FOREST PRODUCTS UTILIZATION
TECHNICAL REPORT NO. 1

GRAY-BROWN CHEMICAL STAIN IN SOUTHERN HARDWOODS[1/]

History and Cause of Stain

From time to time southern hardwood lumber manufacturers encounter a troublesome and costly staining problem--troublesome because this stain develops in chemically dipped as well as undipped sapwood lumber, and costly because, unlike blue stain, it may show up only after final lumber surfacing in the plant.

This nonfungus, gray to brown chemical stain develops rapidly under favorable temperatures and poor drying conditions, especially in the South, where prolonged wet seasons are common. It frequently occurs in soft maple, hackberry, hickory, red oak, and dogwood, where it takes on the appearance of a blue stain. Unfortunately, the chemical stain is not as readily visible as blue stain on rough surfaces; chemical stain usually does not appear until the wood has been planed. This happens because the surface fibers of wood usually dry rapidly enough even under poor drying conditions to prevent stain development. The wood immediately beneath, however, remains wet long enough to allow the chemical stain to develop. The stain is thought to be the result of oxidation and enzymatic action on certain materials stored in wood cells and it develops when favorable conditions of moisture and temperature exist.

In the spring of 1958, slides were made from thin sections of stained hickory and red oak and examined under the microscope. The stain appeared to the naked eye as a brown general discoloration over the wood surface. Under the microscope, however, the stain was found to be present only in ray parenchyma cells of the wood (figures 1-4). These cells serve for food conduction and storage and are rich in carbohydrates and possibly other materials. Because of the *closeness* of wood rays to each other, the stain coloring appeared to cover the general area.

Chemical Stain Identification

Since chemical stain and fungus stain are alike in appearance and develop under similar conditions, a means of differentiating between the two is necessary in order to plan control measures. T. C. Scheffer of the Forest Products Laboratory found that concentrated oxalic acid would bleach out the chemical stain, but

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[1] Originally issued as Georgia Forestry Commission & U.S. Forest Service F.U.S. Release No. 21, Dec. 15, 1959.

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not the fungus stain. Thus, a simple application of oxalic acid will indicate the presence or absence of chemical stain.

Controlling Chemical Stain

The most effective control means is rapid seasoning of the sapwood lumber. Poor drying weather will allow stain development regardless of air-seasoning practices unless some other measures are taken.

Heat treating and low temperature drying.--Clark[2/] of the Forest Products Laboratory has studied chemical stain and recommends preseasoning heat treatments such as steaming or low temperature seasoning (below 50° F.) to control it. Steaming freshly sawn wood arrests the stain development permanently. Since the stain development can be permanently arrested by heat, immediate kiln drying at temperatures above 150° F. may also effectively control the stain.

Seasoning wood at temperatures below 50° F. prevents stain development, but the sapwood is not permanently protected since rewetting the wood can again bring about staining.

Predrying.--Forced-air drying may also be an effective means of preventing stain development. Experimental work with predryers[3/, 4/, 5/] indicates that certain species, such as pine, gum, and poplar, can be dried with little or no degrade in a few days and the resultant lumber is very bright. Dense hardwoods, however, such as oak and hickory, cannot be dried at a rapid rate without serious checking and splitting.

Conclusion

Sapwood chemical staining of southern hardwoods has created a serious problem to manufacturers of dimension lumber, flooring, and specialty items which require bright finished material. In the spring when the humidity is high and drying conditions are poor, this stain has shown up extensively. The stain can be identified by a simple acid test, but its control is more difficult. Steaming, low temperature drying, forced-air drying, or immediate kiln drying may be the only present means of controlling chemical stain.

2/ Clark, J. W. A gray non-fungus seasoning discoloration of certain red oaks. South. Lumberman 194(2418): 35-38. Jan. 1, 1957.

3/ Gaby, L. I. Operation predry--variables in drying southern pine. Forest Prod. Jour. 9(5): 23A-26A. 1959.

4/ Vick, C. B. Drying rate curves for one-inch yellow-poplar lumber in low-temperature forced-air dryers. Forest Prod, Jour. 15(12):500-504. 1965.

5/ Vick, C. B. Low-temperature drying of l-inch sweetgum. Forest Prod. Jour. 18(4): 29-32. 1968.

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October 15, 1970

Figure 1. -- Cross sectional photomicrograph of red oak with chemically stained rays. Heavily stained broad rays are on the left and finer rays are to the right amid the fibers and vessel pores.

