THE GEORGIA MARKET
FOR
WOOD PRESERVATIVES

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THE GEORGIA MARKET

FOR

WOOD PRESERVATIVES

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CHAPTER I

IMPORTANCE OF WOOD INDUSTRIES TO GEORGIA

I. INTRODUCTION

Forest resources occupy a prominent position in Georgia's economy, providing annually a major source of revenue for landowners and for a variety of wood industries. Thus, timber may be marketed on the farm as lumber, fuelwood, pulpwood, poles, piling, cross ties, veneer bolts, shuttle blocks, and cooperage stock. The lumber may then support industries such as planing mills, lumber yards, and furniture factories, while the pulpwood may eventually become wrapping paper, rayon, kraft paper bags, etc. In 1947, one hundred and twenty thousand or more persons were employed in forest activities, and many thousands more were indirectly dependent on the forests for a livelihood. Returns received by forest owners for forest products sold in 1947 amounted to approximately $123,000,000. In the same year, processed products were valued from $275,000,000 to $300,000,000, which represented the greatest return in dollars to landowners and industry before attained.[1] Moreover, in 1947-1948, 159 new wood-using industries began operation,

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[1] A. R. Shirley (Director), Forestry Progress in Georgia, 1947-1948 Biennial Report, State Division of Conservation (Atlanta, Georgia: Georgia Department of Forestry, 1949), p. 2.

thus accounting for more new plants over this period than any other group.

History of Georgia's Wood Industries. The development of wood industries in Georgia is not recent, however. In colonial days, squared pine and cypress timbers for export and live oak for ship timbers were the principal wood products. At the beginning of the nineteenth century, negotiations were completed, resulting in the reservations of Blackbeard's and Grover's Islands off the Georgia coast to insure supplies of live oak for our navy.[2] Thus it was that the wood industries first concentrated along the coast and the main rivers, helping to develop such ports as Savannah, Brunswick, and Darien. However, with the introduction of better transportation facilities, the lumber industry soon expanded northward to the mountains, and grew from a negligible production in 1820 to 1.3 billion board feet in 1899. As the railroads developed, the cross tie industry prospered and became an important factor in forest utilization.

Georgia assumed the lead in production of naval stores late in the nineteenth century, with Savannah as the principal marketing center of the industry, and retained it until shortly before 1905, when Florida became the leader, with a separate marketing center at Jacksonville. However, in 1923, Georgia resumed the leadership, as the adoption of improved naval stores woods practices made possible the utilization of much smaller and younger second-growth timber. The growth of the naval

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[2] LeRoy W. Watson, Jr., Marketing of Forest Products in Georgia, The University of Georgia Institute for the Study of Georgia Problems, Pamphlet No. 8 (Athens, Ga.: The University of Georgia Press, 1941), p. 3.

stores industry led to development of other wood industries, as did the fruit and vegetable industries, and the manufacture of barrels, crates, hampers, boxes, and other containers soon gained a place in the state's economy.[3]

Forest Products Today. Today, every county in Georgia has one or more timber-using industries, which may produce a variety of products from the many species of Georgia woods. Pine boards may be employed for general construction, interior trim, and woodwork, while dense pine lumber finds a ready market as structural timbers. White pine is found in limited quantities in the northeastern corner of the state, and is used to a great extent for wall paneling. Hemlock is cut in small quantities, having a limited use for rough construction. Due to its resistance to decay, cypress lumber is well suited for products coming in contact with the soil or moisture, and is thus in good demand for tanks, boats, and coffins. Many species of hardwoods are cut into lumber, for subsequent manufacture of various products. Flooring material is made from both white and red oaks, maple, and beech. The furniture industry utilizes a variety of Georgia hardwoods, including oaks, maple, sycamore, cottonwood, yellow poplar, red gum, tupelo, and black gum. Ash and hickory are in demand, when of good quality, for handles, ski blanks, implement parts, and furniture.[4]

Most of this lumber is cut from the twenty-three million wood-

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[3]I. F. Eldredge and M. M. Lehrbas, Forest Resources of South Georgia, Miscellaneous Publication No. 390 (Washington, D. C.: U. S. Department of Agriculture, 1941), p. 25.

[4]Watson, op. cit., pp. 10-11.

land acres owned by Georgians, for Georgia ranks first in the nation in privately owned forest area and in the number of forest landowners. However, according to the Census of Agriculture, only about five per cent of the wooded farms in Southwest Georgia sold forest products in 1944, indicating that the small timber owner probably makes only one such sale every 20 years, even though some sell at intervals of five to ten years, or even annually, as is the case of the turpentine farmer. Nevertheless, it is estimated that the average acre of Georgia woodland produces an average of five dollars per year for the owner, and this average acre has a total net volume of sawtimber of 1,606 board feet, of which 1,224 are pine, and 383 hardwood and cypress.[5]

II. WOOD INDUSTRIES IN GEORGIA

The Sawtimber Industry. The largest drain on the forests is by the sawtimber industry. In recent years, the state has consistently ranked either fifth or sixth in the nation in the manufacture of lumber, furnishing annually approximately five per cent of the national timber cut.[6] In 1947, Georgia produced a total of 1,687,414,000 board feet, of which 1,414,593,000 was softwood and the remainder hardwood. Table I shows the quantities of each species of wood produced in Georgia in 1947. This production represents an over-all increase of 86 per cent

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[5]A. S. Todd, Jr. and J. J. Zirkle, Jr., Markets for Forest Products in Southwest Georgia, Station Paper No. 1 (Asheville, N. C.: Southeastern Forest Experiment Station, 1949), p. 1.

[6]See Appendix 1, Table I, for comparative production of lumber in Georgia and the United States for selected years (1939-1947).

TABLE I

Lumber — Production in Georgia by Kind of Wood:1947*

(In thousands of board feet, lumber tally)

Total Production	1,687,414
Softwoods	1,414,593
Cypress	8,480
Hemlock	1,193
Southern yellow pine	1,403,687
White pine	1,233
Hardwoods	272,821
Ash	3,642
Basswood	296
Beech	99
Birch	163
Cherry	2
Chestnut	557
Cottonwood and aspen	869
Elm	674
Black and tupelo gum	28,720
Red and sap gum	73,467
Hickory	1,645
Maple	3,093
Oak	70,272
Yellow poplar	84,633
Sycamore	2,494
Mixed hardwoods	2,195

*Lumber and Timber Basic Products, 1947 Census of Manufactures Reports, MC24A, pp. 14-15.

over the total lumber production in the state in 1939.[7]

The Bureau of the Census lists 2,867 active sawmills and planing mills in Georgia for 1947. Of this number, 772 have a capacity of a million board feet or over annually, and 1,025 have a capacity of between 200,000 and 1,000,000 board feet, while the remaining 1,070 have a capacity of less than 200,000 board feet annually.[8] Most of the latter are small portable mills which run only occasionally, moving about for small, scattered patches of timber. They are usually known as "roofer" mills, because their output is primarily low quality pine boards, one inch thick, known in the lumber trade as "roofers." These portable mills are typically owned by a small businessman or farmer who often farms or carries on some other business in connection with his sawmilling. They are frequently financed by a concentration yard, which is a wholesale lumber establishment usually located in the larger settlement of the county, near shipping facilities. The concentration yard buys rough boards, dries, planes, and grades them, and ships the lumber to market. In 1949, total lumber sales made by the sawing and planing mills in the state amounted to $111,600,000, as compared with a total sales of $183,900,000 by the entire lumber manufacturing industry in Georgia during the same year.[9]

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[7]Lumber and Timber Basic Products, MC24A, 1947 Census of Manufactures Reports, Bureau of the Census (Washington, D.C.: U. S. Department of Commerce, 1949), p. 10.

[8]Ibid., pp. 3-4, 10. See Appendix I, Table II for production and number of mills in Georgia, classified by mill, based on amount of lumber sawed in 1947.

[9]Caldwell R. Walker (Editor), The Blue Book of Southern Progress (1950 Edition; Baltimore, Md.:Manufacturers Record Publishing Co., 1950), p. 41. Sales for the entire industry include logging, sawing and planing mills, millwork and plywood, wooden boxes, and miscellaneous wood products.

Sawmills purchased 36,000,000 board feet of cut logs from the farmers in Southeast Georgia in 1948. However, for the most part, sawmills buy only stumpage, purchasing timber by the boundary for a lump sum, the timber being cut by the companies or contract crews. The prices paid by the sawmills for stumpage, per thousand feet of timber, usually increases with the following factors:

> (1) as the timber increases in size; (2) as the quality improves; (3) in pines, as growth rate decreases, expressed in density of wood; (4) as quantities on an area become more concentrated, thus lowering logging costs; (5) as proximity to established mills and transportation facilities increases; (6) and as the number of competing industries increases.[10]

The Pulpwood Industry. The second largest drain on Georgia forests is pulpwood. Georgia produced more pulpwood during 1948 than any other state in the South, marking the first year that Georgia has been the leader. The state's total production in 1948 was 1,770,600 standard cords,[11] of which softwoods furnished 1,644,077 cords, and hardwoods and chestnuts furnished the remainder.[12] By way of comparison, the pulpwood production in Georgia was 400,000 cords in 1938. The total production in the South for 1948 was 11,358,997 cords.

Five of the seven pulp mills in the state are located in Southeast Georgia, one of them providing employment, directly or indirectly,

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[10] Watson, op. cit., p. 18. Table IX, page 89 shows prices paid for sawtimber in Georgia.

[11] A standard cord is a rick of closely piled bolts occupying 128 cubic feet of space. Ordinarily, this is a rick piled four feet high, four feet wide, and eight feet long.

[12] "Georgia Now Leads the South in Total Pulpwood Production," Georgia Forestry (August, 1949).

to more than six thousand residents of Georgia and neighboring states. The main products of these mills are kraft paper, bags, and boards, but dissolving pulp, insulator board, and roofing felts are also manufactured.

The pulpwood industry provides a market for wood that is unsuitable for the lumber industry. The conservationist would logically gather the pulpwood supply in South Georgia from the work-out turpentine pines, from cull trees, from trees of inferior species, from thinnings of dense stands, and from the salvage of material usually wasted in the cutting of other products. For example, the survey of South Georgia made in 1934 by the U. S. Forest Service showed that approximately 32 per cent of the turpentine area, or over 2 1/2 million acres, was worked-out or resting, thus accumulating timber that had little prospect for utilization other than pulpwood products. As in the case of sawlogs, pulpwood timber is marketed in several ways. The owners can sell it on the stump to local wood shippers, from whom they receive, in Southeast Georgia, approximately $2.73 per standard cord of yellow pine and $2.06 per cord for soft-textured hardwoods; or they can cut it themselves, receiving $10.32 to $10.75 per cord (f.o.b. cars).[13]

The Veneer and Plywood Industry. With large river bottoms, such as the Altamaha, Ogeechee, and Savannah, that still contain a large volume of old-growth hardwoods, Southeast Georgia supports a large veneer and plywood industry. Twenty-three plants, 13 local and 10 out-

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[13] J. J. Zirkle, Jr. and A. S. Todd, Jr., Markets for Forest Products in Southeast Georgia, Station Paper No. 4 (Asheville, N. C.: Southeastern Forest Station, 1949), pp. 3-4.

side, draw all or part of their logs from the area. In 1948, these mills consumed over 62,000,000 board feet of logs, 55 per cent of which went into high grade furniture and panel veneers, while the remainder produced veneer for wire-bound boxes, baskets, and hampers. Yet, unlike the sawmills, all veneer plants buy cut logs, and organize logging crews of their own only when open-market sources of supply are inadequate. The average prices paid by the mills for Grade 1 commercial veneer logs ranged from $46.58 for magnolia to $54.65 for yellow poplar, as of February 15, 1949.[14] The principal species of woods used are black and tupelo gums, followed by sweetgum, maple, yellow poplar, sweetbay, and magnolia. Most of the commercial veneer plants purchase a few species only, often just the gums. However, the package veneer plants are able to utilize the soft-textured hardwoods and even elm and sycamore upon occasion. For thirteen veneer mills listed for Georgia in the 1947 Census of Manufactures, the value of products shipped was given as $3,913,000, while the value added by manufacture was listed as $2,017,000.[15]

The Furniture Industry. The furniture business has expanded rapidly in Georgia since World War II. Total sales in 1939 amounted to $18,900,000, and ten years later, in 1949, furniture sales totaled $35,700,000, of which $30,200,000 represented home furniture, and the remainder, screens, shades, blinds, partitions, shelves, and fixtures. There were 124 furniture manufacturing plants listed for 1949 in The Blue Book of Southern Progress. These plants employed approximately

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[14] Ibid., pp. 4-5.

[15] Lumber and Timber Basic Products, ibid., p. 4.

approximately 5,700 persons, deriving an income of approximately $15,000,000.[16] The majority of furniture made in Georgia is wooden, gums and oaks being used more than any other type of lumber, though most of the plain furniture is pine. The major portion of furniture manufactured is of a cheap to moderately priced grade, with some upholstered and some unfinished articles. Most furniture manufacturers in Georgia sell their products directly to retailers and furniture dealers. However, in some cases, they sell their products directly to individuals within a short radius of the plant, and in a few cases, they maintain their own wholesale and retail establishments.

The Naval Stores Industry. Georgia accounts for about a third of the world's supply of gum naval stores. In 1947-1948, the state produced approximately 72 per cent of the nation's supply. These figures indicate how important is the Georgia naval stores industry, producing an annual income which has varied from $7,500,000 in 1932 to $23,500,000 in 1945. The industry employs annually, on the average, about twenty thousand persons, who work approximately forty million pine faces a year. Georgia's naval stores area is that part of the state south of a line running from Screven County on the east to Muscogee County on the west. However, a majority of the gum is produced in the southeastern part of this region, wherein are contained the principal gum-producing counties in the South.[17]

At one time, the crude gum was processed at hundreds of small

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[16]Walker, ibid., p. 42.

[17]"Georgia Leads the Nation with Her $23 Million Naval Stores Industry," Georgia Progress, III (January 1, 1947).

fire stills, which have largely been replaced by large steam distillation plants. There are fifteen such plants in Southeast Georgia, and four more in neighboring counties to the west. In 1948, these plants purchased nearly nine hundred thousand barrels of crude gum, drawing from Florida and Southwest Georgia as well as from Southeast Georgia. Usually, the gum is purchased directly from the producer, who delivers it to the plant. Although there are about ten thousand producers of naval stores in the state, ranging in size of operation from 500 to 1,000,000 trees each, about half of the trees worked are accounted for by the small, farmer-type producers, who work about 2500 trees each, and who comprise about 80 per cent of all the producers. The prices they receive at the plants are the daily turpentine and rosin quotations of the Savannah Naval Stores Market.[18]

A variety of industries make use of naval stores, as there are more than three hundred products made from rosin, turpentine, and pine oil. Approximately 70 per cent of the annual production of gum rosin is consumed by the paint and varnish trade, synthetic resin, ester gum, and paper and soap manufacturers. However, products are also used in adhesives, metal mining, synthetic rubber, insecticides and disinfectants, inks and dyes, textiles, foundries, asphalt products, and wood preservatives. In addition to these many domestic uses, about 50 per cent of our annual yield of pine products is exported, principally to England, Germany, the Netherlands, Canada, and Australia-New Zealand.[19]

Poles, Piling, and Cross Ties. The markets for poles and piling

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[18]Zirkle and Todd, ibid., pp. 10-11.

