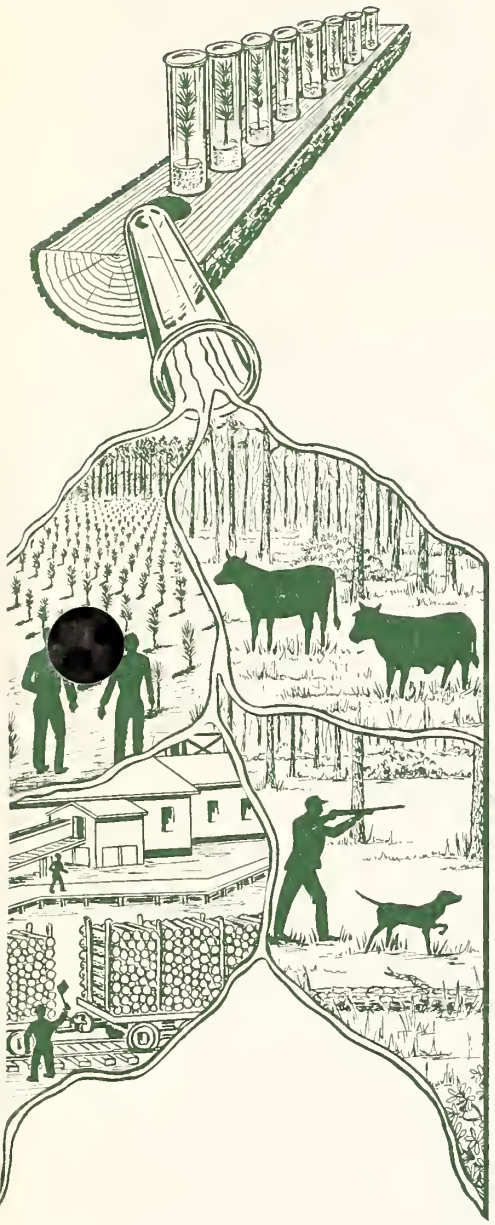
RESEARCH News FOR THE MIDSOUTH

July 1968



To Our Readers:

Here is the first issue of a new publication by the Southern Forest Experiment Station—a bulletin to let you know what's happening in forestry research in the Middle South.

We have been painfully aware for some time that new information relating to forest resources is reaching only some of the people who work daily with these resources. We believe there are segments of the general public who should and do want to be aware of developments that pertain to the natural environment in which they live.

We hope publishers and editors will find stories of interest. Articles in this bulletin may be reprinted. Additional information or photographs may be obtained by calling or writing the Southern Forest Experiment Station, T-10210 Federal Building, 701 Loyola Avenue, New Orleans, Louisiana 70113.

As in most new ventures, we are feeling our way. We will put out several issues each year, as material accumulates. We want to write about what interests you. Your ideas, suggestions, questions, or comments will help us plan future issues. Let us hear from you!

Sincerely yours,

T. C. Nelson

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Meeting A Challenge

The FUTURE is NOW.

That describes the feeling of urgency a visitor gets at the forest products utilization project in Alexandria, Louisiana, as he watches dedicated scientists and their assistants at work in the superbly equipped laboratories.

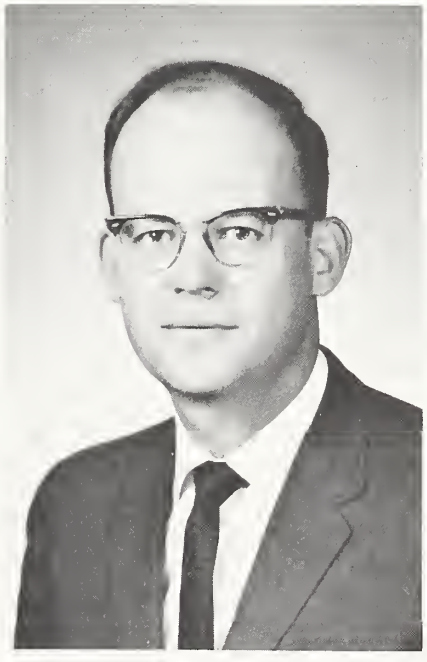
Secretary of Agriculture Orville L. Freeman recognized this project recently when he gave Dr. Peter Koch, Project Leader, a Superior Service Honor Award "for exceptional personal achievement and research leadership." Dr. Koch's achievements were cited as "resulting in substantial benefits to rural economy and employment through more efficient manufacture and broadened outlets for products from southern forests."