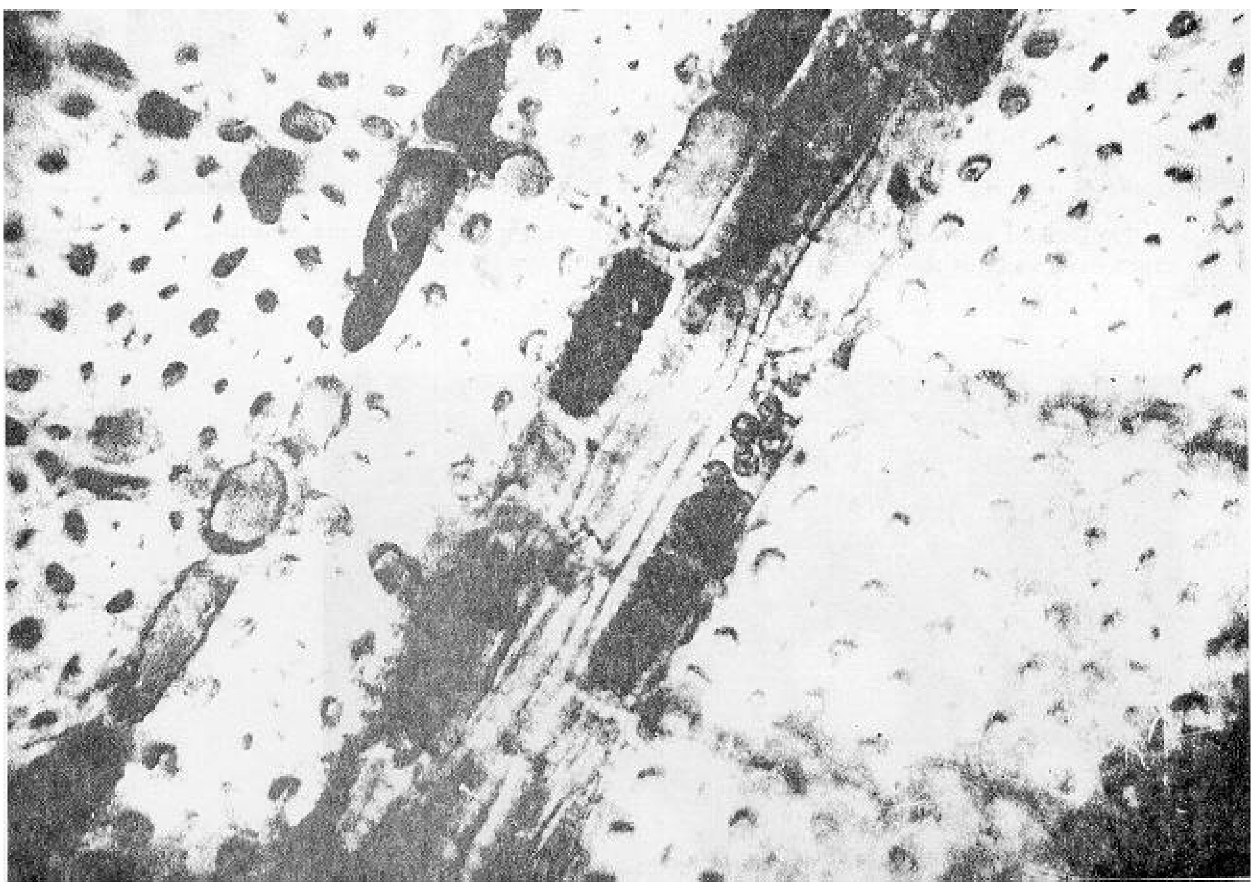

Figure 2.--Cross-sectional photomicrograph of hickory, with four rays crossing diagonally. Dark globules in ray cells exposed by microtome knife are cause of chemical stain. White cells are unstained fibers.

