-8. THE PROPAGATION OF NEEDLE BUNDLES. 151.02. *Pinus elliottii,* P. *taeda.*

OBJECT: To propagate needle bundles of loblolly and slash pines and to stimulate and sustain bud growth and development in rooted needle bundles.

METHODS : (1) One terminal branch from each of 60 young and several older trees will be collected. (2) One hundred needle bundles will be stripped from each of 50 branches. (3) They will be planted in a sand, sand-peat, or perlite medium in the sequence of their occurence on the branch. (4) Observations will be made as to rootability with relation to age or position of needles, at the end of a 6-month period. (5) Within this time interval the condition of bud primordia will be examined. (6) Needle bundles of the remaining branches will be preserved. (7) Slides will be prepared, examined microscopically to determine the condition of bud primordia at the time of planting. (8) The influence of condition of bud primordia on rooting of needle bundles and subsequent bud development will also be considered. (9) Further installations of need bundles into propagation benches will be ma to stimulate root growth and bud developme by treatments with varying concentrations urea, nucleic acids, and kinetin.

COOPERATORS : College Experiment St tion; Georgia Forest Research Council.

ASSIGNMENT : Mervin Reines, Associa Professor.

32—9. *In vitro* CULTURE OF PINE CALLUS ON DEFINED MEDIA. 151.02. *Pinus* spp.

OBJECT : (1) To determine the nutrition factors necessary for the successful growth ar culture of isolated cambial cells on artifici media, and (2) to extend this information in practical ways of propagating members of tl genus *Pinus.*

METHODS: Cambial explants from th four major southern pines are placed on cultu media of known chemical consistency and 01 served for continued proliferation and callu formation. Growth factors such as auxins ar kinins are introduced into the media to stimu late bud and/or root formation.

COOPERATORS : Georgia Forest Researc Council.

ASSIGNMENT: Claud L. Brown, Pr fessor.

32-10. CULTURE OF HAPLOID TISSUES *in vitr* 151.1, 251.1. Hardwoods, softwood

OBJECT : (1) To grow callus cultures female and male gametophyte tissues fro gymnosperms and angiosperms in *vitro; (2* to initiate bud and root formation on such ti sues to obtain haploid plants; and (3) to doub the chromosome number *in* vitro in an attemp to produce a homozygous diploid, i.e., a tru breeding strain which would have much utilit in practical as well as basic utilization.

COOPERATORS : Georgia Forest Researc Council.

ASSIGNMENT : Claud L. Brown, Pr fessor.

32-11. PRODUCTION OF USEFUL MUTANTS I LOBLOLLYPINE BYIRRADIATION. *112.1 Pinus taeda.*

OBJECT : (1) The development of more productive loblolly strains by gamma irradiation of seedlings, seed, and pollen, and (2) the determination of dosages most efficient in the production of mutants.

METHODS : One-year-old dormant and growing seedlings have been exposed to dosages ranging from 200 roentgens to 7,000r at various intensities. Surviving seedlings (200r to 1300r) are planted in randomized plots in Putnam and Spalding Counties. Other pine and hardwood species have been treated for comparison. Loblolly seed have been exposed to dosages ranging from 327r to 50,000r, along with other species. Seedlings from dosages up to 10,000r have been outplanted in replicated plots in Spalding County, for further observations. Irradiated pollen (292r to 2579r) has been applied to the flowers of selected trees, seed have been collected and planted. Seedlings from dosages through 2579r have been field planted in replicated plots in Spalding County for further tests.

COOPERATORS : Biological Laboratories, Oak Ridge National Laboratory; College of Agriculture, School of Forestry, and Agricultural Engineering Dept., Univ. of Georgia.

ASSIGNMENT : Turner S. Davis, Assistant Forester, Georgia Agricultural Experiment Station of the Univ. of Georgia.

33. UNIVERSITY OF TENNESSEE, DEPARTMENT OF FORESTRY
Knoxville, Tennessee

33-l. **PINETUM.** 111.0. *Pinus* species.

OBJECT : To determine which species of pine will grow in Tennessee and to compare their performance. Also, to provide a facility for production of interspecific hybrids as well as studies in cytology and taxonomy.

METHODS : A uniform area of about 100 acres has been set aside for the Pinetum. Following site preparation, the area was divided into l-acre single species plots. To date, 26 species have been successfully established. Data on survival, growth, etc. are obtained periodically on port-a-punch.

ASSIGNMENT : Eyvind Thor, Forest Geneticist.

33-2. **PINE SEED SOURCE TESTS.** 111.1. *Pinus* taeda, P. echinata, ***P.*** virginiana, ***P.*** strobus, ***P.*** *elliottii.*

OBJECT : To compare the performance and adaptability of planted loblolly, shortleaf, Virginia, white, and slash pine of different geographic origins to Tennessee conditions.

METHODS : Fourteen pine seed source test plantings have been established in all major physiographic regions of Tennessee, from 1955 through 1962. Tests with geographic sources of loblolly, white, slash, and shortleaf pine follow the standard pattern recommended for seed source tests. A test of 16 Virginia pine seed sources from a wide geographic range involves 24 replicates, each containing one seedling from each seed source. The Virginia pine test was enlarged in 1959 to include 20 more seed lots.