Mr. Freeman noted three achievements in making the award. First was invention of the chipping headrig, a machine to square debarked logs without waste by converting the round sides into pulp chips. The second achievement was a system for fabricating super-strength laminated beams. The third was improvement in the manufacture of southern pine plywood.

A visitor to the neat buildings set among the pine trees and housing a unique center of scientific achievement is told that the entire project began less than 5 years ago. At that time trees from intensively managed natural stands, as well as trees planted in southern forests after World War II, had begun to reach harvest stage. The market was not big enough to take the new supply. The lumber business experienced a sharp recession. Prices dropped. Some mills closed, others curtailed operations.

The Forest Service recognized the challenge by creating the Alexandria facility to concentrate on utilization of southern woods, with special emphasis on pine.

It hired Dr. Koch, who arrived in Alexandria in 1963 just after he had finished writing *Wood Machining Processes,* a book now regarded as a standard reference on the subject. In two offices in a rented building Dr. Koch and his co-workers set forth their objectives. First was characterization of southern pine wood and bark as industrial raw material. Next was invention of new or improved products or manufacturing processes for southern pine. Improving the durability of southern pine products was also a goal.



The achievements that the Secretary of Agriculture recently cited attest progress toward some of these objectives. And there is other evidence of this progress too.

Already results from this project are being applied in business and industry. Since Dr. Koch's description and photographs of the chipping headrig first appeared, more than 40 chipping headrigs and edgers have been placed in industrial operation in the South and West. Industrial investment is estimated at more than $10 million. New efficiency in converting sawmill residues to pulp chips has been added as a result of the research. In 1966 such chips furnished 17 percent of the South's pulpwood, and were valued at $80 million.

Architects and engineers will find it easy to utilize new super-strength laminated beams in structural designs. The program of research and testing is being watched with interest.

In 1964 there were only four southern pine plywood plants

eginning production, and they aced problems. Many manufacturing variables made the operation one of trial and error. In a single systematic experiment Dr. Koch explored these variables and reported his results, which are now widely accepted and recognized in the recommendations of the American Plywood Association to its member mills. Since 1964 the southern pine plywood industry has grown to 33 producing or soon-to-be producing mills.

Scientific equipment at the Alexandria installation is on a par with the finest to be found for wood science anywhere in the nation. In 1965 the utilization project moved from its rented quarters into a new building where it had six large laboratories, three rooms for conditioning wood specimens, and almost enough office space.

In 1966 a 4,800-square-foot addition was completed for experiments requiring a controlled atmosphere, heavy equipment, and large experimental material. Plans are being made for additional laboratory space.

Plans call for increasing the ofessional staff. At this time persons are employed by the project. In addition to Dr. Koch, staff scientists are Chung Hse, Dr. Floyd Manwiller, and Charles McMillin. Both Manwiller and McMillin have received Wood Awards. These awards, sponsored by the Forest Products Research Society and by the publisher of *Wood and Wood Products,* recognized Manwiller for work on wood anatomy, and McMillin for research on veneer cutting.

Manwiller continues his research into improving knowledge of the wood characteristics of southern pine. McMillin, working with pine chips, has just completed a series of far-reaching studies of the mechanical defiberization process. Hse is working to improve glue lines in southern pine plywood used in exterior exposure.

The Alexandria project actively recruits students and professors of wood science and technology for summer work. During the summer of 1967, two university professors and 23 students carried on investigations at the laboratory, working around the clock to utilize critical equipment fully.

Agreements for cooperative research have been made with Louisiana State University, Yale University, North Carolina State University, Oregon State University, University of Washington, and State University College of Forestry at Syracuse, New York. Research is coordinated with the U. S. Forest Products Laboratory in Madison, Wisconsin, and with several industrial firms.

Knowledge gained from the utilization projects' studies and investigations will be summarized in a single handbook, to be published about 1971.