[19]"Georgia....Naval Stores Industry," Georgia Progress.

are the eight large wood-preserving plants in the state. These concerns have buyers who purchase both stumpage and cut products. Few carry on logging operations themselves, preferring instead to contract such work. A rough estimate of Southeast Georgia's 1948 production of poles and piling would be 225,000 poles of various sizes from 35 to 90 feet in length, and 600,000 lineal feet of piling. For piling stumpage, the farmer receives about 16 cents per lineal foot, while pole stumpage averages from 30 cents to $25.43 per pole, depending on class and length of pole.[20]

In 1937, railroads used about 2,225,000 cross ties from Georgia, of which 51 per cent were pine, 34 per cent cypress, and 15 per cent hardwoods (mostly gums and oaks). Southeast Georgia is one of the leading centers of hewn tie production in the South. The tie buyers are the large wood-preserving plants, tie brokers, and the various railroads. Although the farmers seldom cut their own timber, a notable exception is in the production of hewn cross ties, which must be hewn from living trees. Approximately 55 per cent of the estimated 600,000 ties hewn in Southwest Georgia in 1948 were produced by farmers. The prices received for hewn ties range from $.75 to $1.45, and about $.40 per tie for pine cross tie stumpage. Most of the ties produced in South Georgia are pine, although there are some gum and a very small number of cypress ties. However, the market has fallen off considerably for pine ties during the past two years, and where climate permits, the treating plants prefer oak cross ties.[21] The treating plants will be

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[20]Zirkle and Todd, ibid., pp. 4-5.

[21]Zirkle and Todd, Markets for Forest Products in Southwest Georgia, pp. 4, 8.

discussed in detail in the following chapters.

Other Wood Industries. In addition to the products mentioned, there are a number of minor ones which are important locally or which offer market outlets for classes of material that would not be salable otherwise. These include box cleat bolts, small dimension logs and bolts for table legs, etc., handle and ski logs, spool bolts, shuttle bolts, loom-part logs, naval stores stumps, and fence posts, the latter to be dealt with in detail in Chapter IV. In addition, there is fuel wood, most of which is used in rural homes, although there is no estimate available concerning the current consumption. However, in 1937, approximately 4,750,000 cords of wood were consumed in Georgia for fuel, of which 500,000 cords went into turpentine stills, cotton gins, sirup plants, tobacco barns, laundries, and ice plants.[22] Also worthy of mention are the many independent loggers who buy and log standing timber, selling the cut products. In size, their operations range from the man with one truck and a team of mules to firms with eight or ten trucks, tractors, and other heavy logging equipment. These operators are the principal source of veneer logs and blocks, and they also supply a large volume of sawlogs to the larger sawmills. Finally, there are the miscellaneous manufacturers, too numerous to enumerate, who produce such articles as coat hangers, chicken coops, baseball bats, staves and headings, excelsior, picture frames, wooden dolls, etc.

Summarizing, it may be noted that of the 258,600 manufacturing employees in Georgia in 1949, approximately 17 per cent of them were in

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[22] A. R. Spillers and I. F. Eldredge, Georgia Forest Resources and Industries, Miscellaneous Publication No. 501 (Washington, D.C.: U.S. Department of Agriculture, 1943), p. 30.

the lumber and timber products industries, exclusive of pulp and naval stores. Of the total value of products manufactured in Georgia in 1949, approximately 10 per cent was attributed to lumber and timber products, again exclusive of pulp and naval stores products.[23]

III. FOREST CONSERVATION

The significance of wood industries, past and present, to the economy of Georgia has been studied in detail. Basically, however, the continued progress of these industries is dependent upon the future timber supply. At present, Georgia forest lands are producing less than one-half their capacity, and 4,750,000 acres are poorly stocked. The state still has vast timber resources. Exclusive of Okefenokee Swamp, 66 per cent of Georgia is forest land, having a total net volume of sawtimber of 40,000,000,000 board feet, of which 30,000,000,000 are pine and 10,000,000,000 cypress and hardwood. The total net volume of cordwood is 86,000,000 cords, 40,000,000 of which are pine, 28,000,000 pulping hardwoods, and 18,000,000 non-pulping hardwoods and cypress. In addition, the total net growing stock is 165,000,000 cords, 100,000,000 of which are pine and 65,000,000 hardwood and cypress.[24] However, there was approximately 13 per cent less sawtimber in 1946 than in 1936. In 1948, there was an estimated decrease in total pine growing stock of 9 per cent, with an estimated total increase in hard-

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[23] Industrial Georgia, the Empire State of the South--1950 (Atlanta, Georgia: Georgia State Department of Commerce, 1950), pp. 7, 9.

[24] B. F. Grant and A. E. Patterson, Forest Facts for Georgia, Forestry Bulletin No. 10 (Atlanta, Georgia: The Agricultural and Industrial Development Board of Georgia, 1946), p. 6.

wood and cypress growing stock of 10 per cent, as compared with results of the Forest Service survey in 1936.[25]

Perhaps the greatest advancement toward putting Georgia's timberlands on a sustaining basis has been in the field of fire protection. The acreage under protection was increased by 2,255,526 acres during 1947 and 1948. The total state and privately owned forest land without organized protection has been reduced to 14,981,587 acres, out of a total of 23,572,833 acres. In the field of reforestration, nursery production was doubled in 1947 and almost redoubled in 1948. A third nursery in Georgia is now producing seedlings to help restock the state's 4,750,000 acres of poorly stocked forest land. With the necessary fire control and reforestration, this area can, in time, become fully stocked. However, good cutting and harvesting practices are necessary to increase production to a maximum, because forest products are not so simple to sell as other crops produced by landowners. In this respect, an effort has been made by the State Forestry Department to assist landowners in the management and sale of their timber products. During 1947 and 1948, a total of 1,032 landowners received aid in this field, consisting of technical foresters going into the woods with the farmers, and marking trees for cutting. When the marked trees were estimated, the landowners were given a written report giving the estimated volume and suggestions about how to manage the individual woodlots for maximum production of forest products.[26] In this way, it is hoped that Georgia may insure her future timber supply.

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[25]J. W. Cruikshank, Southern Pulpwood Production and the Timber Supply, Forest Survey Release No. 24 (Asheville, N.C.:Southeastern Forest Experiment Station, 1948), p. 10.

[26]Shirley, ibid., pp. 3, 5, 19.

CHAPTER II

IMPORTANCE OF WOOD PRESERVATIVES

I. THE NEED FOR WOOD PRESERVATIVES

In the United States, wood has always been a primary construction material. Its low cost and availability in many forms and sizes, together with such properties as great strength relative to its weight, ease of shaping and fastening, low heat conductivity, and sound-deadening qualities, have assured its abundant use from the time of the early settlers down to the present. However, following its removal from the forest, timber is subject to various types of deterioration. Wood-inhabiting fungi destroy or depreciate enormous quantities of lumber and other forest products annually. Based on the production and prices for the years 1925-1929, the Copeland Report estimated the average annual cost of replacements, necessitated by decay, to be over $250,000,000, or more than half the annual fire loss reported by the Board of Fire Underwriters during the same period.[1]

Wood-destroying Insects. The annual loss in forest products, resulting from deterioration by wood-destroying insects was estimated at $45,000,000 in 1927. A more recent figure shows the damage by termites alone to be $50,000,000 annually in the United States.[2]

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[1]G. M. Hunt and G. A. Garratt, Wood Preservation (New York:McGraw Hill Book Company, Inc., 1938), p. 25. The Copeland Report was made by the U. S. Forest Service and concerned the forest problems of the United States in 1933.

[2]"Bonded Termite Control Assures Protection," Atlanta Constitution, March 13, 1950, p. 15.

Thus, termites have assumed a position of major importance among insects responsible for the destruction of wood in service. They are found in nearly all sections of the country but are especially prolific in the South Atlantic, Gulf Coast, Southwest, and Pacific Coast regions. Termites infest a variety of structural timbers, such as poles, posts, piles, mine props, oil derricks, bridge timbers, etc., but their greatest damage is inflicted upon various types of buildings. In the area south of a line drawn between Maryland and Nebraska, the destruction to farm buildings by termites was estimated in 1934 to be about $29,000,000 annually. As long ago as 1926, it was reported that 80 per cent of the frame buildings in New Orleans and 50 per cent of the business buildings in Pasadena, California, had been damaged by these insects.[3]

Very few woods used for construction purposes in the United States have any decided natural resistance to termite attack. Service records show that the heartwood of redwood and southern cypress have a definite resistance, especially when used above ground, but sometimes these woods also are seriously damaged. The moisture and temperature conditions that favor the activities of most termites are also such as to promote the development of decay-producing and other wood-inhabiting fungi. Thus, the destruction of wood may become a joint undertaking of decay and termites.

A group of wood-boring animals, known generally as marine borers, cause extensive damage to the submerged area of marine piling and wharf timbers and to wooden portions of fixed and floating structures in salt water. They are especially active along the Pacific, Gulf, and South

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[3]Hunt and Garratt, ibid., pp. 54-55.

Atlantic coasts, where they may completely destroy untreated piles and timbers in less than a year. Although the normal yearly loss caused by these insects is not known, the borers may occasionally become epidemic in nature, and cause sensational destruction to marine timbers. The most serious epidemic in the United States occurred in the northern part of San Francisco Bay between 1917 and 1921, when the marine borers caused damages estimated at $25,000,000.[4]

Countermeasures Against Deterioration. Although much of the destruction of wood in service is inevitable, the loss from this source can be greatly reduced, and may even be halved, according to some estimates. Greater efficiency in wood use is essential to modern industry, which has demanded more exacting requirements for many timber products, with the result that only special grades of wood will meet specifications for strength and durability. This fact has in turn led to relative scarcity of the special woods, resulting in rising costs.

Much can be done by proper handling and storage of the timber from the time it is cut in the woods until it is placed in service. Additional savings can be made, especially in the building field, by the design of structures to avoid unnecessary exposure of wood to conditions favorable to decay and termites. Thus, a wooden building properly constructed and maintained is in little danger from either decay or insect attack and will give indefinitely long life at low annual cost. Protection against decay can be afforded by designing buildings to minimize rainwash over the woodwork, by means of wide roof overhangs and well maintained gutters. In any woodwork exposed to rainwash,

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[4] Ibid., p. 70.

joints should be designed to facilitate water flow past the joint, while all exposed horizontal projections should be flashed.

However, more houses are being built without adequate roof overhang, permitting more water to run over the exterior walls, and inaccurate carpentering provides more open joints for water to seep into. The decay hazard has further increased, particularly in the South, because of the high percentage of sapwood which must be used as general construction lumber. Provided it is well seasoned before use, and kept dry and away from contact with the ground while in use, sapwood lumber will give longtime service against decay and termites.[5] But in the many instances where it is impossible or impracticable to prevent exposure of wood to conditions favorable to decay or termites, a wood preservative should be used.

The Use of Wood Preservatives. A wood preservative is a chemical substance which, when correctly applied to wood, makes it resistant to attack by fungi, insects, or marine borers. Protection is achieved by making the wood poisonous or repellent to the organisms that would otherwise attack it. The primary reason for the preservative treatment of wood is to increase the life of the material in service, thus decreasing the over-all cost of the product and sparing the need for frequent replacements in permanent construction.

The practice of protecting wood from decay and insect attack is not recent. Modern methods of wood preservation were introduced over a hundred years ago. In 1838, two English patents were issued on methods of treating wood with chemicals. One was issued to John Bethell,

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[5]A. F. Verrall, "Decay Protection for Exterior Woodwork," Southern Lumberman, June 15, 1949.

embracing a pressure treatment with creosote, while the other was issued to Sir William Burnett on methods of treating with zinc chloride. These chemicals still constitute the main ingredients in preservatives used in treating more than 95 per cent of the wood treated in the United States today.[6]

The outstanding examples of increased permanence by preservative treatment are those products which are exposed to the most severe attacks of wood-destroying agencies, such as marine pilings, mine timbers, poles, and cross ties. However, the need for preserved farm timbers becomes more important each year. The erection and maintenance of fences is a serious problem in any locality because of the rapid deterioration of the wood in contact with ground. Destruction of fence posts requires large amounts of time, labor, and expense on the part of the farmer in maintaining fences when it should be applied more profitably. In the past, the principal method of dealing with this problem has been to use durable woods for fence posts. Table II shows the relative durability of different species of wood. However, the durable woods are becoming increasingly difficult to obtain, and it is estimated that the United States farms need about 600,000,000 fence posts per year. Thus, the less durable species must be put into service by applying a preservative treatment, which may increase the life of a southern yellow pine fence post from three years to twenty years. In addition to fence posts, the average farm in the United States needs 777 board feet of lumber per year for replacement and repairs to barns, cribs, etc., and that figure multiplied by the 6,500,000 farms in the United States

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[6]A. M. Deiters, "Wood Preserving in the South," Southern Power and Industry, July, 1943, p. 62.

TABLE II

Relative Durability of Heartwood of Common American Woods**

(Species in each class are listed alphabetically and not in order of relative durability)

Softwoods (conifers)		Hardwoods
	Class 1. Very Durable	
Cedars (practically all)		Catalpas
Cypress, southern		Chestnut
Junipers		Locust, black
Redwood		Mulberry, red
Yew, Pacific		Osage, orange
		Walnut, black
	Class 2. Durable	
Fir, Douglas (dense)		Locust, honey
Pine, southern yellow (dense)		Oak, white
	Class 3. Intermediate	
Fir, Douglas		Gum, red
Larch, western		Oak, chestnut
Pine, southern yellow*		
Tamarack		
	Class 4. Borderline between Intermediate and Non-durable Groups	
Hemlocks		Ashes
Pine, lodgepole		Beech
Spruces		Birches
		Hickories
		Maple, sugar
		Oaks, red
		Poplar, yellow
		Sycamore
	Class 5. Non-durable	
Firs, true		Aspen
		Basswood
		Cottonwood
		Gum, black
		Gum, tupelo
		Willows

*Including shortleaf, loblolly, and non-dense longleaf pines.