COOPERATOR : One or more of the following: Maryland Department of Natural Resources; Tennessee Valley Authority.

ASSIGNMENT: Eyvind Thor, Forest Geneticist; James S. Kring, Forester; J. T. Beavers, Forester; P. J. Huffman, Forester.

33-3. **VARIATION IN FRASER FIR.** 111.1, 111.3. ***Abies*** *fraseri.*

OBJECT : To determine variation between trees and seed sources for selection of trees suitable for Christmas tree production.

METHODS : Five trees were selected at each of three elevations in the Great Smoky Mountains. Cuttings were taken from three levels in the crown and of three branch orders. Cuttings from the lower level of the crown rooted best. The rooted cuttings have been outplanted for further observations on growth characteristics and possible clonal relationships. The study is part of the S-23 project.

ASSIGNMENT : Eyvind Thor, Forest Geneticist.

33-4. **WOOD PROPERTIES.** 111.1, 111.3, 151.321, 151.322, 211.1, 211.3, 251.321, 251.322. *Pinus* ***taeda, P. strobus, P. virginiana, Liriodendron*** *tulipifera.*

OBJECT: To study the variation between trees and between regions in specific gravity and fiber length in loblolly pine, white pine, Virginia pine, and yellow-poplar.

METHODS : Specific gravity and fiber lengths are determined from large increment cores. When provenance test plantations are available, the samples will be taken from these in order to eliminate site effect; otherwise, natural populations will be used. The studies are part of the S-23 project.

ASSIGNMENT : Eyvind Thor, Forest Geneticist.

33-5. **VARIATION IN VIRGINIA PINE.** 111.2, 111.3. *Pinus* ***virginiana.***

OBJECT: To determine the variation among trees and stands for Virginia pine in Tennessee and Kentucky. Special emphasis is on wood properties.

METHODS : Fifteen trees were selected from 13 stands. A study of natural variation in wood properties has been completed. Seed has been collected from 10 trees in each stand and an open-pollinated progeny test will be made.

COOPERATOR: Society of American Foresters, Kentucky-Tennessee Section.

ASSIGNMENT : Eyvind Thor, Forest Geneticist.

33-6. **VIRGINIA PINE PROGENY TEST.** 111.3. *Pinus* virginiana.

OBJECT : To study the heritability of bole and crown form and other selected characters in Virginia pine.

METHODS : Progenies from trees selected for good bole and crown form were outplanted in Morgan County, Tennessee, in 1958. Periodic measurements will be taken to obtain evidence on heritability of the selected characteristics.

COOPERATOR : The Tennessee Valley Authority.

ASSIGNMENT : Eyvind Thor, Forest Geneticist; James S. Kring, Forester.

33-7. **WHITEPINE SEEDORCHARD.** 111.3, 122.1. *Pinus* ***strobus.***

OBJECT: To establish and maintain a orchard with clones selected for resistance t fumes.

METHODS : Several good phenotypes wit apparent resistance to fumes from a steai plant have been selected and propagated. Th orchard is located near Wartburg in an are with heavy fume damage. The clones will b evaluated in the orchard and progeny tests wi be made.

ASSIGNMENT : Eyvind Thor, Forest Ger eticist; J. S. Kring, Forester.

33-S. **PINE BREEDING ORCHARD.** 112.02. ***Pinu taeda, P. strobus.***

OBJECT: To establish and maintain a orchard with clones of white pines and lob lolly pine. Primarily this orchard will be use for production of controlled intraspecific an interspecific crosses for later progeny tests.

METHODS : Selection and propagation o superior phenotypes for white pine are unde way. Ramets of exotic white pines have als been established. Good phenotypes of loblolly pine have already been selected by other agen cies, and scions from many of these trees hav been propagated. Loblolly clones from most o the species range will be represented in th orchard near Knoxville, Tennesse.

ASSIGNMENT : Eyvind Thor, Forest Gen eticist.

33-9. **YELLOW-POPLAR SEED SOURCE TEST** ***2*** 11.1. ***Liriodendron*** *tulipifera.*

OBJECT: To compare the performance o different seed sources in the different physio graphic regions of Tennessee.

METHODS : Four seed sources have beer outplanted in five different areas. Four repli cations and 25 trees per plot were used.

ASSIGNMENT : Eyvind Thor, Forest Gen eticist; James S. Kring, J. T. Beavers, and P. J Huffman, Foresters.

33-10. **YELLOW-POPLAROPEN-POLLINATED PRO GENY TEST.** 211.3 ***Liriodendron tu lipifera.***

OBJECT: To determine heritability fo: some important characteristics in yellow-pop lar.

METHODS: Several trees in two locations, the Cumberland Mountains and West Tennessee, were examined and seed collections made. Seedlings were grown and outplanted in the two locations. Large differences are apparent after two growing seasons in the field, both among the two seed sources and among individual trees.