In reviewing the 5-year-old document setting forth objectives for the project, Dr. Koch recently said: "We know what to do and how to do it, and we have the equipment. We have done quite a bit of the job—and we are pressing on."

Hardwoods Unwanted? Try Pines

Hands, machines, aircraft, even feet—all can help to do the job.

The task is that of converting low-grade hardwoods in Tennessee's Cumberland Plateau and Highland Rim to stands of loblolly, shortleaf, and Virginia pines. Direct seeding is a practical way to accomplish the changeover.

Landowners who seek success in converting to pines must do four things: control unwanted hardwoods, prepare sites and seedbeds, sow seeds at the right time, and keep birds and rodents away.

Seeds can be distributed by hand, by tractor-operated machines, or by aircraft. Sowing by hand is efficient on small areas disked in strips. A "cyclone" hand-operated seeder is useful for broadcast sowing on tracts up to 200 acres. Spotting is an old method that is increasing in popularity; a spot about 1 foot square is raked or kicked free of leaves, and five or six seeds are lightly pressed into mineral soil. Furrow seeding has the advantage of preparing the seedbed and sowing at the same time.

Site and Seedbed Preparation

Control of unwanted hardwoods, although difficult and expensive when converting to pines, is necessary whether one direct-seeds or plants.

Dense stands of small hardwoods, which are particularly prevalent on the Cumberland Plateau, must be eliminated before seeding. Bulldozing and heavy disking have proved satisfactory on the Plateau. Rolling choppers, K-G blades, or other equipment can be used where conditions permit. Treatment during the growing season will provide better control with less resprouting than that done when hardwoods are dormant. Sites that are bulldozed or disked should be allowed to settle for about 2 months to minimize seed losses from washing and silting.

Hardwoods of pole to sawtimber size can be killed by appropriate single-stem treatments, such as girdling or herbicide injections, after pine seedlings take hold.

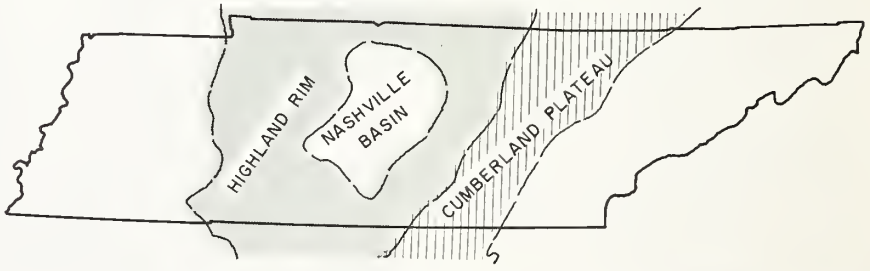
Sometimes both mechanical and chemical methods are needed. Bulldozing or disking may have to be followed by chemical treatment 2 or 3 years later to control sprouting.

The important thing in seedbed preparation is to expose moist mineral soil so that seeds will germinate and catch on and pine seedlings will not be smothered by leaf litter. Any mechanical treatment thorough enough to control hardwoods will fulfill this requirement.

Where hardwoods are to be controlled by mass chemical treatments such as aerial spraying or mist-blowing, litter must still be reduced to expose mineral soil. Fire is the easiest and cheapest method, particularly where rocky soils rule out mechanical site preparation. It can also be used if hardwoods are killed by single-stem treatments. Fire should not be used on steep slopes or soils where erosion may result. For best results, burning should be done during the growing season when the lower layers of litter are dry.

Even when seeds are placed directly on mineral soil, leaves can blow back over the bare ground. To avoid smothering, it is best to burn sites that have deep and matted litter, even when spot seeding. If fire is not used, careful preparation of large seedspots and delay in seeding until late spring will improve chances for success.

Burning deep hardwood litter before furrow seeding is also recommended. Burns for spot or furrow seeding need not completely reduce litter since the goal is to remove loose leaves that might cover seeds. Winter or spring fires (of low intensity) are adequate for this purpose.



Large areas now occupied by hardwoods on Tennessee's Highland Rim and Cumberland Plateau are better suited to loblolly, shortleaf, and Virginia pines. Direct-seeding, which is cheaper than planting, is feasible in the two sections.

