WANTED: A New Job For An Old Friend

Forest Products Laboratory Joins Search of the Forest Utilization Service for New Uses for Hickory

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American hickory stands in a place by itself in all parts of the world. Other countries, which possess nothing like it, have imported large amounts of it in manufactured forms. Its hardness, toughness, and elasticity give it a shock resistance that make it the perfect handle for the cutting, striking, and digging tools that have been important to building throughout the world. It was preferred for carriages, wagons, and agricultural machinery and implements. It once found its greatest market in the United States in the automotive industry, principally as wheel spokes. Today tool handles form the greatest outlet for hickory. Other important uses are for skis, picker sticks used in textile mills, water-pump rods, rustic furniture, particularly chairs, gymnasium equipment, baseball bats, both for softball and lower-priced hardball bats, dowels, and ladder rungs.

There will probably always be a strong demand for high-quality, hard-textured hickory, even, as now, to the point of scarcity but the major hickory problem has become one of finding uses for trees of lower quality that are not being cut at all. These trees include hickory that runs from medium to good quality, but which is not being used because of low density of red heart. Much of the hickory remaining in the forests also consists of trees containing so many defects, such as knots, cross grain, bird pecks, ring shakes, and worm damage, that only small portions of them are suitable for articles customarily manufactured from hickory. The amount of wood obtainable from such trees for such purposes would be so small that it would not pay to take it from the woods unless uses could also be found for the remaining portions of the trees. Even though much of the old-growth hickory is clear of the defects named, a great deal of it is not suitable for handle stock because of soft texture and brashness. While soft-textured heart hickory is not suitable for handles, picker sticks, and the like, it is reported to finish well and to take on an appearance very similar to walnut. It is hoped that use may be found for it in the manufacture of flooring, furniture, school desks, and a variety of similar uses.

FIGURE 1.—*A veneer* bolt mounted in *the lathe, showing* pronounced overgrown *knots that* would produce defects comparable to *that shown in Figure 2, C. The knots shown here are larger than usual,* but *the* prevalence of knots *is* typical of low-quality *hickory and one of the obstacles* to *finding uses for it.*

Practical Uses Sought

The Forest Utilization Service is seeking new uses for this lower-quality hickory. Various units, particularly the Southeastern Forest Experiment Station, the Southern Forest Experiment Station, and the Central States Forest Experiment Station, have supplied test material. A canvass of hickory uses, initiated by the Southeastern Station, has also been made on the National Forests.

Some of the large amount of research work involved is being done at the U. S. Forest Products Laboratory. The Forest Utilization Service would like to interest other research institutions in phases of the work that cannot be undertaken at the Laboratory. Besides new uses for hickory, improved and cheaper techniques and processes for manufacturing the usual hickory products are being sought so that it will pay to remove the high-quality hickory from the lower-grade stands. The Laboratory is now making tests of three shipments of hickory received last fall from the Southestern, Southern, and Central States Regions. Shagbark, pignut, mockernut, and swamp hickory are represented in the shipments. The work includes tests on toughness, gluing,

veneer-cutting, plywood manufacture, pulpwood, and chemically derived

Properties Restrict Uses

Research work is necessary in seeking new uses for hickory because the very properties that make hickory the best wood for some purposes, such as tool handles, may exclude it from other uses. For instance, hickory is difficult to nail compared to other woods that can serve the purposes that require nailing. Also, for some of the new uses proposed for hickory, including its substitution for woods the supplies of which are becoming scarce, hickory may not machine so easily as other woods or may be harder on tools than others.

While hickory is hard to nail in comparison to many other species, the tests might show that it would glue well for some purposes. If so, some of the defects characteristic of low-grade hickory (Figures 1 and 2) might make it attractive if glued into ceiling and wall plywood panels in suitable surroundings, such as those in which knotty pine is now used, or even if used for floor panels. If it glues well, it might also be adapted for use in furniture, such as for drawer bottoms and sides, and the pattern of its defects might even add exterior beauty to furniture. It must be kept in mind, however, that any findings of the Laboratory on uses such as these and others will be for the present only the results of preliminary tests and that for some of the uses for which low-grade hickory may be proposed, actual in-service tests may be required before the wood can be approved as satifactory for such purposes.