ASSIGNMENT : Eyvind Thor, Forest Geneticist; James S. Kring and J. T. Beavers, Foresters.

33-11. **YELLOW-POPLAR BREEDING ORCHARD.** 211.3. Liriodendron *tulipifera.*

OBJECT: To establish and maintain an orchard with a large number of selected yellow-poplar clones. Primarily this orchard will be used for production of controlled crosses for later progeny tests.

METHODS : Selection of outstanding yellow-poplar phenotypes has started and several clones are established. In addition to vigor, form, branches, etc., wood properties like specific gravity and fiber length are considered. The orchard is established near Knoxville, Tennessee.

ASSIGNMENT : Eyvind Thor, Forest Geneticist.

33-12. **TESTING OF IMPROVED BLACK WALNUT AND CHINESE CHESTNUT.** 211.3. *Juglans nigra,* Castanea spp.

OBJECT : To test improved nut trees for their adaptability to Tennessee conditions. Principal species include black walnut and Chinese chestnut.

METHODS : Testing of better varieties in plantings at several locations in Tennessee is in progress. Oldest plantings include a test of black walnut varieties at Knoxville, Tennessee, and a test of black walnut and Chinese chestnut in Hamilton County, Tennessee.

COOPERATOR: Tennessee Valley Authority.

ASSIGNMENT : Dr. B. S. Pickett, Head, Department of Horticulture; James S. Kring, Forester.

33-13. **AMERICAN CHESTNUT BREEDING PROGRAM.** 211.3, 212.02, 212.11. Castanea *dentata.*

OBJECT: To develop trees with resistance to blight.

METHODS : A breeding orchard has been established near Knoxville. Several trees with apparent resistance have been selected and propagation has been started. Several thousand nuts have been irradiated and the seedlings are now being outplanted for natural selection. Controlled crosses will be made with promising individuals.

ASSIGNMENT : Eyvind Thor, Forest Geneticist; Paul E. Barnett.

33-14. **YELLOW-POPLARSEEDORCHARDS.** 222.1. Liriodendron tulipifera.

OBJECT : To establish and maintain orchards with clones selected from specific physiographic regions of Tennessee. These orchards will serve as a source of seed as well as scion wood.

METHODS: Outstanding phenotypes have been selected and several clones have been established in three orchards. East Tennessee (near Knoxville), Mountains (near Wartburg), and West Tennessee (Ames Plantation)..

ASSIGNMENT : Eyvind Thor, Forest Geneticist; James S. Kring, J. T. Beavers, Foresters.

34. UNIVERSITY OF VIRGINIA
Charlottesville, Virginia

34-l. **IRRADIATION OF AMERICAN CHESTNUT.** 212.11. Castanea spp.

OBJECT : To test irradiated seeds for resistance to chestnut blight.

METHODS : Professor Singleton will arrange for collection and irradiation of seed; Virginia Division of Forestry will stratify and raise seedlings at Charlottesville Nursery and transplant them on various State lands for future evaluation as to induced resistance. First shipment irradiated nuts were received in early spring 1958 and 7,700 nuts were planted in

nursery. Because of high rate of irradiation, only 73 irradiated seedlings survived to be outplanted at the Cumberland State Forest (with some untreated checks) in early March 1959. In the same area were 24 seedlings provided by Dr. Albert Dietz and planted November 1958. Only 4 percent survived when checked in spring 1961. One hundred and seventy-five pounds of seed received January and February 1959 were stratified and planted March 20, 1959, (estimated 14,600 nuts planted Charlot tesville Nursery). Yield by spring of 1960 wa 1,200 seedlings which were transplanted to field at Charlottesville Nursery. Only 1 per cent were surviving by fall 1962, the remainde having succumbed mainly to root rot.

COOPERATOR: Virginia Division of For estry.

ASSIGNMENT : C. L. Morris, Forester.

35. VIRGINIA DIVISION OF FORESTRY
Charlottesville, Virginia

35-1. LOBLOLLY, WHITE, AND SHORTLEAF PINE SEED PRODUCTION AREAS AND SEED ORCHARDS. 122.0, 122.1. *Pinus* ***taeda, P.*** echinata, ***P.*** *strobus.*

OBJECT: To produce improved seed for use in the tree nurseries and direct seeding.

METHODS : An intensive search for loblolly, shortleaf, and white pine super trees has been completed. For loblolly pine, both Piedmont and coastal plain seed orchards of 7(acres, will be established. For shortleaf, it i planned to have only a single Piedmont seec orchard of 10 acres. A 40-acre white pine seec orchard is planned. About 86 acres of loblolly pine and 61 acres of shortleaf pine seed pro duction areas have been established. Progeny testing is planned.

ASSIGNMENT : R. L. Marler, Forester.

36. WEST VIRGINIA PULP AND PAPER COMPANY
Summerville, South Carolina

36-1. OPEN-POLLINATED PROGENY TEST OF SUPERIORLOBLOLLYPINEANDPONDPINE SEEDLINGS. 111.3. *Pinus* ***taeda, P.*** *serotina.*

OBJECT : To progeny test open-pollinated seedlings from superior trees selected on deep peat (l-10 feet) sites in eastern North Carolina.