Shallow surface soils are common in Tennessee, and furrow-seeders should be adjusted to cut just deep enough to expose clean, mineral soil. Seeding in deep furrows increases risk of frost heaving (by which seedlings may be lifted above their normal level in soil), not only in the year of seeding but also during the following winter.

Sowing Rates and Dates

How much seed should be sown, and when?

Ten thousand sound seeds per acre are enough for broadcasting on well-prepared seedbeds. On less favorable seedbeds, the number should be increased.

Furrow seeding requires one seed per 9 to 12 inches. In spot seeding there should be at least five seeds per spot.

The favorable climate of Tennessee's Highlands allows landowners some freedom in choosing sowing dates. Good germination and stocking can be obtained from seed sown from December through May. The period from mid-March through April probably should be preferred, because favorable weather for germination is likely to follow. Broadcasting over a somewhat longer season is not risky. However, seeding before December or after May in central Tennessee may increase risks appreciably. Spot seeding in hardwood litter should be done in the spring as late as good germination can be expected.

Stratified pine seeds should be sown in spring. In winter, unstratified seeds should be used. On the Cumberland Plateau and Highland Rim the change from dry to stratified seeds should be made from 2 to 4 weeks before average date of the last killing frost in spring.

Protecting Seeds

Birds, small mammals, and insects will quickly consume seeds that are not treated with an effective repellent. Coated seeds are essential on most areas, and are cheap insurance. A repellent containing Arasan 42-S (a liquid thiram formulation) and endrin is recommended.

Shortleaf and Virginia pine seeds should be obtained either from local stands or from stands growing in a climate similar to that of the Tennessee Highlands. Seeds from warmer or colder climates are likely to produce slow-growing or poorly formed trees. Loblolly pine does not occur naturally in a climate as cold as that of the Highlands, but trees from seeds collected in the northern part of its range are usually vigorous and withstand frost well on the Cumberland Plateau and Highland Rim. Northern sources are thus recommended.

Spot seeding, a method that is growing in popularity, can be done with tools such as a short-handled fire rake.

General Recommendations

Landowners who plan to convert low-grade hardwoods to pines must also consider procurement, storage, and treatment of seed, use of seeding tools, and evaluation of direct-seeding operations. Procedures for determining and controlling potential hazards from livestock, game animals, and minor predators must also be taken into account.

More complete information is to be found in a new publication, "Direct-Seeding Southern Pine in Tennessee's Highlands," USDA Research Paper SO-31, by T. E. Russell and A. L. Mignery. It is available from the Southern Forest Experiment Station.

Need A Loan? Timberland Is Collateral

Time was when a piece of well-managed timberland wasn't worth a nickel as collateral on a bank loan. Not so today. Two Federal land banks in the South took the lead in accepting forest land as security, others followed, and now 10 out of 12 Federal land banks accept timber and forest land as sole security.

Banks in Columbia, South Carolina, and New Orleans, Louisiana, started the whole thing in 1944. After a slow start the two have built up a multi-million dollar timber loan business. Both have staffs of professionally trained foresters and are leaders in promoting good forestry through sound credit programs.

The Federal Land Bank of Houston began its formal timber lending program in 1956, and banks in Spokane and Baltimore followed in 1960. The St. Louis Federal Land Bank actively entered the timber loan business in 1963. Springfield, Massachusetts, and Berkeley, California, banks began making forest loans in 1964. The Louisville land bank began its woodland lending in 1966, after adopting a forest loan policy in 1965.

Because the South got off to an early start and because of very good prospects for timber products from well-managed forest lands, southern banks are doing a lion's share of the timber loan business and are taking the lead to increase flexibility of loan requirements and bring the loans within reach of more people. Of the 980 active timber loans in the Federal land bank system on October 1, 1966, 837 were in the New Orleans and Columbia districts.

Individuals, trusts, partnerships and certain types of corporations are eligible for timber loans, provided they own and manage forest land or expect to do so soon. Collateral may include timber that is to be bought with the loan.