**Hunt and Garratt, ibid., Table III, p. 41.

yields a large potential of lumber which should be treated.[7]

The economy resulting from the use of treated wood is realized primarily through the reduction in the cost of maintenance. However, there are several other advantages in their use which should not be overlooked. As decaying timbers are highly inflammable, preservative treatment keeps the wood sound, thereby reducing the fire hazard. Moreover, well preserved timber maintains its strength for a long time, while decaying timbers rapidly lose their strength. Finally, by increasing the life of timber and by permitting the use of low-grade woods, preservation helps conserve a timber user's resources, and hence, the nation's timber supply.

II. IMPORTANCE TO SPECIFIC INDUSTRIES

The Railroads. The railroads are the greatest users of preserved wood in the United States. In the early days of their development, durable woods were readily available near the construction sites. As the railroads expanded, however, supplies of wood were seriously depleted, and the resulting higher costs for wood, together with the influx of competitive forms of transportation, led the railroads to become economy-minded about their operating costs. This directed attention toward development of more permanent forms of construction, and while structural timbers were abandoned in some instances in favor of steel or concrete, the introduction of preservative treatment of timbers has been so successful, both functionally and economically, that wood is still the approved material for most railway structures.

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[7] Potential Requirements for Timber Products in the United States, (Washington, D. C.:U. S. Department of Agriculture, 1946), p. 3.

However, the economy is reflected nowhere as much as in the use of treated cross ties. Service records show that for over 9,000 experimental ties of 20 kinds of wood, laid in the tracks of the Chicago, Burlington, and Quincy Railroad, the average life of the untreated ties was 5.5 years, while the life of those treated with zinc chloride (1/2 pound per cubic foot) was from 15 to 20 years, and that of creosote-treated ties (10 to 12 pounds per cubic foot) was from 27 to 27.5 years. Naturally, treated ties have increased in usage, from 3.3 per cent of all ties in use in 1900, to over 90 per cent at the present time. This has resulted in fewer annual tie replacements. Thus, in the case of the Baltimore and Ohio Railroad, the decrease from an average replacement of 275 ties per mile of track (3,000 ties per mile) during the period 1912-1916, to the 152 ties replaced per mile in 1929 is estimated to represent a saving of $2,362,000 in the last-named year alone.[8]

Cross ties made up well over 40 per cent of all wood preserved in the United States in 1948. During that year, the preserving plants reported the treatment of 41,158,744 cross ties, a decrease of 6,783,708 from the number treated in 1947. However, in 1948 Class I railroads used 1,798,210 untreated ties, presumably due to an inadequate supply of treated ties.[9]

Telephone and Power Companies. The successful use of treated ties and other wood products by the railroads has done much to stimulate the interest of other large industries in the preservation of their

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[8]Hunt and Garratt, ibid., pp. 15, 290.

[9]H. R. Duncan, Cross Tie Bulletin, January, 1949, pp. 44-47.

structural timbers. Telegraph, telephone, electric light and power companies make wide use of treated poles and crossarms, and for transmission of high voltage current, the familiar H-fixture made with two creosoted poles and crossarms has been gaining in popularity over the steel tower. In 1947, there were 64,000,000 poles standing in the United States, with an average of 16 to a mile of power line, and 40 to a mile of telephone line. It is estimated that there will be 80,000,000 such poles standing within a decade, because of expansion of public utilities, rural electrification, and rural telephones.[10]

In some sections of the country, non-pressure, butt-treated cedar and chestnut poles are used to some extent. Throughout the South, however, pressure-treated southern pine is generally used for both poles and crossarms, and actually furnishes over 60 per cent of all the poles used in the United States. The total number of poles treated in 1948, as reported by the preserving plants of the nation, was 5,543,076.[11]

Textile and Mining Industries. The textile industry has long been a user of preserved lumber for sub-flooring, inside platforms, and roof timbers. Usually, for ground floors, the foundation is of flat rock, bonded with asphalt. Atop the asphalt is a heavy layer of creosoted lumber, and resting on the creosoted lumber is a diagonal, salt-treated sub-floor, over which is laid the finished maple flooring. Roof planking is salt-treated material, and, in the long run, is very economical. Untreated planking has, in some cases, been replaced be-

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[10]H. S. Kernan, "Wanted—80 Million Poles," American Forests, March, 1947, pp. 116-118.

[11]Henry B. Steer, Wood Preservation Statistics, 1948 (Washington, D. C.: U. S. Department of Agriculture, 1949), p. 17.

cause of decay inside of 10 years after original installation.

Another consumer of preserved timber is the mining industry in the United States. A most important problem in that industry is one of safe, economical roof support. Timbering has become very costly because of higher timber and labor costs. Since the timbers contain a great proportion of sapwood today, all permanent mine timbers should be preservatively treated. However, of 538,000,000 board feet of permanent timber used annually in the coal mines alone, less than 10 per cent is treated. Under the unusually severe decay conditions in mines, the untreated timber used underground nowadays will fail in an average of no more than three years. On the other hand, full use of preserved timber by the coal industry in the United States would save that industry $236,741,520 for each year that such a treated-timber program was followed. The savings in labor would probably exceed the savings due to reduced timber consumption.[12]

Millwork Factories. Dipping millwork in a water-repellent, toxic bath has been authorized by the National Door Manufacturers Association since 1938. Any mill meeting the association's preservative minimum standards can be licensed to use the NDMA Seal-of-Approval on treated millwork. This type of dip treatment is in general use throughout the United States where it is desired to protect doors and windows from swelling as well as from decay and termites. Manufacturers of prefabricated houses are using the same type of water-repellent toxic dip, because the prefabricated houses which fit perfectly in the shop do not

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[12] J. M. Bray, "Treated Mine Timber—An Economic Necessity," American Wood-Preservers' Association Proceedings, 1949.

go together well in the field if they become wet in transit or are placed in an atmosphere of different humidity. Changes in dimensions cost money to correct, as well as detract from the quality of the work, thereby delaying acceptance of prefabrication by the public.[13]

Miscellaneous. In the 1920's, the creosoted wood block floor became very popular in the automobile factories. And in constructing the plants that housed American war industries during World War II, this type of floor was installed to a large extent. Even in 1948, the quantity of wood blocks given preservative treatment was 2,087,990 square yards, exceeding the quantity treated the previous year by 552,904 square yards, or about 36 per cent.[14]

The damage to marine piling has been mentioned. Unquestionably, the value of wood preserving here is very high. In harbors along the South Atlantic and Gulf coasts, in which marine borer attacks are especially severe, and untreated wood is commonly destroyed in a year or less, thoroughly creosoted piles are estimated to have an average life or 10 to 12 years.[15]

Other important uses of preserved wood are found in ice plants and storage houses, greenhouses, outdoor theaters, stadium seats, public benches, signs and sign posts, and beverage cases. As time goes on, more industries will doubtless turn to using treated timber, as they discover the economy of its use.

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[13]H. H. Edwards, "Water-Repellent Preservatives Work on Wood," Architectural Record, February, 1949, p. 134.

[14]Steer, ibid., p. 17.

[15]Hunt and Garratt, ibid., p. 77.

III. CONTRIBUTION OF THE WOOD PRESERVING INDUSTRY

During the 51-year period 1890-1940, the United States has consumed 1,685 billion board feet of forest products. In the same period, the preserving plants have treated with preservatives 84 billion board feet of forest products. Of the treated material, approximately 62 billion board feet, or 74 per cent, is still in use. To have provided adequate supplies of untreated timber for these requirements would have required a total of about 200 billion board feet. Thus, preservative treatment has saved about 116 billion board feet of forest products, which represents the cut on 13 million acres of forest land. Moreover, at an estimated value of $20 per thousand board feet at the sawmill, this represents a saving of 2.32 billion dollars.[16]

The average annual consumption of lumber for the five year period 1936-1940 was 25.7 billion board feet, whereas the average annual savings resulting from the cumulative treatment was about 7.5 billion board feet. Therefore, if no material had been treated, the total average annual consumption of lumber might have been 33.2 billion board feet during that period. Since the annual sawtimber growth is about 11.7 billion board feet, the annual depletion of sawtimber would be an average of 21.5 billion board feet. However, because of treatment, the average annual depletion in sawtimber forest lands is reduced to about 14 billion board feet. The annual net savings of 7.5 billion board feet of forest products would provide enough lumber to build 400,000 modern frame homes each year.[17] Figure 1 shows the amount of

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[16] Deiters, ibid., p. 68.

[17] Loc. cit.

wood treated in the United States from 1909 through 1948. Table X, page 90, shows the national output in 1948 by class of material.

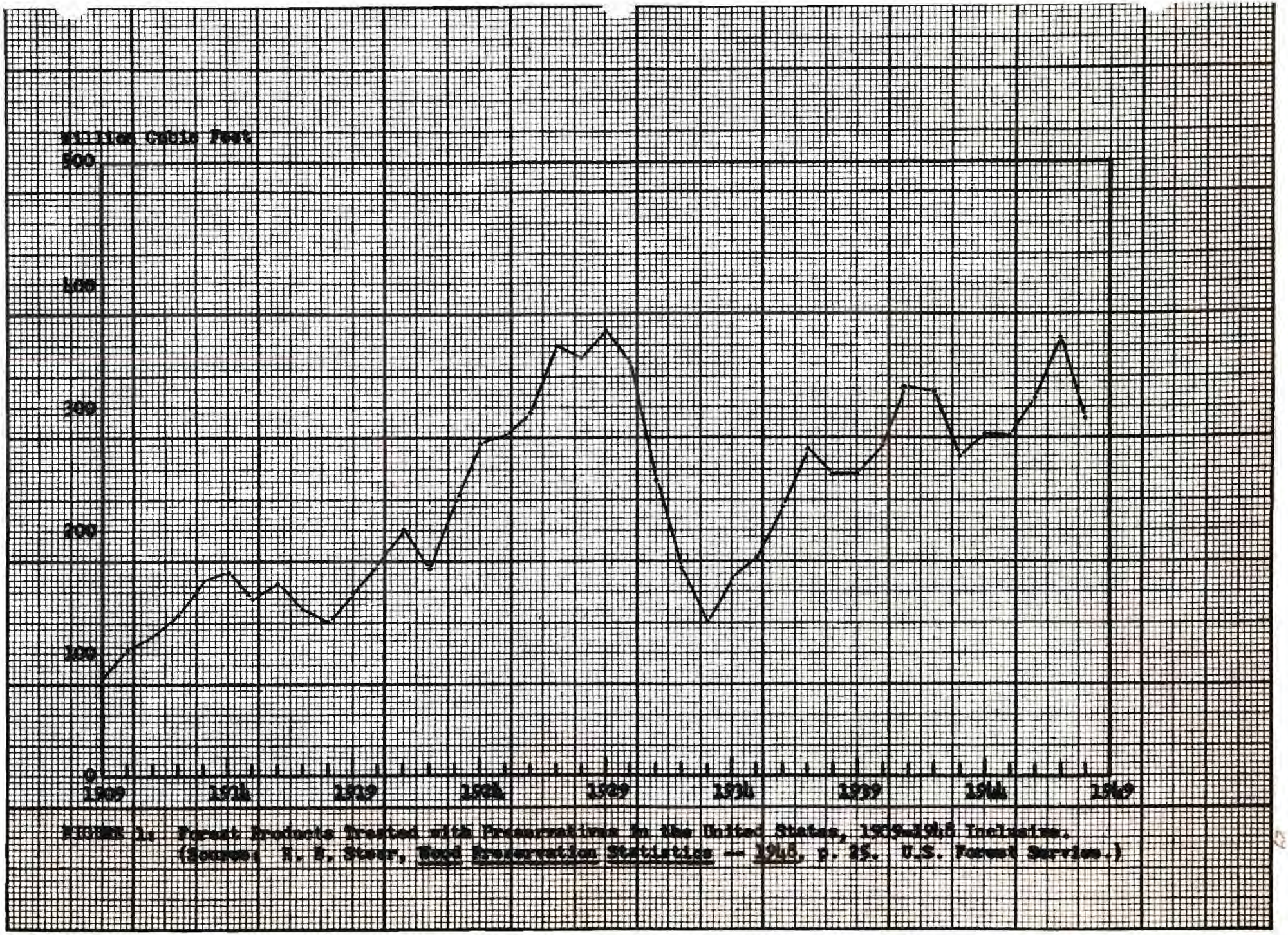

FIGURE 1. Forest Products Treated with Preservatives in the United States, 1909-1948 Inclusive.
(Source: H. H. Steer, Wood Preservation Statistics -- 1948, p. 25. U.S. Forest Service.)

CHAPTER III

PRESERVATIVES AND METHODS OF APPLICATION

I. TYPES OF WOOD PRESERVATIVES

General Characteristics. A list of the various substances that have been suggested for preserving timber from decay would include a large proportion of those known to industrial chemistry. There have been sent to the U. S. Forest Products Laboratory for testing of their preservative qualities the condensed fumes of smelters, the waste liquors of pulp plants, the refuse of tanneries, the skimmed milk of creameries, and a variety of compounds under trade names. However, few materials have been found of value as wood preservatives, most of them lacking one or more of the following characteristics which are essential to a preservative for general use. A good preservative must be: (1) toxic to wood destroyers, (2) highly penetrative, (3) permanent, (4) safe to handle and to use, (5) harmless to wood and metal, (6) and plentiful at a reasonably low cost. For special purposes, it may also need to be clean, colorless, odorless, paintable, fire resistant, or moisture repellent.[1] However, no preservative yet developed is "universal," in that it meets all the requirements. The character of the wood to be treated and the service to be demanded of it determine the properties that are most important in any particular case.

Some of the properties in a preservative can be accurately

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[1]Properties of a Good Preservative, Technical Note No. 177, Forest Products Laboratory (Madison, Wisconsin: U. S. Forest Service.)

measured by laboratory methods, including its toxicity, penetrative ability, chemical properties, corrosiveness, fire resistance, and effect on paint. However, service tests must be made to determine a preservatives' chemical stability and permanence, because laboratory data concerning these properties are insufficient and generally inconclusive. In fact, laboratory tests on a new preservative actually serve only to show whether it is promising enough to justify service tests. Needless to say, this laborious expensive process has done much to retard progress in the development and utilization of improved preservation.