METHODS : Open-pollinated seedlings produced from 16 superior pond pine and 15 superior loblolly pine were field planted on a deep peat (6 feet plus) site beginning in 1960. Final field planting will be in 1966. Plots consist of 25 seedlings from each superior tree and the five best check trees. Each plot is replicated four times in a randomized design.

ASSIGNMENT : J. L. Landino, Project Leader.

36-2. CONTROL-POLLINATED PROGENY TEST OF SUPERIORLOBLOLLYPINEANDPONDPINE SEEDLINGS. 111.3. *Pinus* ***taeda, P.*** *serotina.*

OBJECT : To progeny test control-pollinated seedlings from superior trees selected on deep peat (l-10 feet) sites in eastern North Carolina.

METHODS : Control-pollinated seedlings produced by crossing 16 superior pond pine and 15 superior loblolly pine trees, using 4 pol len testers for each species, will be field planted beginning in 1966. Control-pollinations are wel under way, but of the necessary crosses only 30 percent of the pond pine and 10 percent o: the loblolly pine have been completed. Plo design will be as recommended by the North Carolina State-Industry Tree Improvemen Program under the direction of Dr. B. J. Zobel Seedlings will be planted on a deep peat site.

COOPERATOR: Dr. B. J. Zobel.

ASSIGNMENT : J. L. Landino, Projec Leader.

36-3. CONTROLLED-POLLINATION PROGENY TES OF SEED ORCHARD SELECTIONS. 111.3 112.02. *Pinus* ***taeda.***

OBJECT : (1) To determine superiority o clones used in seed orchard; (2) to determine combining ability of the clones; and (3) t

further determine what characteristics are genetically controlled.

METHODS : Pollen from 14 ortets selected for the seed orchard was applied separately to flowers of another ortet in 1958. Ten seedlings of each cross were outplanted in an old field in 1961. Tree used as the common tester is located at Westvaco Experimental Forest, Georgetown, South Carolina. Pollen parents are located throughout the South Carolina coastal plain.

ASSIGNMENT : D. M. Crutchfield, Project Leader.

36-4. **OPEN-POLLINATED PROGENY TESTS OF SEED ORCHARD SELECTIONS.** 111.3, 112.02. *Pinus* taeda.

OBJECT: To determine whether progeny of ortets selected for seed orchard are superior in the qualities desired; to determine what characteristics are genetically controlled.

METHODS : Plots of open-pollinated progeny, containing 25 seedlings each, are planted adjacent to plots of progeny from trees in same stand as the ortet. Tests of eight ortets established in 1959, replicated four times in one location, once on another site. Seven more ortets were tested in 1960, six additional ortets in 1965. Plantings located on old field and flatwoods sites at Westvaco Experimental Forest.

COOPERATOR: North Carolina State University, School of Forestry.

ASSIGNMENT : D. M. Crutchfield, Project Leader.

36-5. **TESTS OF PINE HYBRIDS.** 112.01. *Pinus* serotina, ***P.*** taeda, ***P.*** palustris, ***P.*** *elli*-ottii.

OBJECT: A group of informal studies to determine inheritance of such qualities as growth rate, bole and crown form, branching habits, and adaptability to various sites.

METHODS : The following hybrids have been planted :

Pond pine × loblolly	60 seedlings planted 8 x 8
Longleaf × loblolly	35 seedlings planted 8 x 8
Longleaf × slash	23 seedlings planted 8 x 8
Loblolly × slash	7 seedlings planted (row)
Loblolly × loblolly	80 seedlings planted 8 x 8
loblolly × loblolly (open pollinated)	60 seedlings planted 8 x 8
(Shortleaf × loblolly) × loblolly	60 seedlings planted 8 x 8
Shortleaf × slash	Seedlings to be raised 1965 and outplanted 1966

ASSIGNMENT : D. M. Crutchfield, Project Leader.

36-6. **POLLINATION OF SUPERIOR PITCH PINE WITH LOBLOLLY POLLEN.** 112.01. *Pinus rigida,* ***P. taeda.***

OBJECT : To produce species hybrids from select parent trees.

METHODS : Over 2,000 grafts were made from 30 loblolly and 28 pitch pine select trees between March 24 and April 30, 1965, at Charlottesville, Virginia. All of the loblolly and the majority of the pitch pine parents were selected by personnel of Northeastern Forest Experiment Station, New Lisbon, New Jersey, Research Center. The Hancock and Charlottesville Research Centers of West Virginia Pulp and Paper Company selected 12 pitch pines.

COOPERATOR: Northeastern Forest Experiment Station, U. S. Forest Service.

ASSIGNMENT : David W. Sowers, Jr., Research Center Leader.

36-7. **SLASH X POND PINE HYBRIDIZATION.** 112.01. *Pinus* ***elliottii, P. serotina.***

OBJECT: Develop superior hybrid for planting on difficult organic soil sites.