Although each land bank has its own loan policy, certain requirements are standard. Applicants must meet normal bank credit prerequisites and have substantial equity in the security. They must also have some experience in managing timberland. Each bank requires collateral acreage to be in economic, self-supporting units, readily salable in normal times.

Except in the New Orleans and Columbia banks, loans are made only on tracts with substantial amounts of merchantable timber. These two banks recently introduced an innovation in timber financing when they authorized selective loans on young pine stands as much as 5 years from merchantability. Plantations on bare land, planted pines on property already partially wooded, and naturally seeded tracts are all acceptable security under the new policy.

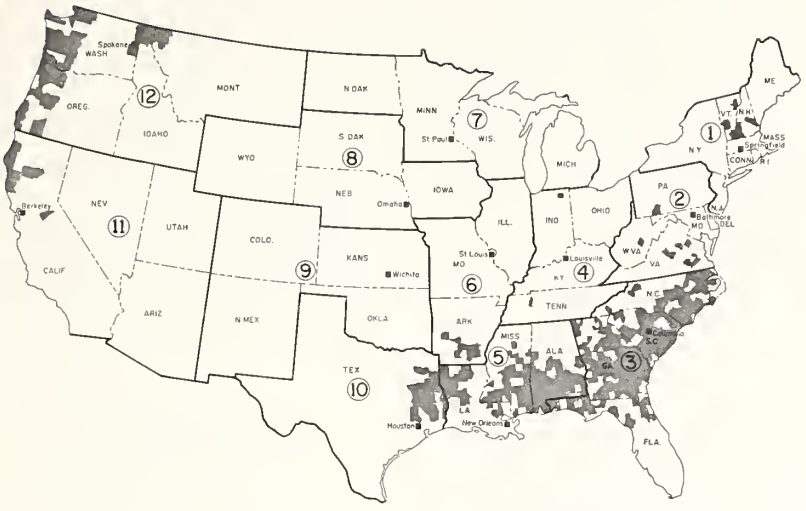
Borrowers are limited to 65 percent of their collateral's normal value and are required to purchase stock in their local land bank association amounting to 5 percent of the loan. Interest rates are the same for timber loans as for other types of notes with a 6 percent maximum.

Repayment plans are generally adapted to timber cutting cycles and the borrower's individual needs. Amortized and partially amortized loans are authorized for terms of 5 to 40 years and unamortized notes for up to 10 years.

Rejections of timber loan applications at each bank have been proportionately fewer than when cultivated land has been offered as collateral. No timber note has ever been foreclosed. The number of timber loans is rapidly increasing, but there is no discernible trend in size of loans or collateral acreage.

Most loans are made for the maximum allowable percentage of normal tract value and very few for less than 50 percent. Only about one-fifth of the active loans in October 1966 were secured by tracts entirely stocked with timber. More than 7 out of 10, however, had collateral that was more than 70 percent forested.

Timber loans written in recent years have generally been for larger amounts than older loans. Most loans are for either 20 or 30 year terms, with those in the Columbia district tending to be for longer periods than those in the New Orleans district.



Form credit districts of the Farm Credit System. Shoded areos represent counties with forest colloterol in October 1966.

Most of the current loans at both banks were written to be amortized on an annual installment basis. Only a handful of contracts were partially amortized—that is, with payment on the principal deferred for a specified number of years, but interest paid periodically. More than one-third of the active loans have been refinanced at least once.

More than 90 percent of the loans have been made to individuals, with most of the rest to partnerships and a few to corporations and trusts.

Biggest reason given for borrowing is to buy all or part of the security. Fewer than 10 percent of the New Orleans and Columbia borrowers put any of their loan proceeds into forestry. Those who did invested primarily in timber improvement.

Cutting immature timber to get cash is usually far less profitable than using it as loan collateral. Value growth of young trees often greatly exceeds the cost of credit. And recent changes in land bank loan programs make it more feasible than ever before to tailor borrowing to woodland management and improvement.

Low rates and flexibility in adjusting contracts to meet individual requirements make Federal land bank loans especially useful to owners of small tracts. The programs can also be of considerable benefit to holders of large acreages.

