WOOD IN THE NATIONAL ECONOMY

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It is indeed an honor to address the American Philosophical Society, which throughout our Nation's history has contributed so much serious thought to the problems and objectives of our way of life. The Society's selection of forestry and public welfare for the topic of today's symposium is, to me, a particularly significant demonstration of the awakening interest to the basic importance of forestry in a successful long-time solution of our economic problems.

Since colonial times, America's forests have contributed richly to our economic growth. During the years immediately preceding the present war, the gross market value of forest products in the United States was about 3-1/2 billion dollars annually. Nearly 6 million of our people were directly supported by workers normally employed in lumber, pulp and paper, and other forest industries. Residential and other construction employed hundreds of thousands of men, and our normal annual lumber requirement for construction and factory purposes has been estimated at about 30 billion board feet. Additional enormous quantities of timber are used in unsawed form and as wood burned for fuel.

During this modern war, as in all past wars, wood has proved indispensable. The normal peacetime production of wood products has been radically curtailed in spite of the staggering total of 37 billion board feet of lumber consumption in 1943. Wood has quartered, transported, and gone into munitions for our troops throughout the world. We are all aware of the vast quantities of lumber going into the construction of military buildings. However, it is likely that few comprehend fully the list of wood items demanded by war's insatiable appetite -- wood for hangars, scaffolding, boats, wharves, bridges, pontoons, railway ties, telephone poles, mine props, antitank barriers, shoring, shipping containers, and air-raid shelters; plywood for airplanes, blackout shutters, prefabricated housing, concrete forms, ship patterns, assault boats, ship interiors, truck bodies, and army lockers; fuel for gasogenes, for trucks and tractors; pulp and paper for surgical dressings, boxes, cartridge wrappers, building papers, pasteboards, military maps, laminated plastics, gasmask filters, printing, and propaganda distribution; synthetic wood fibers, such as in rayon, artificial wool and cotton, for clothing, parachutes, and other textiles; wood cellulose for explosives; wood charcoal for gas masks and steel production; rosin for shrapnel and

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1 Presented before the American Philosophical Society, Philadelphia, Pa., Nov. 17 and 18, 1944.

2 Maintained at Madison, Wis., in cooperation with the University of Wisconsin.

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varnishes; turpentine for flame throwers, paint, and varnishes; cellulose acetate for photographic film, shatterproof glass, airplane dopes, lacquer, cement, and molded articles; wood flour for dynamite; wood bark for insulation, tannin, and dyestuffs; and sugar from wood for cattle feed and alcohol for explosives and rubber.

The amount of lumber used for containers for war material this year is more than 16 billion board feet, or approximately one-half of the total volume of our lumber production.

Long suffering in past years from the encroachment of competitive materials, wood has become the wartime champion substitute of all time. National security demands that it always be available.

This unprecedented demand upon the forests for war purposes has caused the supplies available for civilian use to be cut to the bone, and a backlog of post-war civilian construction and repair needs has been piling up. In an effort to supply the essential demands, the normal inventory of lumber stocks has been steadily depleted and will require renewal. Added to these domestic requirements will be the demand for forest products that will be imposed by the huge reconstruction job in the war-torn countries.

During the years immediately ahead, there seems little likelihood that the national and international demands for forest products will be materially reduced, but that does not mean that our basic forest supply should be overcut so much as to jeopardize supplying our permanent and long-term needs. Following the temporary period of world readjustment to normalcy, wood as a material of industry and commerce will, of course, again be in competition with other materials, but in spite of this, will undoubtedly permanently be required in large quantities and will continue to contribute importantly to the national economy. In order to have our vast areas of forest land and timber stands so managed and developed as to contribute the maximum to the national economy will require much planning and many changes in current practices. Prewar techniques and economies broadly utilized in useful commodities only about one-third of the total volume of timber harvested. Also vast stands of lower quality species which ought to be harvested were entirely neglected. If all such material could be put to economic use, the normal forest contributions to support of labor, employment of capital, and satisfaction of human needs could be enormously increased.

To guide the future to attain these benefits a number of significant factors must be recognized:

First and foremost is that about 80 percent of all the labor employed through forests is from the harvesting, manufacture, conversion, transportation, and distribution of forest products, which activities maintain the great capital investments and communities dependent upon them. We must have large wood industries.