METHODS : Pistillate flowers of superior slash pine growing in Union Bag-Camp's orchard were crossed with pond pine pollen from superior trees selected on deep organic soil sites. Union Bag-Camp has successfully completed the cross started in 1962. The reciprocal of this cross has not been successful to date.

COOPERATOR : Union Bag-Camp Paper Corporation.

ASSIGNMENT : J. L. Landino, Project Leader.

36-8. **EXPERIMENTAL SEED ORCHARDS OF LOBLOLLY PINE AND POND PINE.** 122.1. Pinus serotina, P. taeda.

OBJECT : To produce superior seed for regenerating deep organic soil sites in eastern North Carolina.

METHODS : Grafts from 16 superior pond pines and 15 superior loblolly pines are included in the orchard. The orchard was started in 1957 and consists of approximately 25 acres of each species. The superior trees were all selected on deep peat (l-10 feet) sites.

ASSIGNMENT: J. L. Landino, Project Leader.

36-9. **ROOTING POND PINE CUTTINGS TAKEN FROM MATURE TREES.** 151.02. *Pinus serotina.*

OBJECT: To learn how to root cuttings taken from grafted superior trees to overcome incompatibility or for developing and expanding a seed orchard.

METHODS : Cuttings (6-8 inches long) taken from grafted superior trees in December were placed in a heated rooting bed. The bed consists of 3 inches of peat covered by 3 inches of vermiculite. The entire bed is enclosed in a plastic-covered Wardian case and heated by regular greenhouse heating cables. Temperature in the rooting medium varies between 75" and 85" F. The study was started in December 1963 and 8 percent of the 60 cuttings rooted and were field planted 104 days after being placed in the rooting bed. The study was repeated in December 1964.

ASSIGNMENT : J. L. Landino, Proje Leader.

36-10. **YELLOW-POPLAR PROVENANCE STUD'** 211.1. *Liriodendron tulipifera.*

OBJECT: To determine racial variation i yellow-poplar.

METHODS : Four seedlings each of 12 pr venances of yellow-poplar were supplied b the University of Maryland and were part c a large study. The plantings are in two block with two replicates of four seedlings each i each block. The plots are arranged in a Lati square. Plots were established April 2, 196 on the Robert Eddy tract of West Virginia Pul and Paper Company on the Cairo-Cisco roac Ritchie County, West Virginia. Elevation i 800 feet, aspect N 75 E, slope 15 percent. Are supports a stand of dwarf sumac, and the pop lars were planted under the sumac. Soil i Meigs, heavy-textured, and well drained fror interbedded alkaline and acid shales.

COOPERATOR : Professor John Geny Natural Resources Institute, University c Maryland.

ASSIGNMENT : David W. Sowers, Jr., Re search Center Leader.

A TABULAR SUMMARY

Summaries of the information contained in the project statements are given in five tables. The tables are intended to show the amount and type of work under way with forest tree genera and certain tree species as well as the number of projects or studies. This treatment is necessary because certain projects may involve several species as well as a number of different subjects. Although the tables were not designed to summarize all the information given in the project descriptions, they do indicate the relative amount of research effort devoted to various forest trees and research subjects. The tables do not cross-check because of the combination of factors covered.

Table 1.—*Projects by research agencies and genera*

Genera	Research agencies (code numbers are shown page iii)																																			Total
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	
Abies																																	1				1
Acer						1					2																							1			2
Betula											1																										1
Castanea											1																		1								5
Casuarina																																	2				1
Cupressus	3																		1													1					5
Eucalyptus						3																															3
Fraxinus			1	1						1																											3
Grevillea						1																															1
Juglans											1																						1				2
Juniperus			2								2							1	2													1					8
Liquidambar	3		1	1						4							2		1				1					8		5						26
Liriodendron			1							4	1					2	1		1									1		1			5			1	18
Nyssa			1							1								1	1																		4
Pinus	5	1	6	9	2		1	4	1	8	2	10	8		1	3	4	5	8	3	2	1	13	5	27	7	16	44	3		6	10	7		1	9	232
Platanus	1			1	1				1	1				1			1																			4
Populus											1								1									1		11							14
Prunus											1					1																					2
Quercus											1					3														1							8
Tsuga			1							1						1			1																		1
General										3	2					1	1							1	1		1	1									15
Total	12	1	13	12	3	5	1	4	2	23	15	10	8	1	1	11	9	7	16	3	2	1	14	6	28	7	17	55	4	18	6	13	16	1	1	10	356