Forest investments will become more and more attractive with widespread knowledge that woodland can be used as loan security. Foresters are in a good position to promote use of land bank credit.

Read all about a detailed study of "Federal Land Bank Timber Loans in the United States" by William C. Siegel, USDA Forest Service Research Paper SO-29, available from the Southern Station in New Orleans.

NEW PUBLICATIONS

Popular Populus

The members of the genus *Populus*, poplars, aspens, and cottonwood, have been favorite species for scientific study since before the Civil War. Thousands of papers have been written about *Populus* in German, Dutch, Russian, Finnish, French, Spanish, and other languages in addition to English.

Which papers should be read by the scientist who is planning a new study or by the forest manager who would like to try something new? A bibliography prepared at the Southern Forest Experiment Station helps answer the question.

Basic information for the compilation was supplied by the Commonwealth Forestry Bureau of Oxford, England, which had used the same information in preparing *Forestry Abstracts*. The citations are first arranged by species, then by the subject-matter categories of the Oxford System of Decimal Classification for Forestry. Foreign titles are in English. Most listings are annotated.

Compiled by R. E. Farmer, Jr., and J. S. McKnight, "Populus: A Bibliography of World Literature, 1854-1963," is Reseach Paper SO-27 of the Southern Forest Experiment Station.

Aid To Aerial Fire Fighting

How to help air-dropped fire fighting chemicals do the most good was the purpose of a recent study by the Southern Forest Fire Laboratory in Macon, Georgia.

R. W. Johansen and J. W. Shimmel conducted the tests with the cooperation of the Georgia Forestry Commission and the Georgia Kraft Company.

When surface fuels are burning, a solution capable of penetrating tree crowns and getting through to the understory fuel is needed. But when crown fires are encountered, it is desirable to have the chemicals stick to the crowns. Control of the solution viscosity appears to be one practical way to get these results.

To learn the effects of solution viscosity on penetration of retardants through tree crowns, a study was made in a uniform loblolly pine plantation on level terrain. Crown enclosure was about 80 percent. Three types of liquid were dropped—plain water, wet water, and water thickened with sodium carboxymethylcellulose.

More of the thickened water was intercepted by the tree crowns than either of the two other types. The percentages of solution reaching the ground were about 23 for thickened water and 29 for wet and plain water. Thus viscous water is best for crown fires, and other water for ground fires.

Details appear in Research Note SE-84 available from the Southeastern Forest Experiment Station, Asheville, North Carolina.

Johansen has also reported a new technique for fireline construction. A 30-foot wide chemical line is laid down by a tank truck spraying diammonium phosphate, and strip head fires are then burned into the chemical line. By this system, a fireline up to several hundred feet wide can be laid down at speeds from 3 to 10 miles per hour.

The report was published in *Fire Control Notes,* for January 1967. Copies of both reports are available from the Southeastern Station, P. O. Box 2570, Asheville, N. C. 28802.

New Measuring Device

For the first time, reliable continuous measurements of oleoresin exudation pressure can be made at any distance below the bark of a pine tree.

William G. Dodge and Henry R. Miller describe a device for making this measurement and offer detailed drawings of the device. They describe it as a probe-sensor which transmits pressure changes through oil-filled tubes to an electrically powered recorder. It differs from other means of measurement in its general components as well as in the method of sealing the connection between the tree and instrument. The unique part is the probe-sensor, which is made of ⅜ inch (outside diameter) Plexiglas tubing cut to a length equaling the tree diameter.

This method is suitable where resin crystallizes slowly. When crystallization is rapid, another new technique may be of interest. In *Forest Science* for March 1968, John D. Hodges and Peter L. Lorio, Jr., describe how readings may be taken from glass capillary tubes inserted in tight-fitting holes bored in the tree boles. The outer end of the tube is sealed. Oleoresin flows into the open end, compressing the air trapped there. Exudation pressure is determined by the length of the tube that is occupied by air. The tubes work well on loblolly pine, in which yield of oleoresin is low and crystallization is rapid. New tubes are inserted at desired intervals to obtain the daily pattern of resin pressure.

Details of both methods are available on request to the Southern Forest Experiment Station, New Orleans.