Wood preservatives may be grouped into three general classes: (1) preservative oils, or mixtures of oils, that are of low volatility and only slightly soluble in water; (2) inorganic salts and similar materials that are used in water; and (3) toxic chemicals that are dissolved in some colorless, nonaqueous solvent.[2]

Creosote and Other Preservative Oils. The most important preservative oil for the last hundred years is creosote. As used for wood preservation, creosote is a distillate of coal-tar produced by high temperature carbonization of bituminous coal; it consists principally of liquid and solid aromatic hydrocarbons and contains appreciable amounts of tar acids and tar bases. Thus, creosote is not a single chemical substance but rather it is a mixture of a great number of compounds, many of which are used commercially. It follows that the character of the coal-tar creosotes available for wood preservation

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[2]A. M. Deiters, "Wood Preserving in the South," Southern Power and Industry, July, 1943, p. 63.

varies considerably. However, moderate differences in composition do not prevent these oils from giving satisfactory service, and effective preservation may be expected from any coal-tar creosote that does not vary too much from the normal.[3]

One of the chief advantages of coal-tar creosote as a wood preservative is its high toxicity to wood-destroying fungi, marine borers, and insects. It is so destructive to fungi that it can be diluted with less effective oils and still give good results. Thus, water-gas tar, water-gas tar creosote, gas oil, fuel oil, petroleum oil, and coal-tar may be mixed with coal tar creosote, in most cases to reduce the cost of the preservative. Other advantages of creosote include: (1) its relative insolubility in water and low volatility; (2) its ease of application; (3) the facility with which its depth of penetration can be determined; and (4) its general availability and low cost.

While creosote is an excellent preservative for treating structural timbers intended for general outdoor service and foundations, it has certain properties which are undesirable for many special purposes. Freshly creosoted timber is readily ignited, and will burn freely, producing a dense smoke. Moreover, the use of creosoted wood is occasionally objected to because of its odor. Workmen may object to handling the treated wood because the preservative soils their clothing and, in some cases, may burn the skin, causing an injury similar to sunburn. Finally, the dark color of creosote and the fact that it usually can not be painted over satisfactorily make it unsuitable for finished lum-

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[3]G. M. Hunt and G. A. Garratt, Wood Preservation (New York: McGraw-Hill Book Company, 1938), p. 101.

ber or other forms of wood products where appearance is of prime importance.[4]

Another preservative oil is wood-tar creosote, made by distilling the wood-tar that is produced as a by-product in the destructive distillation of wood. Because of its relative scarcity, this oil is not used to any great extent for wood preservation. Water-gas-tar creosote is derived from water-gas-tar, which is the residue remaining from the carburetion of water gas with petroleum oil. It is not used extensively as a preservative, but is sometimes mixed with coal-tar creosote. Carbolineums are proprietary preservatives similar in appearance and preservative qualities to coal tar creosote, but usually higher in price, and are used principally for brush, spray, and open tank treatments. Tar is generally not used alone as a preservative in the commercial treatment of timber because it is too viscous to penetrate wood efficiently. Petroleum oils, on the other hand, are usually not poisonous enough to wood-destroying fungi to protect wood against decay. Table III shows the quantity of preservative oils used in the United States in 1948 for wood preservation.[5]

Preservative Salts. There are various water-soluble salts employed in the United States as wood preservatives, the chief one being zinc chloride, with a total annual consumption greater than that of all other preservative salts combined. Zinc chloride is a primary product, made by the action of hydrochloric acid on zinc. It is inexpensive, uniform in quality, and plentiful; and wood impregnated with it is clean,

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[4] Ibid., p. 105.

[5] Ibid., pp. 106-116.

TABLE III

Preservatives Used in the United States in 1948*

Preservative Oils	
Distillate coal-tar creosote	133,641,587 gal.
Solutions of creosote and coal-tar	63,776,910 gal.
Petroleum**	36,546,925 gal.
Miscellaneous	653,725 gal.
TOTAL	234,619,147 gal.
Preservative Salts	
Straight zinc chloride	251,322 pounds
Chromated zinc chloride	4,254,569 pounds
Wolman salts	1,286,302 pounds
Celcure	218,137 pounds
TOTAL	6,010,330 pounds
Toxic, Nonaqueous Preservatives (Dry Basis)	
Pentachlorophenol	2,909,314 pounds
Copper naphthenate	31,755 pounds
TOTAL	2,941,069 pounds
Miscellaneous Solids	1,644,164 pounds

**The petroleum was used in a mixture with coal-tar creosote, and as a solvent for the toxic, nonaqueous preservatives.

*Henry B. Steer, Wood Preservation Statistics—1948, Table 7, p. 12.

paintable, and slightly reduced in flammability. Its principal disadvantage is its solubility in water, which causes the salt to leach out of treated timber under conditions of wet exposure. Furthermore, the water injected with the zinc chloride during treatment temporarily adds to the weight of the wood, thus requiring a period of seasoning before the timber can be used for some purposes, i. e., for structures where the shrinkage that accompanies the reduction in moisture content of the material would be objectionable. Zinc chloride is also deliquescent in solid form, although timber impregnated with the specified quantity of the salt does not attract moisture to a noticeable extent. In modern practice, zinc chloride is combined with sodium dichromate to form chromated zinc chloride, which is more resistant to leaching, and hence gives more permanent protection than straight zinc chloride.[6]

Due to the leaching effect under action of rain, melting snow, or soil moisture, zinc chloride gives less prolonged protection to exposed timber than either coal tar creosote or the common creosote mixtures. However, in locations where wood is not exposed to excessive moisture, as in buildings and dwellings, zinc chloride gives practically permanent protection against decay and termites.[7]

There are a number of proprietary preservatives in the "fluoride-phenol" group, so named because the compounds included in the group contain considerable amounts of sodium fluoride and either dinitrophenol or one of its salts. Among the most widely used are Wolman salts, a group of preservatives that were developed by Dr. K. H. Wolman of Ger-

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[6]Hunt and Garratt, ibid., pp. 116-119.

[7]Loc. cit.

many. Typical of this group is Tanalith, containing 25 per cent sodium fluoride, 37.5 per cent sodium chromate, 25 per cent di-sodium arsenate, and 12.5 per cent dinitrophenol. The fluoride and dinitrophenol destroy fungi; the chromate counteracts the corrosive effect of the dinitrophenol and increases toxicity and resistance to leaching; the arsenate gives special protection against insect attack. Wolman salts are highly toxic, and, if used in large enough quantities, are very effective in preventing decay and insect damage.

Also in the "fluoride-phenol" group are the salts used in the Osmose process, developed in Germany and used commerically since 1933. The distinguishing feature of this group is the method of their application, inasmuch as the Osmose process is designed for the treatment of green woods only. The process depends upon diffusion to carry the preservative into the wood; hence, the higher the moisture content of the timber, the better will be the penetration. Under favorable conditions, deep penetrations can be obtained in the sapwood and even the heartwood. Their chief use in the United States has been in preservation of mine timbers and standing poles.[8]

Another commonly used salt is Celcure, which is an acid cupric chromate. A typical solution of Celcure is composed of 5.6 per cent potassium dichromate, 5.6 per cent copper sulphate, 0.25 per cent acetic acid, and 88.55 per cent water. The solution is claimed to deposit insoluble toxic compounds in the wood when the treated timber is seasoned. The test data and service information available indicate that Celcure

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[8] Ibid., pp. 131, 196-198.

gives considerable protection against termites and decay.[9]

Still another salt is zinc-meta-arsenite (Z.M.A.), prepared by dissolving zinc oxide and arsenic trioxide in water acidified with acetic acid. This preservative salt is said to be very resistant to leaching in ordinary soil moisture, and was rather widely used in the United States a decade ago in the treatment of poles, timbers, and even cross ties. However, the quantity of timber treated with this preservative has declined in recent years.[10] Table III on page 34, shows the quantity of preservative salts used in 1948 in the United States.

Toxic, Nonaqueous Preservatives. Transparent, nonaqueous (insoluble in water) preservatives were developed as the result of a demand for a colorless and odorless treatment that could be applied to finished wood products without causing swelling, shrinking, or grain raising, and without interfering with subsequent applications of paint, varnish, or stain. These preservatives are in demand for the treatment of window sash and frames, doors, interior finish, automobile-body parts, and similar articles, as well as farm timbers. High volatility is a desirable characteristic of the solvent, since it can then evaporate from the wood in a few days after treatment, thus leaving the wood well impregnated with toxicant, but suitable for application of finishes. Preservatives of this type are commonly sold in concentrated solutions, which are diluted before use with a suitable solvent, usually a cheap, volatile petroleum.[11]

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[9] Ibid., p. 129.

[10] Ibid., p. 132.

[11] Ibid., pp.123-124.

The most prominent of these toxicants is pentachlorophenol, called penta for short. It is a dry, flaky, grayish powder, and is impregnated into wood as a 5 per cent solution in mineral spirits. First discovered in 1841, penta was not tested in this country until 1931, and therefore has gained widespread use only recently. During World War II, it was used in a solution of 50 per cent creosote, 45 per cent petroleum, and 5 per cent penta for treatment of poles. Penta is highly toxic, and is therefore excellent for the protection of wood against decay and insect attack. Table IV shows the relative toxicity of penta and other preservatives against fungi. It is especially adapted to farm use, because it is easy to handle and penetrates easily, even in cold soak applications. In addition, it is in demand for treatment of millwork, and many miscellaneous products. However, penta is not recommended for protection against marine borers, hence, it is not used in treating salt water piling. To the consumer, the toxicant comes as a 5 per cent solution in petroleum oil, or as a concentrated solution of approximately 40 per cent penta in an aromatic solvent.

Another nonaqueous preservative is copper naphthenate, which was developed during World War II by the Armed Services for the preservation of canvas, rope, and wood. A typical solution of this preservative contains 20 per cent copper naphthenate, equivalent to 2 per cent metallic copper, and 80 per cent petroleum solvent. It is highly toxic to a broad range of wood destroying organisms and has been demonstrated to be effective for protection against termites. Like penta, copper naphthenate is convenient for farm use, and is generally diluted to a

TABLE IV

Killing Concentration of Various Chemicals to the Fungus "Madison No. 517" (% by weight)**

Chemical	Killing Concentration
Arsenic Trioxide	0.025
Borax	0.13
Boric Acid	0.25
Copper Arsenate	0.04-0.05
Copper Sulphate	0.064*
Mercuric Chloride	0.005-0.006
Sodium Chromate	0.034
Sodium Dichromate	0.03
Sodium Fluoride	0.25
Zinc Chloride	0.35
Zinc-Meta-Arsenite	0.10
Beechwood Creosote	0.12-0.24
Betanaphthol	0.15
Coal-tar Creosote	0.07
Wood-tar Creosote	0.025-0.05
Trichlorobenzene (1-2-4)	0.007
Trichlorophenol (2-4-5)	0.001-0.002
Pentachlorophenol	0.002

*Total inhibition point given when killing point not known.

**Hunt and Garratt, ibid., Table V, pp. 94-95.

5 per cent solution for treatment. Although it turns wood slightly green upon treating, it can easily be painted over, and is noncorrosive to metals.[12] Table III, on page 34, shows the quantity of nonaqueous preservatives used in 1948 in the United States.

Miscellaneous. There are numerous other preservatives. Some are important locally, such as Pinola, which is a patented product containing pine rosin; and some are important for special purposes, such as Bruce Terminix, which is used chiefly in termite control. Another development in preservatives which has become popular recently is that of water-repellent preservatives, which contain the ingredients needed for both water repellency and preservation, thus affording protection against moisture changes and fungi in a single treatment of the wood. The ingredients in the commercial water repellents for wood are generally kept a trade secret. However, solutions possessing all of their important properties might be made by dissolving 2 to 3 per cent by weight of paraffin wax and 5 to 10 per cent of resin in mineral spirits. The wax imparts the water repellency, but interferes with subsequent painting, while the resin largely overcomes this interference. The fungicides most widely used in these water-repellent preservatives are the chlorinated phenols, phenylmercury oleate, and copper naphthenate where its green color is acceptable. These preservatives are used chiefly by the millwork manufacturers, for treatment of doors and window sashes.[13]

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[12] Copper Naphthenate-Petroleum Solutions for Hot and Cold Open Tank Treatment of Lumber, Posts, Ties, and Timber, Technical Bulletin CN-400 (Augusta, Georgia: Phoenix Oil Company).

[13] F. L. Browne, "Water-Repellent Preservatives for Wood," Architectural Record, March, 1949, pp. 132, 174.

Considerable work has been done on fire-retarding treatments, although it has been difficult to impregnate wood with a sufficient amount of salt to make it fire-resistant without damaging the wood. Among the most effective fire-retardants are the dibasic and monobasic ammonium phosphates, and one or the other of these salts is probably included in most of the fire-retarding formulas on the market. Other chemicals of value in this respect are phosphoric acid, aluminum sulphate, ammonium bromide, ammonium chloride, and monobasic zinc phosphate.[14] In 1948, a total of 9,579,787 board feet of wood was given fire-retardant treatment in the United States, with 1,582,437 pounds of chemicals (dry basis).[15]

In the last two decades, much progress has been made in the development of chemicals for protection of lumber against blue stain. While the wood-staining fungi do not affect the strength and general usefulness of the lumber, the resulting discolorations detract from the appearance of the wood, thus reducing the salability and selling price of the material. Experiments of the U. S. Bureau of Plant Industry have demonstrated that some of the more moderately-priced of the new chemicals are much more effective than the sodium carbonates in prevention of stain, and the lumber industry is now using several of them. The investigations with southern lumber, over several years, showed good preventive characteristics with borax, ethylmercury chloride, sodium tetrachlorophenoxide and phenylmercury acetate on hardwoods, and ethylmercury chloride and sodium 2-chloroorthophenylphenoxide on pine.

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[14]Hunt and Garratt, ibid., pp. 408-410.

[15]Steer, ibid., p. 23.

Several patented compounds are on the market today, which contain the chemicals mentioned as their main ingredients.[16]

II. METHODS OF APPLICATION

Even the best preservative may prove ineffectual if it is improperly applied. Thus, good penetrations and adequate retention of the preservative are essential to the successful treatment of wood.

Pressure Methods. The major proportion of wood treated annually is impregnated by pressure methods in closed cylinders. The cylinders are of welded or riveted steel construction, and vary from six to nine feet in diameter, some of them being as much as 175 feet long. They are equipped with tram-rails, and timber to be treated is moved in and out of them on specially constructed tramcars. Auxiliary equipment includes air compressors, vacuum pumps, centrifugal and reciprocating pumps for pumping preservatives, and a centrifuge for removing water from used preservative.[17]

Pressure methods for treating wood may be divided into two main groups, known as full-cell and empty-cell processes. The object of the full-cell process is to retain the greatest possible amount of liquid that has been forced into the timber during the pressure period, thus leaving the maximum concentration of preservative in the treated zone. In the empty-cell process, part of the preservative forced into the wood under pressure is subsequently recovered, thus leaving the wood cells

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[16]Hunt and Garratt, ibid., pp. 387-388.