Table 2—*Projects*

	Subject-matter classification	*Abies*	*Cupressus*	Juniperus	*Pinus*	Tsuga	General/Total
11	Selection and testing of variation				1		1
111	Natural variation				6		6
111.0	Natural variation among species		3	3	72		6 84
111.1	Natural variation among races	1	1	3	86	1	92
111.2	Natural variation among stands				7		7
111.3	Natural variation among individuals	1	2	2	109		114
112.01	Interspecific hybridization				57		57
112.02	Intraspecific hybridization				42		42
112.03	Self ing				5		5
112.11	Mutation by physical treatment				7		7
112.12	Mutation by chemical treatment				1		1
122.0	Seed production areas				11		11
122.1	Seed orchards		1	.	21		22
122.2	Registered seed				2		2
13	Genetics in silviculture				3		3
14	Fundamental genetics studies				4		4
141	Mode of inheritance		1	1	43		2 47
144	Evolution				1		1
151.0	Physiology				17		17
151.01	Flower induction				6		6
151.02	Vegetative propagation		2	1	12		15
151.03	Nutritional studies				9		9
151.07	Drought resistance				1		1
151.08	Phenology				1		1
151.09	Soil effects				4		4
151.1	Cytology				1		1 2
151.3	Morphology and anatomy			1	4		5
151.32	Wood characteristics				20		1 21
151.321	Wood density				8		8
151.322	Fiber length				6		6
151.5	Pathology				10		10
152.0	Entomology				10		10
153	Biometry				12		1 13
154	Special techniques				2		2
154.0	Controlled pollination				3		3
154.3	Seed orchard tree shaping			.	4		4
154.4	Seed orchard spacing				1		1
154.5	Pollen flight			.	1		1
	Total	2	10	11	610	1	i i 645

Table

	Subject-matter classification	*Acer*	*Betula*	*Castanea*	*Casuarina*	*Eucalyptus*	*Fraxinus*	*Grevillea*	*Juglans*	*Liquidambar*	*Liriodendron*	*Nyssa*	*Platanus*	*Populus*	*Prunus*	*Quercus*	General	Total
211	Natural variation									2	1	1				11		6
211.0	Natural variation among species	1	1	1	1	2	1	1	1	3	3	1	1	4	1	2	4	28
211.1	Natural variation among races	1			1	2		1		4	6	1				2		18
211.2	Natural variation among stands									1				1				2
211.3	Natural variation among individuals	1	1	3		1	1		2	7	6		3	11	2	4	1	43
212.01	Interspecific hybridization			1														1
212.02	Intraspecific hybridization			1		1			1		1			2				6
212.11	Mutation by physical treatment			2														2
221	Clonal lines													1				1
222.1	Seed orchard										1							1
241	Mode of inheritance									3	2		1	4		1	3	13
251.02	Vegetative propagation						1			4	2		1			1	1	10
251.05	Thermoperiodism									1								1
251.07	Drought resistance													1				1
251.09	Soil effects					1				2				1				4
251.1	Cytology									1	1						1	3
251.3	Morphology and anatomy						1		1		1		1					4
251.31	Flower primordia													1				1
251.32	Wood characteristics						1			1	1	1	1			1	1	7
251.321	Wood density										1			1				2
251.322	Fiber length										1							1
251.5	Pathology															1		1
252.0	Entomology													1				1
253	Biometry																1	1
254.0	Controlled pollination									4	1							5
	Total	3	2	8	2	6	6	2	3	35	27	6	7	28	3	13	13	164

Table 4.—Pinus by *research* agencies and species

	Agencies conducting research	*clausa*	*echinata*	*elliottii*	*elliottii* var. *densa*	*glabra*	*palustris*	*rigida*	*serotina*	*x sondereggeri*	*strobus*	*taeda*	*virginiana*	Genus [1]	Total
1	Auburn University		1	1			1					2	3	1	9
2	Buckeye Cellulose Corporation		1	1										1	
3	Clemson University			1			1					3	2		8
4	Continental Can Company			7			3					7	1	2	20
5	Florida Forest Service	1		2	1		1							5	
7	Ida Cason Callaway Foundation		1	2			1					2			6
8	International Paper Company			1										3	4
9	Louisiana State University										1				1
10	North Carolina State University			1					1				1	7	13
11	Tennessee Valley Authority		1								2	2	2	1	8
12	Texas Forest Service		2									10			12
13	Union Bag-Camp Paper Corporation	1	6				1	1	1				1	2	14
14	U.S.F.S., Forest Products Laboratory													1	1
15	U.S.F.S., Region 8													1	1
	U.S.F.S., Southeastern Forest Experiment Station														
16	Asheville, North Carolina										2			1	3
17	Athens, Georgia		2							1				1	4
18	Blacksburg, Virginia		3								1	2	3	1	9
19	Charleston, South Carolina	1	1	2		1	5		1			4			16
20	Cordele, Georgia			3											3
21	Fort Myers, Florida			1	2	1						1			5
22	Franklin, Virginia											1		3	1
23	Macon, Georgia		2	6		1				1		8			21
24	Marianna, Florida	4	2	3		2						3	1	1	15
25	Olustee, Florida	1		26		4				1		2			35
	U.S.F.S., Southern Forest Experiment Station														
26	Alexandria, Louisiana		3	5			6					3		1	18
27	Crossett, Arkansas		4			1				1		15		1	22
28	Gulfport, Mississippi		11	22			13	1		3		12		7	69
29	Harrison, Arkansas		1									2			3
31	University of Florida			3			1					1		3	8
32	University of Georgia		1	6								7		2	16
33	University of Tennessee		1	1							4	3	4	1	14
35	Virginia Division of Forestry		1								1	1			3
36	West Virginia Pulp and Paper Corp.			2		1	1	6				7			17
	Total	8	36	104	3	3	42	3	9	7	11	101	18	40	385

[1] Apply to several pine species.