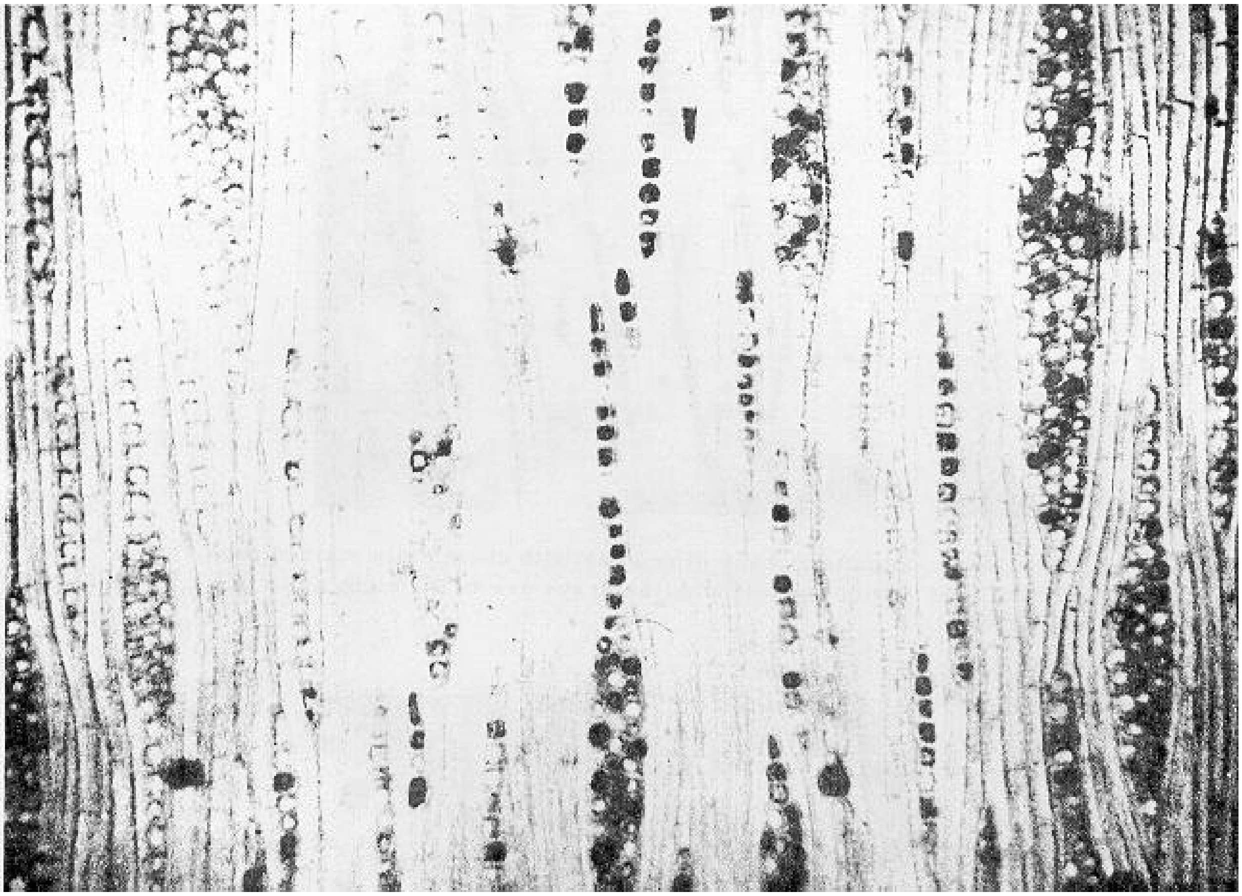

Figure 3.--Tangential photomicrograph of hickory, showing rays with some staining on the right hand side of the photograph and unstained rays on the left.

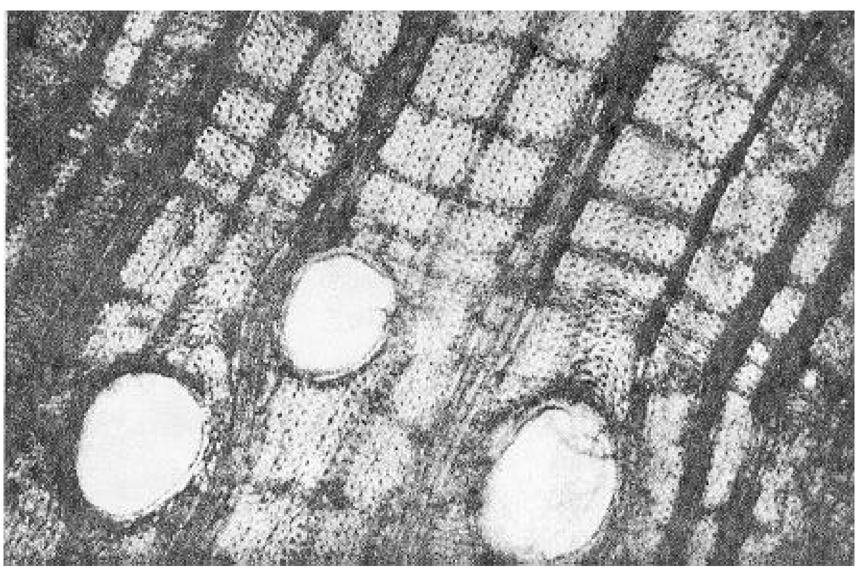

Figure 4.--Cross-sectional photomicrograph of hickory, showing diagonal lines of stained and unstained rays.