[17]Deiters, ibid., p. 62.

coated with preservative rather than filled with it.

The most widely used full-cell treatments in the United States are the Bethell and Burnett methods, which are essentially the same, except that the former is used with creosote and the latter with zinc chloride and other water-borne preservatives. The general procedure provides for seasoned wood being placed in the treating cylinder, which is then sealed shut. A preliminary vacuum is drawn on the charge, the purpose of which is to exhaust part of the air from the outer layers of the wood, thus facilitating the entrance of preservative into the wood. After maintaining the vacuum for fifteen minutes to an hour, the cylinder is pumped full of hot preservative, and maintained at a hydrostatic pressure of from 125 to 200 pounds per square inch, until desired absorption is attained. The pressure is then released, and the oil drained from the cylinder. A short final vacuum is usually applied to dry the surface of the timber. The full-cell process is used most in treatment of marine piling and other products where maximum net retention is desired.[18]

There are two distinct empty-cell methods, the Rueping and the Lowry, both of which are usually, though not necessarily, restricted to the treatment of timber with creosote or similar preservative oils. The Rueping process is designed to obtain the most thorough penetration while leaving a minimum amount of preservative in the wood. In the process, the wood is first subjected to air pressure, varying up to eighty pounds per square inch, depending on the character of the wood being treated and the net retention of preservative desired. The air pressure is main-

[18]Hunt and Garratt, op. cit., pp. 206-208.

tained as the cylinder is filled with preservative, thus trapping in the wood cells a certain amount of air. Then the cylinder is subjected to a hydrostatic pressure, as in the full-cell process, until sufficient preservative has been forced into the wood, whereupon the cylinder is quickly drained of preservative. The charge is then subjected to a high vacuum, under which conditions the air originally trapped in the wood will expand to maximum volume, thus ejecting an appreciable amount of the preservative from the wood, and at the same time leaving the cell walls coated with preservative.[19]

The Lowry process is a modification of the Rueping method, the main difference being that no initial air is forced into the wood at the beginning of treatment. Therefore, only that amount of air contained in the wood at atmospheric pressure may expand during the subsequent vacuum, and the proportion of the gross absorption recovered after the final vacuum will be reduced accordingly. The empty-cell methods are generally used when less than maximum obtainable absorption is required, but where deep, uniform penetration is desired.[20] See Table XI on page 91 for standard net absorptions of creosote for different treated products.

Non-pressure Methods. Next to pressure treatment in effectiveness is the hot-and-cold bath treatment in open tanks. It involves the immersion of seasoned wood, for a matter of hours, in successive baths of hot and relatively cool preservative. The function of the hot bath is to expand the air in the outer layers of the timber, since

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[19]Deiters, ibid., p. 66.

[20]Loc. cit.

little penetration takes place during the hot bath. The duration and temperature of the bath will largely determine the extent to which the air and water vapor will leave the wood. The cold bath, in turn, causes the air and vapor remaining in the outer shell of the wood to contract, forming a partial vacuum. Because of this vacuum, atmospheric pressure tends to force the surrounding preservative into the wood. The change from hot to cold bath may be accomplished in three ways: (1) by transferring the heated wood to another tank containing relatively cool preservative; (2) by withdrawing the hot liquid and replacing it with cold solution; or (3) by merely discontinuing the heating and allowing the wood and preservative to cool together overnight.[21]

A modification of this process is the boiling-in-water method, which was developed to simplify operations, reduce cost of treating, insure accurate head control, eliminate evaporation, and reduce hazards of body injury or fire damage. This method of treatment employs the same principles and general procedure as the hot-and-cold bath process, except that water is used as the heating medium to expel air from the wood. This eliminates the evaporation loss incident to heating the preservative, and at the same time reduces fire hazards and irritating fumes.[22]

The hot-and-cold bath method is especially suitable for oils,

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[21]G. M. Hunt, The Preservative Treatment of Farm Timbers, Bulletin No. 744 (Washington, D. C.:U. S. Department of Agriculture, 1928).

[22]H. D. White and R. D. Dixon, "The Boiling-in-Water Method of Treating Southern Pine Fence Posts," Bulletin of the University of Georgia, XLIX (Athens, Georgia:University of Georgia Press, February, 1949).

though it may be used with water-born preservatives, provided the solutions are continuously checked and their strength corrected from time to time by the addition of water or chemical. The method, regardless of the preservative used, is not cheap, nor can it be used without the proper equipment. One or two oil-tight tanks, with coils for heating should be obtained, and the tanks should be large enough to hold the required amount of timber completely submerged. In addition, it is necessary to provide safety measures.

The cold-soaking process of applying preservatives is a limited-purpose treatment, in which the wood is simply submerged in an unheated preservative solution and allowed to soak for a few hours or days. Where the method is used with a salt preservative, dissolved in water, the process is called steeping, and involves soaking seasoned or green posts in the solution for several days or weeks. The cold-soaking method is used when it is impracticable to use the more effective impregnation methods, because it is relatively simple and economical. Tanks suitable for treating farm timbers can be made from steel drums, discarded oil storage tanks, or stock watering troughs. The timber to be treated must be well seasoned and free from bark. If easy to treat, such as sapwood of pine, the wood may absorb enough preservative to provide a high degree of protection against decay and termites. On the other hand, woods difficult to treat will not absorb a great deal of preservative.[23] However, the preservative used will determine the penetration to a large extent; pentachlorophenol and copper naphthenate are admirably suited to

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[23] Selecting a Suitable Method for Treating Fence Posts, Publication No. R1468, Forest Products Laboratory (Madison, Wisconsin: U. S. Forest Service, 1946).

this type of treatment, whereas the more viscous creosote is not.

The brushing, spraying, or dipping treatments are recommended for use in treating existing construction which has begun to deteriorate because of decay or insect attack, and to touch up treated materials where it was found necessary to saw or cut through the protected area after treatment by other means. When painting, two coats of preservative are recommended, and when spraying, it is recommended that a low-pressure sprayer with a coarse nozzle be employed. However, regardless of the preservative used, these surface treatments will give little penetration or absorption, and, hence, provide limited effectiveness.[24]

Seasoning. The most important consideration in securing thorough penetration of wood is the moisture content. Since the sapwood of most trees is practically saturated with water, it is not physically possible to inject more than a negligible amount of preservative into the wood until some of the moisture is removed.

The most popular process for removing the moisture from timber to be treated is by air seasoning. However, complete air drying varies from three months for pine and six months for gum, to as much as 12 to 14 months for oak. Thus, occasions may arise when material needed is not carried in stock and there is insufficient time to permit proper air seasoning. In such cases, southern yellow pine and hardwoods of small cross-section can be effectively kiln-dried. In most pressure-treating plants, however, the removal of moisture is usually accomplished by the steam-and-vacuum process, in which the sapwood is placed

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[24]Selecting a Suitable Method for Treating Fence Posts, loc. cit.

in a treating cylinder and subjected first to live steam, and then to a high vacuum. The purpose is to heat the wood first, then lower the boiling point of water in order that a maximum amount of water will flash to steam. During the process, as the steam leaves the wood, it forces a considerable amount of sap moisture with it. The steam-and-vacuum process can only be applied to soft woods such as southern yellow pine.[25]

In addition to moisture content, there are other factors which determine the capacity of timber to absorb preservative. Penetration attained during pressure treatment will be affected by the species of wood treated. Some woods, notably Douglas fir, are incised to a depth of 3/8 inch to 3/4 inch, in order to increase penetration. However, the greatest structural difference affecting the penetration of preservatives in both hardwoods and softwoods is generally the difference between heartwood and sapwood, because it is much easier to penetrate sapwood than the heartwood of the same species.

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[25]Deiters, ibid., pp. 64-65.

CHAPTER IV

THE MARKET IN GEORGIA

I. PRESSURE-TREATING PLANTS

By far, the largest users of wood preservatives in Georgia are the eight commercial pressure-treating plants located in the state. In a normal year, these eight plants consume approximately 8,750,000 gallons of distillate coal-tar creosote, 4,000,000 gallons of creosote-coal-tar solutions, and from 35,000 to 40,000 pounds of chromated zinc chloride. The greater portion of the coal-tar creosote is domestic, although three of the treating plants purchase some low residue creosote from Great Britain and Belgium. In addition, a negligible quantity of creosote-petroleum-pentachlorophenol solutions is being used in the treatment of poles.

A personal survey of these plants was made, in which it was determined that their combined annual output is approximately 13,300,000 cubic feet of timber, of which 70 to 75 per cent is southern yellow pine, and 25 to 30 per cent is oak and mixed hardwoods. The treated material is made up chiefly of power and telephone poles, and cross ties, although there is considerable volume of piling, flooring blocks, cross arms, lumber, and miscellaneous items such as fence posts. Moreover, one plant is equipped to treat wood conduit for underground cables, although demand for this type of material has declined considerably in recent years. From time to time, the two coastal treating plants get orders to preserve marine piling; the other plants, generally speaking, are too far inland to compete with the coastal plants for that

market. Although 7 to 8 per cent of the lumber treated is impregnated with chromated zinc chloride, the treating plants in Georgia use only creosote and solutions of creosote, as a rule. Table V shows the aggregate amount of material treated by these eight plants, together with volume of preservatives used for each class of material. All of this data was obtained by personal interview and refers to the normal output at the time the survey was made. Comparison may be made with the output for the entire United States in 1948, as shown in Table X, on page 90.

All of the pressure plants do a large out-of-state business, ranging from 50 per cent of total output in one plant to as much as 90 per cent in another. Due to the steady requirements of railroads and public utilities for preserved wood, the business is relatively stable. The railroads must replace about 1/25 of their cross ties annually; however, because of the 12 to 14 months seasoning period required of oak cross ties prior to treatment, they sometimes place orders two years in advance of their needs. Some railroads buy treated ties outright, while others purchase untreated ties and ship them to the preserving plants for seasoning and treating.

Although power and telephone poles must be replaced at approximately the same rate as cross ties, they are southern yellow pine, which may be air-dried in three months, or dried sufficiently by the steam-and-vacuum method within 18 hours. Therefore, poles may be bought by the year or as the need arises. One treating company finds the market for poles is seasonal, since very little pole-setting is done in northern United States during the severe winter months. The demand for

TABLE V

Annual Volumes of Material Treated and Preservatives Used in Eight Commerical Pressure-Treating Plants in Georgia:1948-1949**

	Usual Units of Measure	Cubic Feet Content	Volume of Preservative Used Gallons*
Cross Ties (Number)	1,400,000	4,900,000	4,300,000
Poles (Number)	500,000	6,700,000	6,700,000
Cross Arms (Number)	400,000	300,000	300,000
Piling (Linear Feet)	300,000	200,000	400,000
Wood Blocks (Sq. Yds.)	250,000	400,000	300,000
Fence Posts (Number)	200,000	100,000	75,000
Lumber and Miscellaneous (Board Ft.)	8400,000	700,000	675,000 (and 40,000 pounds of chromated zinc chloride)
TOTAL		13,300,000	12,750,000 gallons

*Gallons of distillate coal-tar creosote or solutions of creosote and coal tar, except where specified.

**This information was obtained by personal interview.

flooring blocks is highly erratic, because it is dependent upon the amount of factory construction being done. Most of the creosoted lumber is sold to the government and to state highway departments, while the salt-treated lumber finds its biggest market in the textile industry.

In addition to the eight commercial pressure-treating plants, there are two new pressure plants in Georgia, of a specialized nature. One of these, operated in connection with a large sawmill, uses a pentachlorophenol-petroleum solution for its preservative, and has treated lumber, poles, and fence posts since June, 1949. The other plant, consisting of a 35-foot cylinder, has just been placed in operation for the purpose of pressure-treating fence posts with creosote-petroleum solutions.

II. OPEN VAT PLANTS

Next to the pressure plants in consumption of wood preservatives in Georgia are the many open vat plants throughout the state, which confine their activities principally to treating fence posts, sign posts, and lumber. During this survey personal interviews were conducted with nine vat operators, and a mail questionnaire sent to 103 others. It is estimated that these 112 plants constitute at least 80 to 90 per cent of all the open vats in Georgia, based on the following reasons.

In 1948, the State Agricultural Extension Service made an inquiry of all county agents in Georgia concerning the open vats in their respective counties. The Extension Service report of that inquiry

listed all counties having vats at that time, together with preservatives used and designations as to whether the vats were privately, county, or cooperatively owned. In the present survey, letters were written to the county agents of all 64 counties listed in the Extension Service report, requesting names and addresses of all known vat operators in their counties. Replies were received from all but three of the agents, and the Extension Service report listed but four vats in those counties. Furthermore, the list of vat operators thus obtained was supplemented by a former state forester who is now a salesman of wood preservatives throughout Georgia. The resulting list shows 112 vats, of which 52 are privately-owned, 28 are county-owned, 26 are cooperatively-owned, two are operated by the U. S. Department of Agriculture, two by the State Highway Department, one by the University of Georgia and one by the State Experiment Station.[1]

Including the open vats polled by personal survey, there was a return of 66 out of the 112 known vats, or a coverage of 58.9 per cent over-all. The great majority of the vats are in the central and southern parts of the state, whereas North Georgia has no vats to speak of, because of the quantities of durable black locust in that section which make good, economical fence posts.

Cooperative Vats. With the exception of two or three vats, all of the so-called cooperative plants are operated by the vocational agricultural units attached to various high schools throughout the state. They are operated by the Future Farmers of America, and by

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[1]A vat plant, for the purpose of this study, may refer to more than one vat, so long as they are at the same location and operated under the same management.

"young farmers and adults." The plants are cooperative in the sense that the farmers may use the vats for treating timbers, providing they pay for the amount of preservative used. The few cooperative vats not connected with the vocational units are sponsored by the county farm bureaus, which sell stock to 60 or 70 local farmers, and purchase a vat with the money thus derived. Fence posts are subsequently treated on a cost basis plus a small percentage charged to liquidate the stock.

Out of 26 known cooperative plants in Georgia, the present survey accounted for 18, or 69.3 per cent coverage. In a normal year, these 18 plants treat from 105,000 to 122,000 fence posts and from 90,000 to 120,000 board feet of lumber. Since most of the cooperative vats are about the same size, it may be assumed that the output of the plants covered is representative of the whole. Following this assumption, the annual output of all 26 vats would be from 151,500 to 176,000 fence posts, and from 130,000 to 173,500 board feet of lumber. Fortunately, the validity of this survey may be checked against the actual figures, which are sent in each year by the cooperative plants to the State Board of Education. The annual reports of the Board show that in the fiscal year, 1948-1949, these vats treated 168,152 fence posts, but in the fiscal year, 1947-1948, they treated 384,746 posts. No figures were obtained for lumber treated. In appraisal of these figures, it may be pointed out that the year 1947 was an unusually active year for the entire wood-preserving industry.