The second is that our utilization practices up to the present have been largely opportunistic, unbalanced, and poorly integrated.
The third is that past and present cutting methods are changing radically the diameter composition of the future stand. In the future, small-sized trees will predominate. A few decades will largely see the end of the big timber.

The fourth is that the available forest resources can be made to sustain an annual growth which at least in volume can exceed the predepression cut. It would seem to be entirely possible to provide a permanent and adequate supply of forest material for the maintenance of large forest industries, even though this supply must be different in size and quality from what has been available in the past, for the forest, unlike mineral resources, is potentially inexhaustible.

The fifth factor will be continuing competition in the wood products markets. Of course, as population grows and a more widely distributed prosperity is achieved, we may look forward to a more bountiful use of wood products, along with other commodities. But, on the other hand, as competing materials and products are improved and developed by research, wood products will lose their markets unless they too continue to be improved and developed by research.

Basically, it is final cost and serviceability to the ultimate user that will determine the success of industry in the face of all kinds of competition; and while serviceability, or quality, is largely subject to technical control and development, low cost hinges in a critical degree on CHEAP AND ABUNDANT RAW MATERIALS AND PERMANENCY AND STABILITY OF OPERATIONS.

The sixth factor, which arises directly from the preceding one, is the trend toward greater public ownership of forest lands and greater public aid to private owners. Regardless of our individual views and of shifts in political currents, the impact of economic and social factors seems headed, through one process or another, in that direction. Such developments will have the advantages of easing the land situation, of reducing migration and adding stability to the utilization industries, and of insuring them a larger continuing wood supply.

The trend to shorter hours and higher wages for labor presents a seventh factor which we can hardly expect to diminish in the future. A man-day of work promises to become more expensive as time goes on; the question the wood industries must face is whether the labor cost per unit of product is going to increase also. The answer depends on two things -- what the product is, and how the product is made. Some years ago, on the West Coast the lumber cost dollar lacked 25 cents of being big enough to go around, while at the same time the labor share of that dollar was just over 50 cents.

If the trend toward greater man-per-hour production is a fundamental element in higher wages and higher standards of living, what does that mean for the future of logging and lumbering? Out-put per man in the lumber industry was not materially higher just before the depression than it was in 1899, whereas there was a gain of 24 percent in the iron and steel industries, 53 percent in stone, clay, and glass, 62 percent in paper and printing, 120 percent in non-ferrous metals, and over 1,000 percent in motor vehicles; labor absorbs a larger proportion of the total production costs of lumber than it does for other basic materials that compete with lumber in the construction field. All this points
to the need for greater mechanization in the wood-utilization industries, from tree to finished product; also, along with efforts to improve lumber production methods, there is need for a conscious development of other products, in which improved mechanization and technical methods may count even more heavily and more effectively.

An eighth and closely allied factor is the greater economic value arising from the production of refined rather than simple or crude products. Number of employees and wages paid are a better guide to the importance of an industry than the mere bulk of material used; and while the normal lumber industry still ranks first among the wood-using industries in number of wage earners, that does not tell the whole story. For example, a given quantity of wood, if converted into paper, will provide employment for nearly three times as many wage earners as when converted into rough lumber; and if converted into rayon there will be nearly sixty times as much employment.

Other factors are that our large timber supplies are becoming increasingly distant from the great centers of consumption, and that future forest industries will give increasing attention to productive capacity of lands in relation to markets and transportation; ten trees on Pike's Peak may be worth less than one tree on the outskirts of Philadelphia on good soil.

Progressive evolution towards the foregoing objectives will require the adoption of proper controls, adequate fire protection, and taxation policies to stimulate long term stabilized and integrated forest industries. Basic to all is research - diversified and adequate to the issues at stake. It must be directed at steadily improving the usefulness of normal forest products to which we have become accustomed, and of developing new products that will serve the consumer; it must give particular attention to use developments for the species available but heretofore not used and to the staggering quantity of waste material incident to logging and lumbering operations.

Fortunately, because of its variability and versatility in composition and properties, wood offers great opportunities for new developments through research. Today we are only on the scientific frontier of wood utilization.