Table 5.—**Pinus** *projects* by subject categories and species

Subject-matter classification		*clausa*	*echinata*	*elliottii*	*elliottii* var. *densa*	*glabra*	*palustris*	*rigida*	*serotina*	*x sondereggeri*	*strobus*	*taeda*	*virginiana*	Genus	Total
11	Selection and testing of variation													1	1
111	Natural variation	3	7	12	1	1	2	10	1	1	2	16	2	4	72
111.0	Natural variation among species														
111.1	Natural variation among races	2	14	23	1	1	9	1		1	4	23	6	1	86
111.2	Natural variation among stands	1		1								3		2	7
111.3	Natural variation among individuals	10		30			9		2	2	4	37	7	8	109
112.01	Interspecific hybridization	1		9	13	1	8	3	3	3		7	1	8	57
112.02	Intraspecific hybridization	5	16		6						1	9	5		42
112.03	Selfing	1		3									1		5
112.11	Mutation by physical treatment		1	1								5			7
112.12	Mutation by chemical treatment											1			1
122.0	Seed production areas	1	2	1	4	4	1	2	1		1	3	5	1	22
122.1	Seed orchards														21
122.2	Registered seed	1										1			2
13	Genetics in silviculture	3													3
14	Fundamental genetics studies	1		1			1					1			4
141	Mode of inheritance	1		16			5		1	2	1	10	1	6	43
144	Evolution													1	1
151.0	Physiology	3		7			2					3	1	1	17
151.01	Flower induction	3										1		2	6
151.02	Vegetative propagation	4							1			3	1	3	12
151.03	Nutritional studies	5										1		3	9
151.07	Drought resistance											1			1
151.08	Phenology	1		1	1		1					1		4	1
151.09	Soil effects														
151.1	Cytology													1	1
151.3	Morphology and anatomy	1	1				1					1			4
151.32	Wood characteristics	1		6			3		1		1	7		1	20
151.321	Wood density			2							1	4	1		8
151.322	Fiber length			1							1	3	1		6
151.5	Pathology	2		4			1					1	2		10
152.0	Entomology	1	2		1			1				2	3		10
153	Biometry	3	2				2					2	3		12
154	Special techniques			1								1			2
154.0	Controlled pollination	1				1						1			3
154.3	Seed orchard tree shaping	2										2			4
154.4	Seed orchard spacing	1													1
154.5	Pollen flight													1	1
	Total	9	63	173	3	4	63	4	11	10	19	157	27	67	620

A GENERAL SUMMARY

The information given in the tables can be summarized as follows to give an over-all view of forest tree improvement and forest genetics research in the South and Southeast:

1. Some 36 agencies, or combinations of agency and geographic location, such as various field projects of the Forest Experiment Stations, are conducting 305 projects or studies involving 20 forest tree genera and 39 research subjects. A few projects characterized by general subject matter are reported (page 3 and tables 1, 2, and 3).

2. Of the 305 projects or studies reported, 186, or 61 percent, are being conducted by the two U. S. Forest Service Forest Experiment Stations; 61, or 20 percent, by education institutions usually in connection with State Agricultural Experiment Stations; and 58, or 19 percent, largely by industry but including some by state forestry agencies, the Tennessee Valley Authority, and other Federal agencies (page 3 and table 4).

3. The 305 separate projects reported often include work on more than one genera, so that there are 356 combinations of investigations by research agency and genera (table 1) . The 356 investigations include 232, or 65 percent, with the genus *Pinus;* 14, or 4 percent, with other softwood genera; and 110, or 31 percent, with some 15 hardwood genera or with forest trees in general (page 3 and table 1) .

4. Studies concerned with natural variation and variation among species, races, and individual trees are by far the most numerous. In softwoods these three subjects account for 47 percent of the research effort. In hardwood they account for 57 percent (tables 2 and 3).

5. Studies concerned with induced variation by hybridization among and within species, selfing, and creation of mutations receive 17 percent of the research effort in softwoods and 6 percent in hardwoods (tables 2 and 3).

6. Utilization of selected variants for planting by production of clonal lines or by seed from seed production areas or seed orchards and the application of genetics in silviculture receive 6 percent of the research effort in softwoods and about 1 percent in hardwoods (tables 2 and 3). However, as was stated in the section on the pattern of project descriptions, no effort has been made to include all seed production areas and seed orchards in the survey.

7. Fundamental genetic studies receive about 8 percent of the research effort each in the softwoods and hardwoods (tables 2 and 3).

8. Supporting sciences in physiology, cytology, taxonomy, morphology and anatomy, ecology, pathology, entomology, and biometry, plus work on special techniques related to pollination methods or seed orchard culture account for 22 percent of the research effort in softwoods and 28 percent in hardwoods (tables 2 and 3).