In treating this material, 15 of the 18 vats polled used a total of 51,000 gallons of 50-50 or 60-40 creosote-petroleum solutions, while

the remaining three plants used a total of 13,000 gallons of copper naphthenate (five per cent) in petroleum. All of the plants mix their own treating solutions, whether it be coal-tar creosote with fuel oil, or copper naphthenate concentrate with petroleum.

County Vats. The county-owned vats are operated by the county farms, chiefly for the purpose of treating bridge timbers for maintenance of county-owned bridges. The original Extension Service report showed 39 such plants in Georgia, while the present survey showed only 28. A personal survey made indicates that some of the county vats discontinued operation due to lack of funds, while others, because of the large increase in number of privately-owned commercial vats, have found it economical to cease operation and contract their work to private vats.

Out of 28 known county-owned vats coverage was obtained on 15, or 53.6 per cent of the total. Some of the county vats treat wood for the public in addition to their bridge work. Of the 15 polled, nine treated some fence posts, with an aggregate of 90,000 treated annually. Also, in a normal year, these 15 plants preserve about 2,400,000 board feet of lumber, mostly bridge timbers. For posts and lumber, these plants use approximately 150,000 gallons of creosote-petroleum solutions annually. No attempt is made, in the case of the county vats, to estimate the output of all 28 plants, since they vary considerably in size, depending generally upon the number of miles of bridges in the respective counties.

Private Vats. The original Extension Service report showed 25 privately-owned vats in Georgia, while the present survey shows 52, or

an increase of 108 per cent. Part of this increase may be due to the passage of a fence law in Florida; however, the greater part of the increase is probably due to the realization on the part of the farmers that wood preservation is economical in the long run, resulting in an increased demand for treated fence posts and lumber. The size of the private vat plants varies considerably more than either the cooperative or the county plants; thus, a private plant may be for the personal use of one farmer who treats only 500 posts per year, or it may be a commercial vat, treating as many as 200,000 posts annually. On the other hand, some of these vats specialize in treating lumber, and produce relatively few fence posts.

Out of 52 known private vat plants in Georgia, 55.8 per cent or a total of 29 were polled, either by personal interview or by mail questionnaire. Of this number, three have just begun operations, two are in the process of building or planning a vat plant, and one is planning to install an additional vat to his existing facilities. At least two others have been in operation less than a year. However, 24 plant operators were able to give annual figures for plant output, showing that in a normal year, they treat from 570,000 to 580,000 fence posts, and approximately 4,800,000 board feet of lumber. In this treatment, 13 plants used a total of 300,000 gallons of creosote-petroleum solutions, five used a total of 19,000 gallons of penta (5 per cent) in petroleum, three used a total of 121,000 gallons of Pinola, two used a total of 120,000 pounds of Celcure, and one used 36,000 pounds of chromated zinc chloride. Of the three vats which have just begun operations, two are using creosote-petroleum solutions and the other, penta-petroleum so-

lutions. As may be seen, the private vats employ a diversity of preservatives. All but about 90,000 of the fence posts treated by them annually are preserved with creosote-petroleum solutions. Relative to fence posts, there is a common misconception of this market, in the belief that only the large farmers buy treated posts. However, one vat operator, who treats from 100,000 to 200,000 posts per year, said that fully 65 per cent of his fence posts were sold to the small farmers, buying 500 posts or less.

Other Vats. As mentioned in an earlier paragraph, there are six other vats in Georgia which can not be placed in any of the three categories discussed. Two of these are operated by the U. S. Department of Agriculture, one of which is inactive at the present time. The other is part of facilities on the Limestone Valley Land Utilization Project, and has not been placed in operation as yet. Two vats are maintained by the State Highway Department, which uses about 35,000 gallons of preservative each year for maintenance work. Another is operated by the State Experiment Station for its own use, employing Osmose Salts for its preservative. Finally, the University of Georgia operates an experimental plant of two vats, in which various types of preservatives are tried. Table VI shows a summary of the open vat plant operations in the state.

III. OTHER MARKETS

The Textile Industry. Among the largest users of preserved wood in Georgia are the textile mills. As mentioned in Chapter II, they use preserved material in their subflooring to a great extent, and also make

TABLE VI

Annual Output of Treated Wood and Amount of Preservatives Used in Open Vats in Georgia, by Type of Plant:1948-1949*

Preservative Used	Amount Used	Number of Plants Using
Private Vats		
Creosote-petroleum	300,000 gallons	13
Penta-petroleum	19,000 gallons	5
Pinola	121,000 gallons	3
Celcure	120,000 pounds	2
Chromated Zinc Chloride	36,000 pounds	1
TOTAL		24
TOTAL SURVEYED		29
TOTAL KNOWN VATS IN STATE		52
NUMBER OF FENCE POSTS TREATED ANNUALLY		570,000 to 580,000
AMOUNT OF LUMBER TREATED ANNUALLY		4,800,000 board ft.
Cooperative Vats		
Creosote-petroleum	51,000 gallons	15
Copper Naphthenate-petroleum	13,000 gallons	3
TOTAL		18
TOTAL SURVEYED		18
TOTAL KNOWN VATS IN STATE		26
NUMBER OF FENCE POSTS TREATED ANNUALLY		105,000 to 122,000
AMOUNT OF LUMBER TREATED ANNUALLY		90,000 to 120,000 board ft.
County Vats		
Creosote-petroleum	150,000 gallons	14
TOTAL SURVEYED		15
TOTAL KNOWN VATS IN STATE		28
NUMBER OF FENCE POSTS TREATED ANNUALLY		90,000
AMOUNT OF LUMBER TREATED ANNUALLY		2,400,000 board ft.

*This information was obtained by personal interview and mail questionnaire.

use of it for roof timbers and inside platforms. Subflooring may be creosoted or salt-treated or both, while roof timbers and inside platforms are salt-treated. No attempt was made to survey the entire textile industry in Georgia; however, a poll of ten of the largest mills in the state was conducted by personal interview and mail questionnaire. In addition, two prominent contractors were interviewed who do a large share of the textile industry construction in Georgia.

Of the plants surveyed, only one treats any of its own timber, and this is only for maintenance. For this purpose, that mill uses about 3,000 gallons of penta-petroleum solution yearly, and also makes use of Pinola and Wolmanized lumber to some extent. The plant policy is to treat all pine lumber used; however, for all new construction, pressure-treated lumber is purchased. Of the nine mills remaining, only two did not use any preserved lumber, and one of these expressed the desire to obtain some salt-treated material, stating that it was not available locally at an economical price. The other seven mills used treated lumber to varying degrees, the majority of which was either Celcured or Wolmanized. Three of these six mills indicated that their normal annual needs, exclusive of new construction, was from 30,000 to 50,000 board feet.

One of the contractors interviewed stated that more and more preserved lumber is being used in the textile industry as more exacting manufacturing processes are developed, requiring high humidity. He further stated that in new construction, a mill may require from 150,000 to 250,000 board feet of treated material, most of which will ordinarily be salt-treated. In fact, most of the treated timber purchased is in

connection with new construction, which has proved generally satisfactory over 11 to 15 years of service. However, one of the mills interviewed had to replace about 10 per cent of its treated timber which had been improperly treated originally. Still another is shifting to concrete flooring to obviate the necessity of treated subflooring. The conclusion from this spot survey is that the majority of the larger textile mills use preserved timber to a large extent, and, in most cases, purchase material already treated, even for maintenance work.

Termite Control Companies. The exterminator companies also provide a large market for wood preservatives in Georgia. No attempt was made to survey all of the termite control companies in the state, since they are so numerous and many of them quite small. In Atlanta alone, there are 14 listed in the telephone directory. However, personal interviews were conducted with two of the largest companies operating in Georgia, and it was found that together, they use approximately 75,000 gallons of ready-to-use preservative solutions annually. Most of this is used by injecting it into the wood at intervals along the sills, etc., and also in treating the soil surrounding the foundations. For replacements, however, these companies buy pressure-treated wood from wood-preserving plants.

Millwork Manufacturers. Still another market for wood preservatives in Georgia is the manufacturers of millwork. This market was spot checked, entirely by personal interview. Thirteen millwork manufacturers were contacted, five of which are in Atlanta. Of the 13 interviewed, three dip their outside doors and window assemblies in

solutions of penta-mineral spirits with a water repellent added using a total of about 10,000 gallons annually. Four manufacturers will dip their millwork when specified; the remaining six compete in a low-price market and, thus, do not treat any millwork because of the added cost involved. None of the manufacturers interviewed in metropolitan Atlanta treats its work, although two of the five will treat to order. The most that can be said at the present time is that, in general, the millwork plants in Georgia are not treating their work except in special instances.

Lumber Companies. A spot check of lumber companies was conducted, consisting of personal interviews of several scattered companies and a mail questionnaire to 30 of the largest lumber companies and sawmills in the state. Inquiry was made as to whether these companies either treated any lumber or carried any treated lumber in stock. Results showed that three companies treated lumber in private open vats,[2] and one sawmill had a pressure plant in which it treated some lumber. Of the three treating in open vats, one uses penta, and most of the lumber treated is used either for grain bins or for FHA housing. Another treats with chromated zinc chloride, usually for special jobs, as does the third company, which uses creosote. Two lumber companies carry stocks of treated lumber, one of them carrying both creosoted and Celcured material, while the other maintains inventories of Wolmanized lumber.

As a side light to the preservative market, the lumber mills were

[2]These vats are included in the number given on page 55.

also surveyed to determine the market for anti-staining compounds. Out of the 30 mail questionnaires sent to large mills in the state, replies were received from 20. Of these 20, nine dip from 75 to 100 per cent of their lumber against blue stain, with either Permatox, Dowacide, or Lignasan. Two others have equipment for dipping their lumber, but have discontinued the practice of using anti-staining compounds because of the added cost involved. However, of the nine reporting the use of these compounds, eight reported the quantity used, amounting to a total of approximately 43,600 pounds annually, or enough to treat about 43,600,000 board feet of lumber per year. This is only about 2.5 per cent of the state's lumber production. This spot survey, however, was not broad enough to do more than make the observation that the large mills in and around the larger communities usually dip their lumber before air-seasoning or kiln-drying it, while the mills located away from the larger communities, as well as the smaller mills, do not dip their lumber against sap stain.

Miscellaneous. A spot check of building and supply companies in the state was conducted, while making a personal survey of the treating plants in Georgia. The purpose was to ascertain what preservatives were being carried in stock to sell for home use. There were ten different preservatives in as many stores, many of them the same composition but bearing different trade names. Except in North Georgia, which was not covered in the survey, the overall favorite is, of course, creosote. Next in popularity to creosote, particularly in South Georgia, is Celcure. Pinola also enjoys fairly wide use in that section. Pentachlorophenol gains favor as one goes north, but Celcure

remains the most popular. In most cases, the dealers say that people are buying more wood preservatives than they did in years past, although the amount of increase could not be determined for this survey.

Some of the miscellaneous uses of wood preservatives which were encountered include salt-treated lumber for street benches and for outdoor theaters. One treating plant operator said that he was currently treating lumber for seven drive-in theaters. In addition, ice houses purchase considerable quantities of salt-treated wood, for use in platforms and storage boxes, where the ice comes in contact with the wood repeatedly.

With increasing frequency people are beginning to inquire of treating plants about having subflooring treated in residential construction. In some localities, the architects are specifying treated lumber, and several of the contractors will paint-on Celcure or copper naphthenate, the amount varying from house to house, ranging as little as five gallons to 30 gallons. Although no especial emphasis is being placed upon wood preservation in the Department of Architecture at Georgia Tech, mention is being made in class of its desirability.

There are three chemical companies in Georgia that compound penta solutions. One of these companies also compounds solutions of copper naphthenate, in addition to building and installing open vat plants. The main outlets for their penta solutions at this time are the termite control companies. They sell a 39-42 per cent concentrate calculated to reduce freight costs and hence to encourage the Georgia farmers to begin buying more penta solutions.

CHAPTER V

PRICES

A discussion of the market would be incomplete without considering the costs of preservatives and preserved wood to the consumer.

I. CREOSOTE AND CREOSOTED PRODUCTS

Coal-tar creosote is the most important wood preservative in the Georgia market. Of course, large volumes of creosote can be purchased at a quantity discount, while smaller volumes command a higher unit price. Thus, the large commercial treating companies buy creosote for 15 to 20 cents per gallon, whereas the individual consumer buying a one-gallon can pays $1.10 for it. If he buys a five-gallon can, the price is $1.00 per gallon. The cost of creosote to the open vat operators varies considerably, depending upon the quantities bought and where obtained. One concern sells Number One creosote, delivered, for 24 cents per gallon; consequently, several open vats patronize this concern. The majority of the operators, however, are paying from 42 to 50 cents per gallon for creosote, and from 13 to 20 cents per gallon of fuel oil. Thus, the fuel oil and creosote are mixed together to form a 50-50 preservative solution, costing from 28 to 35 cents per gallon of solution. Of course, those operators buying 24-cent creosote may well expend as little as 18 cents per gallon of 50-50 solution. In fact, one county vat operator was experimenting with a 50-50 mixture of creosote and "Bunker C," the latter costing him only 6 cents per gallon, thus reducing the cost of his preservative solution further. This so-

lution is unsatisfactory, however, due to residue and bleeding, and the operator will probably shift back to creosote and fuel oil.

The price of fence posts sold by the commercial vats ranges from 20 to 25 cents for a two-inch grape arbor post, and from 45 to 60 cents for a standard four-to-six-inch post, six and a half feet in length. The cost of creosoted lumber is roughly $130 per thousand board feet, and for custom work, from $40 to $55 per thousand board feet, depending upon who does the preserving. Relatively speaking, treated poles and cross ties, sold by the commercial pressure plants, market for a lower price, due to the mass output involved. This pressure-treated timber generally sells for 75 to 95 cents per cubic foot of wood, the cross ties costing slightly more than poles, per cubic foot, because of the additional shaping operations and longer seasoning period required of the former. Poles may sell for as little as $5 for a 25-foot pole, to $23 for a 40-foot pole, and even over $100 for a pole over 100 feet long. Pressure-treated lumber sells for about the same prices as vat-treated timber, and one pressure plant will custom treat lumber for $44.50 per thousand board feet.