A Profitable Investment

Two reasons landowners often give for not practicing forestry on their woodlands are long investment periods and low earnings. Neither reason is likely to be valid on some 6 million acres of loblolly-shortleaf pine type in the South, according to a recent study in Georgia. Investments in pole and sawtimber-sized stands in need of improvement in this forest type are likely to yield returns of 15 to 30 percent per year. And the payoff may come in as little as 5 years.

These rates of return compare favorably with those from most industrial investments, and should be large enough to interest most landowners. Opportunities for such return were present in some 10 percent of the loblolly-shortleaf pine stands in Georgia, and probably exist in about equal proportion in the same type elsewhere in the South.

Revolutionary forestry methods are not required. The profits come from application of recommendations foresters have been making for years—deadening cull trees, removing competing hardwoods, and thinning overdense stands. Once the trees

ve been marked for treatment a professional, many landowners may choose to complete the work themselves.

For a description of the economic analysis see "Rating Investments for Improving Georgia Timber Stands," by Dr. Walter C. Anderson. The article appeared in the February 1968 issue of *Land Economics*. For reprints, write to the Southern Station.

Rapid Rotter

A building owner can hardly be blamed for suspecting the supernatural when he finds that a wall or floor he replaced just a year ago is rotten again. Or that wood formerly high and dry is now wet. Research has shown that the man is not dealing with the Little People, but probably with the fungus *Poria incrassata*.

This organism is the most spectacular decayer of wood in U. S. buildings. It does not occur frequently, but the rapidity of attack and the extent of damage make it important.

The fungus is unusual in that it produces large, tough, water-conducting strands or rhizomorphs. When these are rooted in a constant and abundant supply of moisture, they wet wood many feet away from the source of moisture. Thus the fungus can destroy wood normally too dry to decay.

Fortunately, control is usually simple. The organism's water supply must be permanently eliminated. Prevention is even better than control. When a building is being erected, therefore, only uninfected, dry lumber should be used. The site should be graded to prevent water from collecting around the foundation. All wooden forms and ground stakes should be removed after concrete is poured. Any wood that will be in contact with the ground or any other source of moisture should be treated with preservatives to prevent attack.

Complete descriptions of the fungus and its damage, prevention, and control are found in Dr. Arthur F. Verrall's "*Poria incrassata* Rot: Prevention and Control in Buildings," U. S. Department of Agriculture Technical Bulletin 1385, available from the Southern Forest Experiment Station.

Pines In Missouri

Interested in learning about ways to manage shortleaf pine and oak-pine types in Missouri?

If so, a recent publication should help. K. A. Brinkman and N. F. Rogers, silviculturists for the North Central Forest Experiment Station at St. Paul, Minnesota, have authored guidelines for management of the two forest types.

In describing basic management guides, Brinkman and Rogers offer a number of recommendations. They favor even-aged management. In young oak-pine stands where site index is 45 to 55, they advise increasing the pines by eliminating low-grade hardwoods. If the site index is 55 to 65, the stand should be managed as an oak-pine type. Beginning at age 20 or 25, pines may be thinned in both types.

Length of rotation? If the pine and oak-pine stands are managed intensively, 70 years or less is sufficient. The rotation may be as long as 90 years if the trees are of good quality and large enough to offset the additional costs for the extended period.

The authors then talk about more specific prescriptions for the two types on forest sites and pine plantations on abandoned fields. Sapling stands should be thinned to release potential crop trees spaced at least 10 to 12 feet apart. In pole-size stands, pines should be thinned to leave about 65 square feet of basal area per acre; oak should have from 5 to 10 square feet less after thinnings. Desirable stocking in saw log stands is 80 to 90 square feet of basal area per acre for uniformly stocked pine stands and somewhat less for oak-pine stands.

For pines on abandoned fields the authors recommend delay of the first thinning until age 30-35 because of the threat of *Fomes annosus* infection. The second and final thinning should be made about age 50. Rotation age is about 65 years, when most trees are large pole or saw log size.

More details are to be found in USDA Forest Service Research Paper NC-19, "Timber Management Guide for Shortleaf Pine and Oak-Pine Types in Missouri," which is available from the North Central Forest Experiment Station, Folwell Avenue, St. Paul, Minnesota 55101.