There is an extensive body of technical information about forest products available, contributed by the forester, the engineer, the chemist, the technologist, the physicist, and the economist, upon which to base the programs of the future. We already know much about the properties of wood, its chemical makeup, and means whereby it can be improved. The manifold uses to which forest products can be put have been demonstrated by the present war.

Wood is an extremely adaptable and versatile material. It can be converted into many useful things. As in the past, however, the bulk of our future timber crop will undoubtedly go into use in the "raw" state, as lumber, for construction of all kinds.

The lumber industry as a whole is still operating under handicaps imposed by traditional methods of using its products. While engineering developments have greatly increased the ease of handling logs and brought about other refinements in the manufacture of lumber, there is still need for improvements through
research and development in reducing the cost, enhancing the quality, and eliminating wastes in the manufacture of trees into boards.

Along with efforts to improve lumber production methods, there is need for a conscious development of improved mechanization and technical methods to improve its serviceability. For example, the use of modern timber connectors by the construction industry has helped to keep wood in use in large engineering structures. These connectors, which are iron, steel, or wood rings, plates, or dowels, are inserted between timbers and surround the bolts to bring greater areas of wood into bearing and consequently increase greatly the over-all strength of the entire timber structure. Thus wood radio towers, which were formerly restricted to a height of about 100 feet because of the limitations of joint strength, can now be connector jointed and erected to a height of 300 to 400 feet. In the short period between 1933 and 1943 there were built more than 100,000 structures in which modern connectors were used, employing about 5 billion board feet of lumber valued at $165,000,000. Connector-built wood structures have been estimated to have saved 400,000 tons of critical steel in 1942.

Similar improvements in other types of fastenings could not fail to make wood serve more satisfactorily.

War has tremendously accelerated the process of making wood available in improved forms. Some of the new wood derivatives and modified-wood products are so altered as not to be recognized as wood; others look like wood but magnify wood’s major virtues and add to its versatility. Notable among the improvements is the reduction of swelling and shrinking characteristics of normal wood that have limited its serviceability.

Moisture-resistant plywood is especially outstanding in new developments. Ordinary plywood, a product that dates back hundreds of years, made wood available in large sheets having properties more nearly uniform in all directions than normal wood; but only within recent years have weather-resistant glues been developed that make this material of major importance for outdoor uses, especially for housing, industrial and farm structures, and even for boats. Mass production of housing — conventional, prefabricated, and demountable — achieved significant headway only with the development of water-resistant phenolic-resin glues for structural plywood.

A recent development in timber structures, directly traceable to the development of improved glues and gluing techniques, is laminated wood. Such members are made in straight or curved form by bonding seasoned and properly surfaced boards with a water-resistant glue. A principal application is in the construction of roof arches, which have greater strength and efficiency and better appearance than were previously possible. Seagoing counterparts of the glued wood arch are the glued, laminated ship keels and frames now going into hundreds of small naval craft to take the place of solid white oak timbers of large cross section, which are increasingly difficult to obtain.

The properties of laminated members are essentially the same as those of solid wood, but of particular significance to the timber grower is the fact
that laminated members permit the use of up to 60 percent of low-grade and short length material in the interior laminations.

A familiar example of making wood serve more satisfactorily is the preservative treatment of railway ties and telephone poles. It is interesting to note that a paper entitled "To Preserve Wood from Decay" was read by Dr. G. Emerson before the American Philosophical Society in 1869. Today, 3,000 treated railway ties are used for each mile of main-line track throughout the country, and have an average life of 25 to 30 years whereas untreated ties average only 6 years.

Recent estimates place the total quantity of wood used as fuel in country, town, and city at the huge figure of more than 61 million cords per year, representing the largest single form of consumption of tree volume in the United States, with the possible exception of lumbering.

As fuel, wood supplies a diversity of needs, such as house heating, the firing of sawmill boilers, cooking, some commercial baking, and the curing of tobacco and meat products. In some of its uses it may never be displaced, but in others large displacements have occurred and are still in progress. The development of more efficient wood-burning equipment for cooking, heating, and industrial service promises to give wood and wood waste a stronger economic hold as fuel where an adequate supply is available.

While the chemical products from wood bulk small in the over-all picture, it would be a mistake to dismiss them as of little consequence. Their importance as forest products is much greater than the volume of raw material consumed to produce them would appear to indicate.