II. PRESERVATIVE SALTS

Celcure is the most popular preservative salt in Georgia. The individual consumer buys a 12 per cent solution of Celcure, whereas the concentration generally used in open vat treatment is a three per cent solution. Retail prices vary somewhat, since dealers are allowed a mark-up of approximately 33-1/3 per cent. The retail price for a gallon of 12 per cent Celcure is usually from $1.65 to $1.75 per gallon; five-

gallon-cans may be purchased for $1.50 per gallon; and 55-gallon drums cost approximately $1.00 per gallon, or slightly less. Quantity lots may be bought cheaper, one vat operator reporting a price of 70 cents per gallon. In addition, dilution to a 3 per cent solution for vat treatment reduces the final cost of the preservative considerably. Proper impregnation of the timber treated should result in three fourths pound of Celcure per cubic foot of wood. This lumber may be purchased for approximately $130 per thousand board feet, although prices will vary with different jobs. Custom work may generally be obtained for about $30 per thousand board feet. At present, there is relatively little market for Celcured fence posts, since those available are too costly, ranging from 65 to 85 cents per post.

Chromated zinc chloride, if purchased in quantity, may be bought for 6 cents to 12 cents per pound. Approximately 60 pounds are required to treat a thousand board feet of lumber, with three fourths pound of chemical to the cubic foot. Treated lumber may be purchased for $130 per thousand board feet, and custom work ranges from $30 to $40 per thousand. So far as this survey showed, the use of chromated zinc chloride in Georgia is confined to commercial plants, both pressure and non-pressure.

A considerable volume of Wolmanized lumber is used in Georgia, purchased at approximately $135 per thousand board feet. It is used principally in the textile mills, as well as in football stadiums, porches, and benches. However, this product comes from Florida, however, at the present time, there is no plant in Georgia authorized to use Wolman salts.

III. NONAQUEOUS PRESERVATIVES AND OTHERS

There are a number of different brands of wood preservatives being marketed in Georgia, containing pentachlorophenol. The prices of these solutions vary considerably, depending upon what the preservative is intended for. Thus, those solutions intended for treatment of finished millwork and furniture, containing a high grade mineral spirits and water repellents, are higher priced than those intended for treatment of fence posts and farm timbers, where odor and color are not objectionable. Penta concentrates range in price from $2.35 per gallon to $3.75 per gallon, when purchased in 55-gallon drums, and may cost as much as $4.27 for a one-gallon can. When bought in sufficient quantity and diluted with 13 to 15-cent fuel oil, the treating solution can be made to cost approximately 30 cents per gallong. Many operators purchase the 5 per cent, ready-to-use penta solutions. When purchased in carloads, the ready-to-use solutions can be purchased for 20 to 25 cents per gallon; in 55-gallon drums, the price is about 80 cents per gallon; in five-gallon cans, the cost is $1.15 per gallon; and for a one-gallon can, the consumer pays approximately $1.45. One lumber company is selling a ready-to-use penta solution suitable for millwork, ranging in price from $1.11 per gallon in 55-gallon drums, $1.38 per gallon in five-gallon cans, and $1.62 for a one-gallon can. Still another company sells a water-repellent type formulation for $4.00 per gallon can. For treatment, this gallon is mixed with two gallons of petroleum oil. Penta-treated lumber is sold by one vat operator for $105 per thousand board feet, while custom work is done for $30 per thousand.

Copper naphthenate is usually sold to the vat operators in a 45 per cent concentrate, and sells for $2.05 per gallon in 55-gallon drums. The concentrate is diluted with nine parts of petroleum oil before using, which procedure will result in the treating solution costing about 34 cents per gallon. Pinola is sold in numerous building and supply stores for $1.50 to $2.50 per gallon can. All other preservatives sold in Georgia are of little consequence.

IV. IMPORTANCE OF COST

The problem of cost is all-important to the success of the small vat operators. In the survey of vats, it was found that two private vats had ceased operations because of their inability to realize a profit, and a third was contemplating closure, stating his intention of buying treated material from a pressure plant for resale to the public. The supervisor of one cooperative vat admitted that it had never proved popular due to high cost of materials and the amount of labor required in cutting, de-barking, and treating of fence posts. Still another operator said that the high price of creosote made treated fence posts too expensive for the average farmer to be interested. One county had a vat which was inactive because the farmers could get black locust posts cheaper than they could cut, peel, and treat pine posts. And one vat operator was shifting from the use of penta to Osmose salts, due to the higher cost of the former.

Not only is the cost of the preservative itself important, but the net retention of preservative in the wood may mean the difference between profit and loss. Conceivably, dry posts can absorb 16 to 20

pounds of creosote per cubic foot, and if they are allowed to do so, the cost of treating is two to three times what it should be. Also, the posts will bleed, resulting in unsatisfactory work. Normally, for open vat treatment, timber should absorb from one-half to one gallon of creosote-petroleum solution per cubic foot. Likewise, absorption of penta-petroleum solutions should be about one-half to three-quarters of a gallon per cubic foot. The various salt treatments are calculated to leave about three-quarters of a pound of salt per cubic foot of wood, while copper naphthenate should be absorbed at about six pounds per cubic foot. Of course, the retentions mentioned are approximate, but if the vat operator allows the net absorption of his preservative to vary too far from these estimates, he will either have to operate at a loss or raise the prices of the treated posts beyond what the farmers are willing to pay.

CHAPTER VI

TRENDS

Final consideration must be given to the trends in the preservative market. In other words, what can the wood-preserving industry in Georgia expect in the way of business and new developments during the future?

I. CONSERVATION

One of the trends significant to the future of wood preservation is the changing attitude of the people in Georgia toward their forests. In years past, the people have tended toward exploitation of their forest resources without regard for the future supplies. Now the farmers are beginning to realize that all of the old heart timber is gone, and that Georgia will eventually lose all of her valuable forests if measures are not taken to conserve them. The increasing interest in reforestation and planting machines has increased the demand for seedlings. To meet this demand, the State Forestry Department has added a third nursery during the past three years, with new machinery and more and better-trained personnel. Moreover, there is increasing emphasis on fire protection for Georgia's forests. In January, 1947, the Forestry Department operated with 34 organized protection units, representing 6,335,720 acres. As of January 1, 1949, there are 43 units, representing 8,591,246 acres. These figures indicate a trend toward conservation, which is an encouraging sign to the wood preserving industry in Georgia, because conservation-minded people will demand more and more preserved timber as their

needs arise.[1]

II. PROSPECTS FOR PRESSURE PLANTS

Generally, the business for the commercial pressure-treating plants is leveling off, after sustaining a sharp decrease in 1948, as compared with the boom year of 1947. However, one plant reported an eight per cent increase in volume of business in 1948 over 1947, and an increase of 14 per cent in 1949 over the volume in 1948. Still another plant is operating at capacity at the present time, being forced to turn work away. The general opinion of the plant operators is that business will remain at a par with the 1948 level of output. Even the plant which increased its output in 1948 and in 1949 says that its business is beginning to level off.

Doubtless, one of the reasons for the present trend is the fact that the REA program is nearing completion. In 1935, only 6.956 farms, or 2.8 per cent of all the farms in Georgia were receiving central station electric service. However, as of June 30, 1949, REA estimated that 193,449 farms, or 85.6 per cent of all farms in the state, were served. By December 31, 1949, the REA borrowers in Georgia were operating 48,325 miles of line, out of a total of 55,503 miles of line which have been authorized by REA. This indicates that there is very little business remaining for the wood-preserving industry in REA pole-treating.[2]

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[1]A. R. Shirley (Director), Forestry Progress in Georgia, 1947-1948 Biennial Report, State Division of Conservation (Atlanta, Georgia:Georgia Department of Forestry, 1949), pp. 5, 18.

[2]The REA Program in Georgia, Rural Electrification Administration (Washington, D. C.:U. S. Department of Agriculture.

However, one of the pressure plant operators expressed the view that whereas the REA cooperatives are using single-phase current, increasing loads may force them to shift to three-phase current, which, in turn, would necessitate heavier poles than are now being used, thus bringing more business to the preserving industry.

In addition, rural telephone systems may add to the number of consumers of treated poles in the near future. Although more than 80 per cent of the nation's farms now have electric power, as compared with 10.9 per cent in 1935, recent figures released by the Bureau of Agricultural Economics show that only 40 per cent of the nation's farms have telephone service of any kind. Since REA is now undertaking a new rural telephone program, there will be new demands for the smaller, treated poles from the pressure plants. Although these poles will be smaller, they may be more numerous, since there are usually about 40 telephone poles to the mile of line, as compared with 16 for power poles.

The opening of another pressure plant in Georgia is a good indication that the wood-preserving industry is expanding. The new plant, operated in connection with a large sawmill, has been in operation since June, 1949, and uses pentachlorophenol as its preservative. These facts would indicate that the new plant hopes to treat considerable lumber for public consumption.

III. TREATED HOUSE TIMBERS

The subject of lumber poses a perplexing problem for the pressure-treating plants. They have long recognized that treated lumber for house construction represents the biggest potential market for the industry;

however, they do not know how to exploit this market, for, in order to realize a profit from preservation of timber, the large pressure plants must attain mass output. One plant in Georgia even went so far as to rig up a portable pressure plant, some years ago, which was to be carried on two railroad cars, stopping at lumber mills throughout the state in order to treat their lumber on their own yards. Unfortunately, there was not enough demand to make the venture profitable.

Thus, the use of preserved wood in residential construction is of relatively small proportion in Georgia at this time, one reason being that the added cost, due to the use of preserved lumber, might lose the sale for the architect who specified it. Nevertheless, it is necessary to treat only a small amount of the timber to protect an entire house from decay and termite attack, and on the average home, the cost of preservative treatment would probably not exceed one per cent of the cost of building. For this reason, the demand for treated house timbers is beginning to increase, and people are awakening to the fact that the wood now going into house construction is not the heart timber of 50 years ago, but instead, is sap timber, which has no natural resistance to rot and termites.

In certain localities, the architects are beginning to specify preservative treatment for one to two thousand board feet of lumber going into the average house being built, including subflooring, sills, etc. Moreover, some of the contractors will paint-on preservatives where treated lumber is not readily available, since, as one contractor expressed it, the lumber is so sorry that he hates to use it without doing something to prolong its life. These attitudes are reflected in

South Georgia more than in the other parts of the state, but are spreading to the central section also.

It is natural that the growing appreciation of treated house timbers would bring about an increase in the amount of lumber treated by the commercial plants, and the plant operators confirm the fact that this type of material has assumed a larger proportion of their business, especially in the case of the open vat operators. In fact, one operator, whose output is chiefly lumber, is about to open another branch in the state, and possibly two. Moreover, one concern is currently investigating the market around Savannah to see if it will support a plant for pressure-treating finished lumber. The investigation involves a survey of various building and supply companies and contractors in the Savannah area, inquiring if they will be willing to use or to carry inventories of pressure-treated lumber. The increased demand for treated house timbers is further reflected in the fact that the lumber companies themselves are beginning to install treating facilities. In the survey of treating plants in Georgia, it was found that five lumber companies have facilities for treating lumber, three of which have been in operation only a year or less.

With a trend toward the use of treated house timbers, the question now arises as to how much house construction can be expected in the near future. At the present time, housebuilding is breaking records in the Atlanta metropolitan area. In February, 1950, builders started 1,070 new dwelling units, of which 77 per cent were single family homes. This number represents the greatest number of units started for any February on record; furthermore, February was the tenth consecutive month in

which housing activity in the area has increased over the same month of the previous year.[3]

A projection of nation-wide residential construction for the immediate future has been made recently by Mr. S. Morris Livingston, who concludes that approximately two-thirds of the backlog existing at the end of 1945 has now been met. However, he believes that the remaining backlog is still large enough to warrant peak construction for probably three years, assuming favorable business conditions. Specifically, Mr. Livingston states that a normal increase in dwelling units at the present would be about 500,000 annually, based on studies of family formation, death rates, etc. However, from April, 1947 to April, 1949, there was an increase of 1,450,000 units per year; furthermore, at the end of 1949, there was still a deferred demand of 1,800,000 dwelling units. Added to the so-called normal increase, this means that from the years 1950 through 1952, there will be approximately 1,100,000 dwelling units built per year, after which the wartime backlog will have been met and a normal vacancy ratio of five per cent will have been restored.[4]

In view of the facts just presented, and also of the fact that the majority of dwelling units built in Georgia are one-story, detached, frame houses, it appears that during the next three years the treating plants in the state will have greater opportunities to further develop

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[3]B. A. Bagdon (Director), Homebuilding in Atlanta at Record-High for February, Bureau of Labor Statistics, Southern Regional Office (Atlanta, Georgia:U. S. Department of Labor, 1950).

[4]S. M. Livingston, "Family Formation and the Demand for Residential Construction," Survey of Current Business, Vol. 30, (March, 1950), pp. 8-13.

the market for treated house timbers, than they are apt to experience in a long while.

IV. TRENDS IN OTHER FIELDS

Fence Post Business. In Chapter IV, it was noted that the number of private vat plants have doubled during the past two years. Since all but a few of these vats were installed principally for treating fence posts, this is a very good indication of the trend toward the use of preserved fence posts in Georgia. Moreover, there is little danger of flooding the market with treated posts. Although at this time, there are being treated probably 1,500,000 fence posts in Georgia annually, there were a total of 14,500,000 fence posts cut in the state in 1937.[5] The latter figure is not intended to be an accurate estimate of the needs today, but it is certainly indicative of the number of posts the market can hope to absorb, especially in view of the fact that an untreated pine post will rot within three years. The operator of one of the largest post-treating plants in the state said that he could sell as many posts as he could treat, but that suitable, untreated posts were sometimes hard to obtain for preserving. At the time, he had about 12,000 untreated posts air-drying on his yard, but a relatively small stock of creosoted posts.

The survey of treating plants in Georgia showed that the great majority of fence posts treated are creosoted. Although the various other preservatives are gaining favor slowly, at the present time the

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[5] A. R. Spillers and I. F. Eldredge, Georgia Forest Resources and Industries, Miscellaneous Publication No. 501 (Washington, D. C.:U. S. Department of Agriculture, 1943), p. 30.

farmers apparently want "black" posts, so that they may see what they are paying 45 cents for. As if in recognition of this fact, one open vat operator who had previously been using chromated zinc chloride, has just installed a pressure cylinder for the specific purpose of pressure-treating lumber with creosote. Still another operator is installing a second vat this spring for the purpose of treating lumber with penta; however, he intends to continue treating posts with creosote. In many cases, provided the prices of these creosoted posts are reasonable, the farmers would rather buy the posts from a commercial vat than to go to the trouble and expense of cutting, peeling, and treating his own posts in a cooperative vat. But as mentioned before, treated posts find very little market in North Georgia, where black locust and chestnut posts are popular.