9. The 356 investigations reported include 26, or 8 percent, concerned with sweetgum and 18, or 5 percent, with yellow-poplar. The work with these two species is about 46 percent of the total research effort on hardwood genera or trees in general (table 1) .

10. Of the *385 Pinus* investigations reported by agency and tree species; 36, or 9 percent, involve shortleaf pine; 104, or 27 percent, slash pine; 42, or 9 percent, longleaf pine; 101, or 26 percent, loblolly pine; and 129, or about 29 percent, the 8 other pine species, one variety, one natural hybrid, and *Pinus* in general (table 4).

11. A total of 620 investigations are in progress (table 5).

SUBJECT-MATTER CLASSIFICATION

TREE IMPROVEMENT RESEARCH PROJECTS

1 I. Softwoods
11 A. Selection and testing of variation
111 1. Natural variation
111.0 a. Among species
111.1 b. " races (ecotypes)
111.2 c. " stands
111.3 d. " individuals
112 2. Induced variation
112.0 a. By recombination
112.01 (1) Interspecific hybridization
112.02 (2) Intraspecific hybridization
112.03 (3) Selfing
112.1 b. By mutation
112.11 (1) Physical treatments (radiation, etc.)
112.12 (2) Chemical treatments (colchicine, etc.)
12 B. Utilization of selected variants for planting by production of
121 1. Clonal lines
122 2. Seed
122.0 a. Seed production areas
122.1 b. Seed orchards
122.2 c. Registered seed
13 C. Applications of genetics in silviculture and management of naturally reproduced stands
14 D. Fundamental genetic studies
141 1. Mode of inheritance
142 2. Reaction range
143 3. Experimental taxonomy
144 4. Evolution
15 E. Supporting sciences and special techniques
151 1. Botany
151.0 a. Physiology
151.01 (1) Flower induction
151.02 (2) Vegetative propagation
151.03 (3) Nutritional studies
151.04 (4) Photoperiodism
151.05 (5) Thermoperiodism
151.06 (6) Chemistry
151.07 (7) Drought resistance
151.08 (8) Phenology
151.09 (9) Soil effects
151.1 b. Cytology
151.11 (1) Chromosome numbers
151.2 c. Taxonomy
151.3 d. Morphology and anaton
151.31 (1) Flower primordia
151.32 (2) Wood characteristics
151.321 (a) Density
151.322 (b) Fiber length
151.323 (c) Fibril angle
151.324 (d) Heartwood, sapwood
151.325 (e) Compression wood
151.326 (f) Tension wood
151.331 (1) Agamospermy
151.332 (1) Vegetative reproduction
151.34 (1) Leaves
151.4 e. Ecology
151.5 f. Pathology
152 2. Zoology
152.0 a. Entomology
153 3. Biometry
154 4. Special techniques
154.0 a. Controlled pollination
154.01 (1) Pollen collection
154.92 (2) Pollen storage
154.03 (3) Bagging
154.04 (4) Methods
154.1 b. Climbing gear
154.2 c. Nursery techniques
154.3 d. Seed orchard tree shaping
154.4 e. Seed orchard spacing
154.5 f. Pollen flight
2 II. Hardwoods
21 A. Selection and testing of variation
211 1. Natural variation
211.0 a. Among species
211.1 b. Among races (ecotypes
(Continue as in Softwoods)

INDEX TO GENERA

Numbers refer to subject matter category and research agency

Liriodendron

Nyssa

Pinus

Platanus

Populus

221 Clonal lines, 30
241 Mode of inheritance, 28, 30
251.05 Thermoperiodism, 30
251.07 Drought resistance, 30
251.09 Soil effects, 30
251.31 Flower primordia, 30
251.321 Wood density, 30
252.0 Entomology, 30

Prunus

211.0 Natural variation among species, 11
211.3 Natural variation among individuals, 11, 16

Quercus

211 Natural variation, 10
211.0 Natural variation among species, 11, 19
211.1 Natural variation among races, 3, 16
211.3 Natural variation among individuals, 3, 11, 16
241 Mode of inheritance, 10
251.02 Vegetative propagation, 30
251.32 Wood characteristics, 10
251.5 Pathology, 16

Tsuga

111.1 Natural variation among races, 16

General

(Softwoods)

111.0 Natural variation among species, 1, 5, 16
122.0 Seed production areas, 11
122.1 Seed orchards, 11
141 Mode of inheritance, 10, 28
151.02 Vegetative propagation, 11
151.32 Wood characteristics, 14
153 Biometry, 10

(Hardwoods)

211 Natural variation, 10
211.0 Natural variation among species, 1, 5, 16
211.3 Natural variation among individuals, 17
241 Mode of inheritance, 10, 28
251.02 Vegetative propagation, 11
251.1 Cytology, 32
251.32 Wood characteristics, 14
253 Biometry, 10

INDEX TO RESEARCH WORKERS

Numbers refer to research agencies

INDEX TO COOPERATORS

Numbers refer to research agencies with which cooperators work