Proper Seasoning Is Vital

Closely associated with the machining properties of hickory are its seasoning characteristics. Hickory has had a reputation of being a difficult wood to dry, and proper seasoning of the wood is vital to its wider utilization. In recognition of this fact, the Forest Utilization Service at the Southern Forest Experiment Station initiated hickory-seasoning studies in September 1947.

Hickory is one of the hardest of native woods, and, as every woodworker knows, the drier a wood is, the harder it is. Probably very few persons realize the great effect this fact may have on the ability of hickory to be machined by ordinary woodworking machinery. Possibly this is one reason why medium- and low-grade hickory has not yet found a natural market in the flooring industry. The effect of moisture content on machinability will be given consideration in the over-all study of the Laboratory on hickory utilization.

The Laboratory has previously made kiln-drying studies on hickory, but it is now approaching the problem from the angle of what to do with the large number of hickory trees of common quality in the woods that are not desirable for high-grade tool handles, picker sticks, skis, and the like. As a part of its regular research program on the seasoning of Southern hardwoods, the Laboratory has just completed a study of the seasoning of hickory handle stock. This research was directed toward a reduction of waste due to seasoning defects and toward making better seasoning more economical by reducing drying time. One set of kiln schedules developed in the study keeps pinking of the hickory at a minimum, while another set disregards pinking. Pinking is brought about by chemicals in sound white sapwood that give the wood a pinkish color when temperatures higher than 105° F. are used during the early stages of drying. This coloration does not affect the strength of the wood in any way, but some manufacturers have discriminated against pinked hickory in the same way that red heartwood has been discriminated against.