Millwork Manufacturers. As indicated in Chapter IV, of the 13 manufacturers of millwork who were surveyed, three treated their work and two had been doing so for ten years or more. Four would treat to order and the other six were engaged in a price war over a cheap product. However, all of them agreed as to the advisability of treating millwork, but where quality work is required, most of them import quality, treated window assemblies, etc. from California or Iowa. The question arises as to whether the millwork manufacturers in Georgia will begin treating their work. An encouraging sign is the fact that four plants will treat their work when specified, because this indicates that there is beginning to be some demand on the part of the Georgia public for treated millwork, despite the resistance of the manufacturers. In addition, the sales manager of a plant now treating its work opined

that the industry would be forced into treating its work because of the tremendous inroads made during the war, and immediately after, by the steel industry in the manufacture of doors and window frames.

The Textile Industry. The trend for the textile industry is not clear. Most of the plant engineers in the ten mills surveyed stated that they anticipated a shift from the use of treated subflooring with finished maple flooring to concrete. One particular mill has replaced 2,000 square feet of wood flooring with concrete thus far; the engineer of this mill estimated that he could install concrete for roughly 20 per cent more cost than for treated timber and maple floors, but that the difference in maintenance costs made the concrete more economical. Another mill is replacing the porches on its village houses with concrete in order to eliminate the cost of maintenance required by wooden porches. Thus, it would appear that wood is pricing itself out of the market, for prior to the war treated lumber could be purchased for $80 to $90 per thousand feet, while now it costs $130 per thousand.

However, the contractors interviewed disagreed with this view. They believe that the textile industry will continue to use maple floors because of the mechanical disadvantages of concrete and because of the workers' objections to standing long hours on concrete. One plant tried placing rubber mats over concrete floors, but the workers were still dissatisfied. The contractors further point out that as textile manufacturing processes become more exacting, more treated timber will be required for roof timber. However, regardless of whose opinions are supported, the fact remains that one contractor is completing two textile jobs at this time, using a total of 400,000 board feet of treated

timber. It therefore seems logical that, if the treating industry can lower the price of its treated lumber, a big step will be taken in preventing the textile mills from shifting to other construction materials.

V. NEW USES AND DEVELOPMENTS

Beverage Cases. One of the potential markets for the colorless, nonaqueous preservatives is the treatment of beverage cases. While this survey did not discover any bottlers in Georgia treating their cases, the engineer of one beverage company was interested in contacting the Forest Products Laboratory regarding the use of wood preservatives for this purpose. The Coca-Cola Bottling Company of Louisville, Kentucky dip-treated 4,000 of their cases in 1940 with pentachlorophenol, and in 1948, approximately 95 per cent of the test cases were still serviceable. The Coca-Cola Bottling Company in Atlanta estimates that, under normal conditions, the average case lasts about six years, with maintenance and painting. The important point to consider is that, prior to the war, beverage cases could be purchased for 35 cents each, while now they cost 75 cents. When it is realized that one bottling company in Georgia has a million cases, it is easily seen that treatment of beverage cases would result in tremendous savings to this industry alone. Inevitably, preservative treatment of cases will become widespread, thus providing a large outlet for penta and copper naphthenate.

Water Cooling Towers. Another potential outlet for wood preservatives is in the treatment of water cooling towers. During the survey of textile plants, one engineer complained that someone should do something about extending the life of cooling towers, most of which are made

of redwood. One commercial treating plant has received requests for bids to treat cooling towers in recent years. This would indicate that either redwood towers are not completely dependable, or that supplies of redwood are becoming less plentiful and thus more costly. Exactly what the total volume of wood is, represented by the cooling towers in and around Georgia, this survey did not determine. Treatment of tower timbers apparently is a possible future outlet for any good, non-aqueous preservative.

Pine Rosin. One of the new developments in the preservative field is the investigation of pine rosin as a possible commercial wood preservative. Early in 1950, the secretary of the American Turpentine Farmers Association Cooperative in Valdosta went to the Forest Products Laboratory, where he requested that the Laboratory test rosin as a possible wood preservative. The Laboratory is now conducting various accelerated tests to determine the practicability of giving rosin service tests. Since Georgia produces over 60 per cent of the nation's naval stores, the wood preservative field could well become a big outlet for Georgia's pine rosin. The secretary of the Cooperative remarked, however, that rosin would have to be three times as toxic as creosote to compete with the latter, because creosote is selling for about two cents per pound, while rosin markets for about six cents per pound.

New Anti-termite Products. Another indication of the trend toward the use of preservatives is the appearance on the market of new anti-termite compounds. A survey of the preservative field revealed a new product soon to be released on the market to the exterminator trade. This toxicant contains 5 per cent pentachlorophenol, 2 per cent DDT,

0.1 per cent of high gamma-isomer of BHC, and a special narrow cut of petroleum oil. New products, such as this, show that more emphasis is being placed on termite protection, which, in turn, indicates broader horizons for the preserving industry, particularly in the field of residential construction.

Stabilized Wood. A new development indirectly pertinent to the wood preservative field, is the recent successful production of stabilized wood. One lumber company in Georgia, after extensive research and expense, has become the first company in the United States to successfully impregnate a soft wood with dimethylurea, in order to stabilize the wood against moisture or insect attack. The pressure process results in a hard wood, which will be of particular value in the manufacture of textile bobbins, furniture, and even flooring. The introduction of this product is another sign of the ever-increasing demand by the public for making wood a more durable material.

VI. CONCLUSION

In conclusion, an appraisal of the future outlook for wood preservatives in Georgia may best be summarized by repeating the comments of a prominent Georgia contractor. In an interview, he stated that if he were in the wood preserving industry today, he would worry, not about the demand for his product, but rather, about his supply of treated timber to fill that demand.

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APPENDIX I

APPENDIX I

TABLE VII

Lumber—Production of Softwoods and Hardwoods in Georgia and the United States, for Selected Years:1939-1947[1]

Lumber Sawed—(In thousands of board feet, lumber tally)

Year	GEORGIA			THE UNITED STATES		
	Total	Softwood	Hardwood	Total	Softwood	Hardwood
1939	907,169	803,406	103,763	25,148,384	21,407,699	3,740,685
1942	1,971,087	1,719,546	251,541	36,332,248	29,510,184	6,822,064
1943	1,856,585	1,550,552	306,033	34,288,757	26,917,342	7,371,415
1944	1,407,588	1,150,775	256,813	32,937,549	25,159,695	7,777,854
1945	1,510,080	1,124,744	385,336	28,122,244	21,139,872	6,982,472
1946	1,981,881	1,529,383	452,498	34,112,357	25,856,584	8,255,773
1947	1,687,414	1,414,593	272,821	35,404,212	27,937,398	7,466,814

[1]Taken from Lumber and Timber Basic Products, 1947 Census of Manufactures Reports, U. S. Department of Commerce, Bureau of the Census, MC24A (Washington: U. S. Government Printing Office, 1949), Table 6-D, pp. 10-12.

APPENDIX I

TABLE VIII

Lumber—Production and Number of Mills in Georgia, Classified by Size of Mill Based on Amount of Lumber Sawed in 1947*
(In thousands of board feet, lumber tally)

Production in mills sawing	Number of active mills	Lumber sawed
25,000 M ft., b.m. and over	None	None
15,000 M through 24,999 M ft., b.m.	1	**
10,000 M through 14,999 M ft., b.m.	6	83,352***
5,000 M through 9,999 M ft., b.m.	17	109,388
3,000 M through 4,999 M ft., b.m.	39	138,391
1,000 M through 2,999 M ft., b.m.	351	547,794
500 M through 999 M ft., b.m.	745	556,878
200 M through 499 M ft., b.m.	398	137,224
50 M through 199 M ft., b.m.	895	105,359
1 M through 49 M ft., b.m.	415	9,028
TOTAL	2867	1,687,414

*Lumber and Timber Basic Products, Table 6-G, pp. 16-17.

**Production figures combined with the following figures to prevent disclosing information for individual companies.

***Figures combined with the preceding class.

APPENDIX I

TABLE IX

Average Prices Paid in 1949 in Georgia, by Areas, for Standing Timber and Saw Logs Delivered at Local Points*

Kind of Timber	Area 1**	Area 2	Area 3	Area 4	Area 5
			STANDING TIMBER		
Pine	14.50	13.75	13.00	12.50	10.25
Red Oak	12.00	9.00	10.25	10.00	8.25
White Oak	11.50	9.00	10.75	10.25	9.25
Gum	11.25	6.25	9.75	8.25	6.75
Poplar	14.00	12.50	11.75	11.50	9.50
			SAWLOGS		
Pine	32.50	32.25	32.75	27.75	25.00
Red Oak	23.00	22.50	27.00	23.75	22.50
White Oak	25.25	22.50	27.50	25.25	23.25
Gum	27.75	30.00	29.00	21.50	19.00
Poplar	28.00	32.50	31.00	26.50	26.50

*Georgia Crop Reporting Service, Georgia Agricultural Extension Service, U. S. Department of Agriculture, Bureau of Agricultural Economics, September 15, 1949.

**Area 1 covers Southeast Georgia; Area 2 covers Southwest Georgia; Area 3 covers Central Georgia; Area 4 covers North-Central Georgia; and Area 5 covers North Georgia.

APPENDIX I

TABLE X

Wood Treated by Class of Material in the United States in 1948*

Type of Material	Usual Units of Measure	Cubic Feet Content**
Cross Ties (Number)	41,158,744	133,448,996
Switch Ties (Board ft.)	138,675,542	11,556,295
Piles (Linear ft.)	15,799,694	11,404,219
Poles (Number)	5,543,076	69,670,922
Wood Blocks (Square yards)	2,087,990	3,700,336
Construction Timbers (Board ft.)	67,413,069	5,617,756
Cross Arms (Number)	2,250,558	1,754,310
Fence Posts (Number)	11,591,484	7,819,615
Miscellaneous (Board ft.)	369,503,248	30,791,937
TOTAL		275,763,550

*Henry B. Steer, Wood Preservation Statistics—1948, p. 25.

**1948 conversion factors.

APPENDIX I

TABLE XI

Net Retention of Preservatives in Different Types of Treated Material*

	Pounds per cubic foot
Railroad Crossties and Switchties	6-8 (creosote-coal-tar solutions)
Bridge & Structural Timbers	12-16
Marine Pilings	22-24
Fresh Water Pilings	16
Poles	8-10
Crossarms	8
Flooring Blocks	6
Outdoor Paving Blocks	12-16
Water-borne preservatives recommended in Federal Specification TT-W-571b for treatment of wood not to be used in contact with the ground and water:**	
Zinc Chloride	1.0
Celcure	.50
Chromated Zinc Chloride	.75
Wolman Salt (Tanalith)	.35
Zinc Meta Arsenite	.35

*A. M. Deiters, "Wood Preserving in the South," Southern Power and Industry, July, 1943, p. 64.

**J. O. Blew, Jr., "Preservatives for Wood Poles," Purchasing, April, 1946.

APPENDIX II

GEORGIA

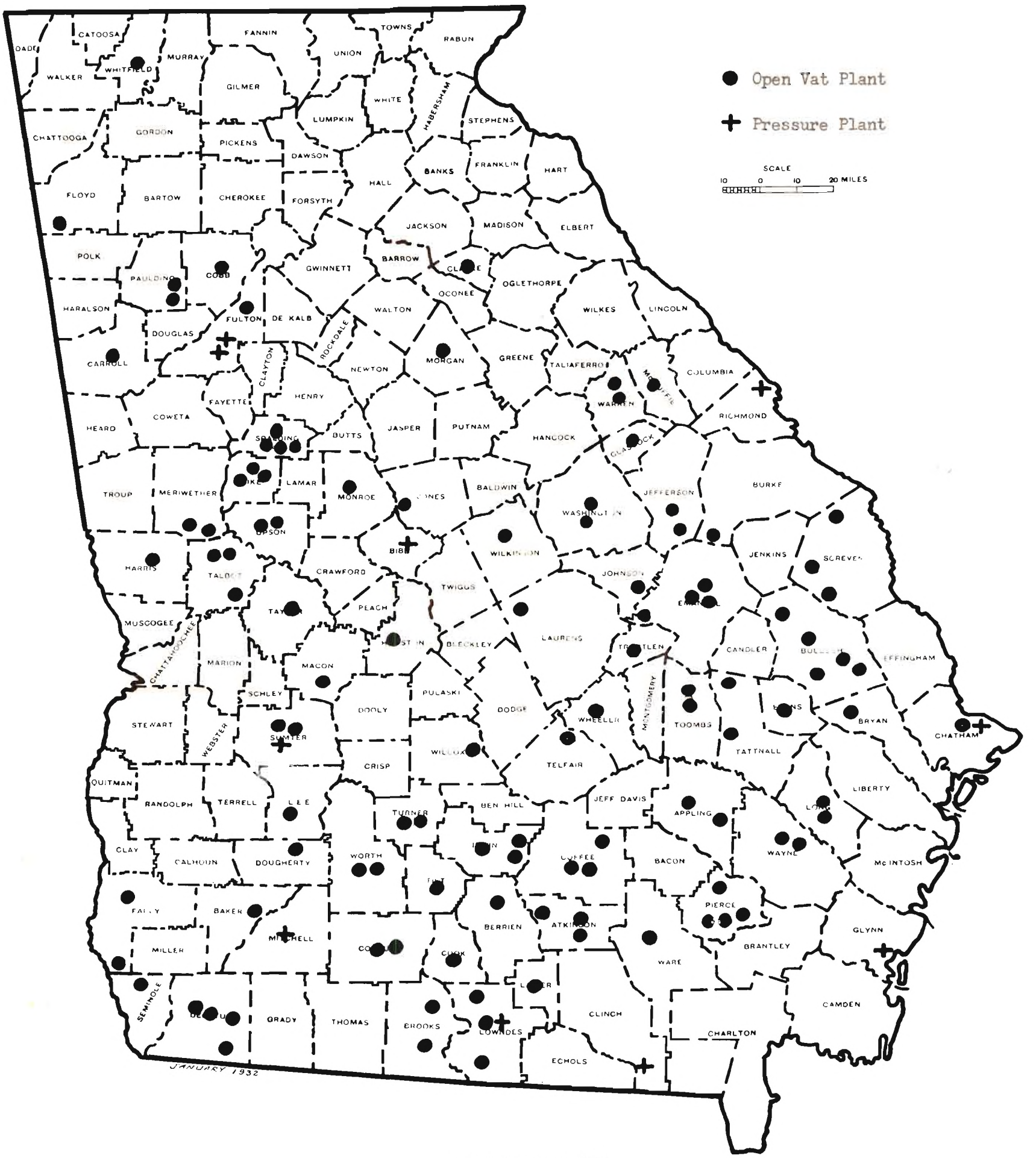

FIGURE 2: Open Vat and Pressure Plants in Georgia, 1950.