Thin And Grow Tall

After a good seed year, slash pine seedlings may number as many as 50,000 per acre. Overdense stands should be given an early, precommercial thinning. Such a thinning is desirable to increase volume and height growth. For a short pulpwood rotation, such a thinning is imperative.

A study gives evidence of the value of thinning. Three treatments were applied to dense plots of 3-year-old natural slash pine: thinning to single trees at 10- by 10-foot spacing, thinning to clumps of 6 to 8 trees at the same spacing, and an unthinned plot as a check. Conclusions are based on measurements made 14 years later.

The measurements tell the story. Single-tree plots averaged 16.8 cords per acre and clump plots 9.9 cords per acre. Salable volume on the unthinned check plot averaged 1.5 cords an acre. The two most dense plots, each with over 6,000 trees per acre, produced no commercial wood.

By the end of the 14-year-period, thinned trees were as much as 15 feet taller than those left alone.

Read about the subject in USDA Forest Service Research Paper SE-27 by Arthur B. Collins, III, available on request from the Southeastern Forest Experiment Station, P. O. Box 2570, Asheville, North Carolina 28802.

It's Hot Outside

If you dry veneer fast—as you have to do when you're making southern pine plywood commercially—you run the risk of creating gluing problems. You can get speed by operating the dryers at very high temperatures, but the heat may deteriorate the veneer surface or cause extractives to concentrate there.

A study recently reported by Dr. Otto Suchsland and R. R. Stevens began with the premise that damage occurs only in the last stages of drying. Early in the cycle, veneer is cooled by the evaporation of water from it. But when most of the water has been removed, the outside of the wood may become almost as hot as the air being blown over it.

To avoid damage from this last surge in temperature, the researchers dried southern pine veneer samples in an oven maintained at 500° F. but removed them the instant the surfaces reached specified limits. Then they glued the veneers into plywood and applied a standard test for shear strength.

The glue bond proved acceptable on all veneer dried at surface temperatures of 200° through 425°. On wood from which the extractives had been removed before drying, temperatures of 500° did no harm, even though they left the outside of the veneer somewhat darkened. When extractives were not removed they were driven to the surface by 500° heat and the glue bond was weak.

The darkened appearance, however, was not a direct result of high drying temperatures but a sign that the veneers had been overdried. Therefore, the authors concluded, "It appears feasible to dry veneer at temperatures in excess of 500° F. The danger of overdrying could be reduced by using a two-stage dryer. High temperatures would be applied in the first stage where most of the water would be removed. The second stage would operate at a more moderate temperature to prevent excessive veneer temperatures."

Details of the study appear in the *Forest Products Journal* for January 1968. Reprints may be had from the Southern Forest Experiment Station.

Deer Food In The Ozarks

Annual and seasonal deer food crops and their importance to deer maintenance in four forest types in the southeastern Ozarks are compared in a paper by two Southern Station scientists.

Data were collected with two stocked enclosures, one approximately 600 acres and the other 675 acres, on the Sylamore Experimental Forest in north Arkansas. Both enclosures included varying acreages of the four forest types which were designated upland hardwood, upland pine-hardwood, cedar glade, and stream-bottom hardwood. The two enclosures were stocked from 1963 to 1967 at the rate of approximately one deer to 30-40 acres. This rate was near or slightly above the estimated winter carrying capacity.

During spring and summer deer favored the cedar glade and stream-bottom forests, where legumes, composites, grasses, and browse were abundant.

But in the Ozarks, as on most deer ranges, winter is the critical season, and the mast crop then largely governs the animals' eating habits. When mast —mostly acorns—was abundant, deer ate little else and concentrated in the upland hardwood forests, which contained the most mast-producing trees. In years when mast crops were poor the deer moved to the glades and got through the winter mostly on the evergreen and herb browse they found there. Eastern red cedar, though classed as a starvation food and of low palatability, was the most heavily browsed species during the winter.

The study was made by Charles A. Segelquist and Walter E. Green and reported in the *Journal of Wildlife Management* for April 1968. Reprints are available from the Southern Forest Experiment Station.