Exploratory tests on the drying of

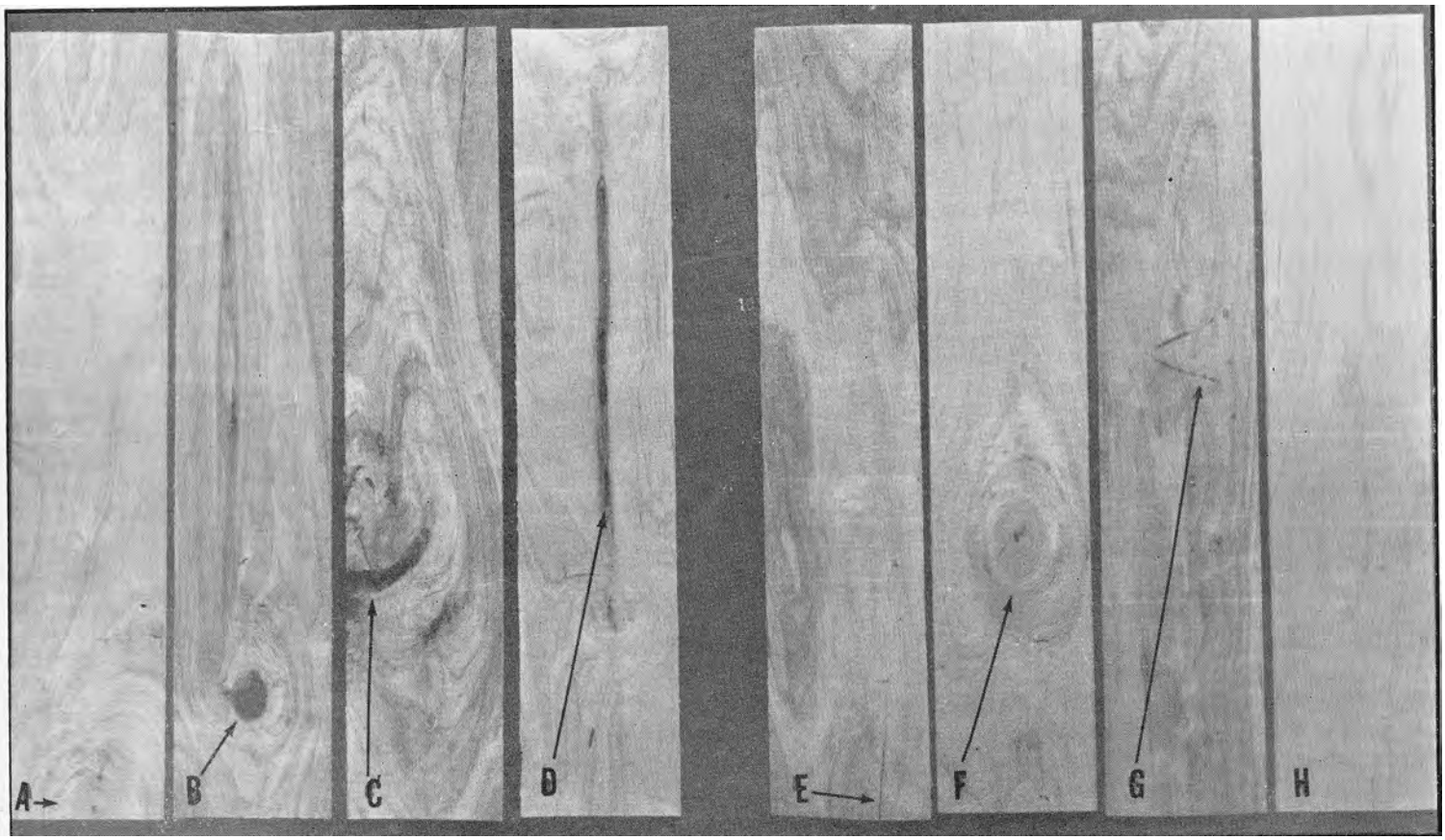

FIGURE 2.—*Shipping-container boards showing some* types of defects *encountered in the search for uses* for low-quality *hickory. Boards A, B, C,* and D *were considered unsuitable for* containers; *boards E, F, and G, as having permissible defects. A shows a* knot that *would interfere with nailing; B, an* open knot *so* large that *it would cut into fruit* or *other shipped material; C, a defect so large that it would* weaken *the piece; D, wormholes so large that they would damage th3e container contents; E, a split in one end not large enough to weaken the piece; F, a permissible large tight knot; G, a permissible type of worm damage; and H, a board free of defects.*

FIGURE 3.—Hickory logs being removed from mixed stand near Pickens, S. C., for tests at U. S. Forest Products Laboratory as to adaptability of common grades for new uses for hickory. The two logs on the truck are hickory; those on the ground are other hardwoods from the stand, which contains yellow poplar, white oak, and Northern red oak as well as hickory. To make the harvest of the stand profitable, the trees are being removed in mixed loads. The occurrence of hickory in mixed stands is one of the economic handicaps that must be overcome in seeking new uses for the lower grades of hickory.

some lumber items during the handle-stock study indicated possibilities for rapid drying of at least one kind of hickory without any seasoning degrade. In the coming year's research program, the kiln-drying of other kinds of hickory, from other sites, will be studied to learn if all hickory lumber can be dried as rapidly. If it turns out that there are fewer difficulties in seasoning second-growth hickory than there were in seasoning old-growth hickory, wider utilization of the wood should result.

Veneer, Plywood Outlets Sought

The cutting of veneer involves some of the problems encountered in drying and machining hickory for other purposes, and those of gluing as well. No veneer-cutting of hickory had previously been done at the Laboratory. Sweet pecan, which is closely related to the hickories and almost as hard, has been cut into veneer without difficulty. It dried surprisingly well, considering the fact that pecan shrinks considerably on drying. The sweet pecan logs were found to have a considerable amount of insect damage, so that sweet pecan would not be wanted for plywood in which appearance would be an important factor. It is being considered for flooring in the form of glued panels, but tests as to its adaptability for this purpose have not yet been made.

Shagbark, pignut, and mockernut hickories are to be tested at the Laboratory to learn if the material can be cut into veneer suitable for plywood, for veneer containers, or for special products, such as ply wood flooring. The tests are designed to show the temperatures at which veneers can best be cut from these species, and the lathe settings, knife angles, and nose-bar pressures that will be most suitable. The effects of different temperatures on the hickory in the veneer drier will be determined to learn if drying defects will develop in the veneer, or if defects such as checking will occur during drying. Even if these tests show that the veneer and plywood are suitable for purposes such as those proposed, an economic factor may still need to be considered, one concerning the relative costs of making hardwood and softwood plywood, for which conclusive data do not seem to be yet available.

Roofing Felt Produced

The Laboratory, under funds provided by the Research and Marketing Act, has already investigated the value of low-grade hickory, among other low-grade woods, as a material for making roofing felts and corrugating board. The experiments indicated that hickory, with suitable processing, can be used in small proportions in combinations with waste paper for making a satisfactory quality of roofing felt. A little hickory is now used in mixtures with other hardwoods and waste-paper for this purpose. The Laboratory also found that the low-grade hickory could be made into medium-grade hardwood sulfate and semi-chemical pulps, and that the hickory semi-chemical pulp made in yields of 70 to 75 per cent provided corrugating boards equalling average commercial hardwood semi-chemical corrugating boards in strength and in other use requirements. More work will be done at the Laboratory in pulping and in making papers and boards from low-grade hickory.

Hickory as Livestock Feed

In its derived-products study of hickory, the Forest Products Laboratory will continue its research into the possibilities of turning hickory waste into molasses and yeast for livestock food. In its previous studies it has found that because hickory is an open porous wood, the cooking acid used in the process penetrates the wood so readily that it can be cooked without trouble. The hickory used ranged in size from fine sander dust from handle factories to the largest chips ordinarily obtained from woodworking plants. It was found that this material yielded about 45 per cent of the weight of the wood in sugar, or about 90 per cent in molasses, of which one-half was sugar.

Integrated Operations Desirable

In fact, it is possible that a number of integrated operations by which all portions of the trees could be utilized might be required for the most profitable harvesting of common grades of hickory. In this regard, it would be most helpful if existing plants cutting other hardwoods would integrate their processes to include hickory and to harvest it as they come to it rather than to leave it for someone else to cut.

Because hickory grows in mixture with other woods (Figure 3) , it cannot be harvested as economically as woods growing in unmixed stands. Lower-grade hickory has an additional disadvantage in that it yields wood only in smaller sizes and in smaller amounts for purposes for which high-grade hickory is ordinarily used; that is, the tree has a much smaller proportion of high-quality wood. The harvesting of hickory of the more common grades would therefore hardly be attractive to large-scale operators. Perhaps enough high-quality hickory could be obtained from the lower-grade stands to supply existing factories in the same area with material for making high-quality hickory articles of small size, either separately or in conjunction with articles that the present research program may find can be profitably made from lower-grade hickory. The success of hickory operations in such plants would be better assured, however, if costs of cutting the hickory trees and removing them from the woods could be reduced by other operations in the area, such as molasses and pulp and paper production from the lowest grades of hickory, that would utilize as well every other portion of the logs not used in manufacturing, including mill waste and rejected and degraded

material, and perhaps some trees of other species. Their success would be further assured by the development of cheaper harvesting, processing, and manufacturing methods.

Old Prejudice Is Handicap

In adapting hickory to new uses, the old prejudice against red hickory is likely to be encountered. Forty years ago, when hickory threatened to become scarce because of such prejudice, the Forest Service proved that the color of hickory has nothing to do with its strength properties. Repeated tests at the Forest Products Laboratry have since shown that, weight for weight, sound red hickory is equal in strength to sound white hickory. As a result, considerably more red hickory is now used, particularly in the higher grades. Uninformed consumers, however, continue to show a preference for white hickory, probably because of its better appearance, or possibly under the assumption that an article that costs a little more is of higher quality. Some manufacturers may also have felt justified in rejecting red hickory because much of the old-growth heartwood is lighter and much more brash than the younger sapwood, and more likely to contain hidden defects.

Experience indicates, however, that manufacturers will continue to favor white hickory as long as their customers prefer it. In favoring it, they have only followed a practice that is general throughout trade and industry, that of providing, and getting more for, an article that is in greater demand. But since a new group of consumers enters the market each year as young folks grow up, probably the best way in which they can be told that color alone is not a factor in the strength of hickory is by the manufacturers and retailers themselves. These, perhaps, could further aid in the more efficient utilization of hickory through such merchandising techniques as pointing out to the customer comparative strength characteristics, such as fewer annual rings and a greater proportion of summerwood in the hickory of better quality, whether red or white, the oily or glossy finish of good hickory, and the ringing sound emitted by high-quality hickory when dropped on a hard surface. It should make no difference to the manufacturer if customers would buy more red hickory articles as long as he could make them and sell them. In fact, it might be to his advantage, because it would probably provide him with a greater and a cheaper supply of raw material.

Stand Management Gives Promise

In time, with proper management of future stands, the hickory color problem may take care of itself. By proper management of the stands, young hick or y trees can be grown to merchantable sizes without having much, if any, red heartwood (Figure 4) . By proper management is meant that type of management by which hickory will grow rapidly and can be cut young. Rapidly grown hickory can be cut young because the wood is used for small-dimension stocks; but old-growth hickory was deprived of the rapid growth that makes the best hickory wood by the competition of faster-growing species in mixed stands. For this reason, second-growth hickory, freed from competition by the harvest of other species, contains better wood. Management that will maintain the maximum rate of growth of future stands means, however, more than merely thinning the stands. Hickory should not be grown on an old dry ridge just because it will live there or has always grown there. For the best rate of growth, and thereby for stronger wood, it should be grown on the moister sites. Since the solution of the hickory color problem by proper stand management may, however, be well in the future, until that solution is realized, the red hickory will have to be marketed along with the white if the lower-grade stands are to be harvested profitably.

Research Door Open

It is toward finding a market for the lower grades of hickory that the research program of the Forest Products Laboratory above outlined is directed, in cooperation with the program advanced by the Forest Utilization Service. Wider utilization of hickory is not, however, just a problem of the Forest Products Laboratory nor of the Forest Utilization Service. It is a problem in which the entire nation should be interested, for the utilizing of available wood supplies for exacting uses and the providing of adequate and properly balanced forest growing stock is of vital concern to all. The Forest Service hopes that other agencies will enter the field of hickory research. Mississippi State College is already taking part in a kiln-drying study, in which the Forest Utilization Service at the Southern Forest Experiment Station is cooperating. North Carolina State College plans similar research. The South Carolina Agricultural Experiment Station at Clemson College has been cooperating with the Forest Utilization Service at the Southeastern Forest Experiment Station in studies on the splitting of hickory when it is felled and is eager to investigate other phases of the problem. The door is wide open for other agencies to study these and other phases of the hickory problem.

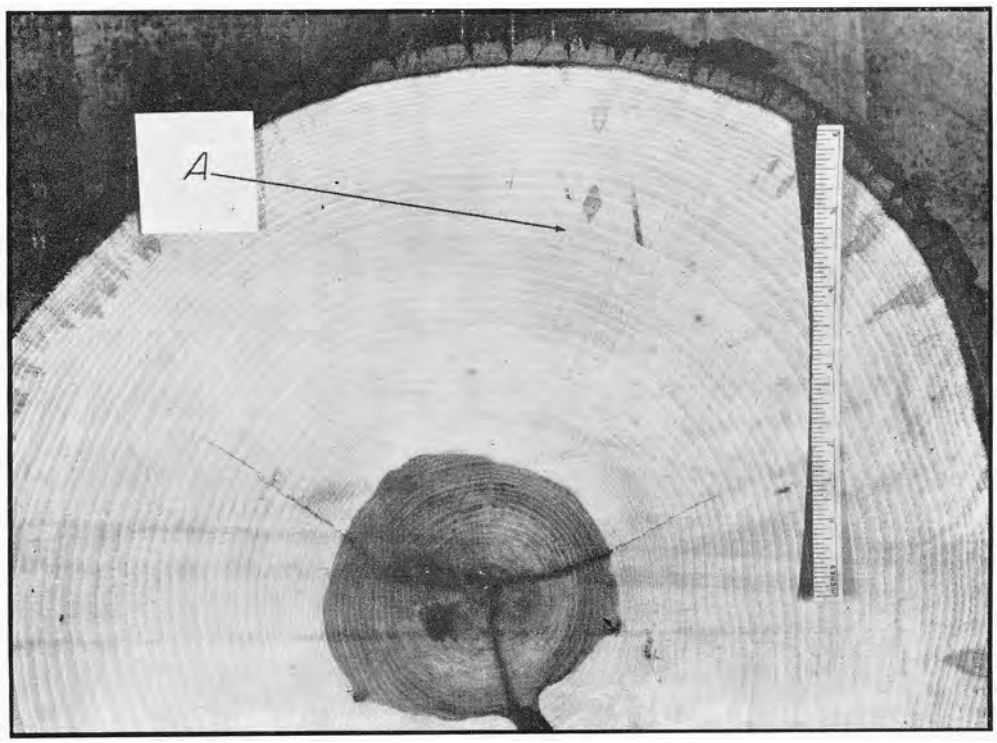

FIGURE 4.—Cross *section of a hickory tree that was given additional growing space 34 years before it was cut. The wood* of *faster growth* produced *since that time is of high mechanical quality. The preponderance of white* sapwood *indicates that wood of this character* can be grown by proper management *on suitable sites. The wide bands of dense* summerwood (A) *and small number of annual rings per inch are an indication of the strength and rapid growth of the* tree.

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