Expanded chemical utilization offers a major opportunity for successful new industries and of gaining more complete utilization of the forest crop, because it does not require high quality wood and can use largely what is left from other operations, thereby reducing the enormous wastes that exist today. To make more economic use of wood by such utilization requires, of course, a degree of integration in the wood-using industries that, for practical purposes, is today almost nonexistent. Much research is also needed to evolve production processes and new products that can meet a competitive place in our markets. But enough is known about the potentialities of chemical utilization to warrant the belief that its products will have an increasingly important part in the forest industry of the Nation.

The most valuable chemical constituent of wood today is cellulose, from which are made, besides paper, such modern products as rayon, cellophane, films, lacquers, and explosives. Cellulose comprises about 50 percent of all wood; the remainder includes hemicellulose, lignin, and extractives. Wood yields a variety of chemical products, such as methyl and ethyl alcohol, acetic acid, tannin extracts, naval stores, essential oils, charcoal, wood preservatives, furfural, and oxalic acid.

From the chemist's standpoint, lignin, which constitutes about one-fourth of wood substance, remains the enigma of wood. However, its chemical mysteries are slowly being penetrated, and a variety of alcohols, oils, and an alkali-soluble resin have been recovered in recent laboratory experiments. Possibilities
for its future extensive utilization are not only bright but of great importance. For example, great improvements have been made in a process of the low-cost production of ethyl alcohol from wood. The process is to be applied to the production of alcohol for munitions and synthetic rubber in a plant under construction in Oregon, to operate on saw-mill waste. Since one-fourth of the wood used remains as lignin, development of methods to profitably utilize this by-product is of great importance to the post-war success of such alcohol production.

Paper is by far the greatest single chemical product of wood, and indications are that it will continue to be. There has been a consistent and striking increase in paper consumption aggregating 300 percent in the past generation, and the forces that generated this growth appear destined to remain fully operative for a long time to come as the population grows increasingly literate, disposable paper service goods gain in popularity, manufacturers broaden their use of packaged merchandise, and various other industrial uses new and old are stimulated. The Forest Service some years ago estimated our probable future pulpwood requirements at 25,000,000 cords as compared with a normal prewar consumption of 12 to 15 million cords.

The anticipated increase, in terms of employment, represents some 70,000 jobs in the comparatively well-paid pulp industry. Against this, however, must be weighed the facts that, in prewar years, more than one-half of our wood for paper was imported as pulpwood, pulp, or paper; that an important segment of the industry is located in areas that no longer sustain it with locally grown pulpwood; and that it still leans preponderantly on a relatively few species. However, extensive capital investment in new mills can be looked for, on the West Coast including Alaska and no doubt also in the South, where technological developments have already created a thriving paper industry utilizing Southern yellow pine. In the established paper producing areas, however, pulp mills will be compelled to utilize an increasing diversity of tree species hitherto rejected or overlooked, and to develop processes for higher pulp yields from the wood. Fortunately, research has already shown striking future possibilities in these fields.

Any review of the utilization prospects of our forests would be incomplete without at least a mention of what is being done abroad. We know, for example, that Germany has exploited her forests and those of her neighbor nations to feed her war machine. She has used wood for clothing, for cattle feed, to furnish motive power, and for many other purposes. While in our own national economy, rich as it is in wool, cotton, textiles, agricultural products, and petroleum resources, these phases of wood utilization may seem at present of relatively small significance, we cannot afford to ignore the potentialities of any promising development either at home or abroad in terms of our own future forest industries.

In conclusion, let me re-emphasize the following:

Research must blaze the trail for better construction, fabrication, and unit construction; better treating, coating, and gluing processes; better conversion and harvesting methods and facilities; keener selection and grading; the
improvement of pulping processes and machine operations in paper manufacture; the development of plastics and other new and special chemical products; and more fundamental knowledge of the composition, properties, and minute characteristics of wood substance.

We must continue to use wood on a large scale. Just as our future supplies of wood depend upon intelligent revival of our forests through the principles of sustained yield management, the very core of the forest conservation movement lies in maintaining and expanding industries using wood to produce products to satisfy human needs and wants.

We must have a more successful integration of the forest products industries. The sawmill, the veneer mill, the fabricating works, the pulping plant, and the chemical factory should complement one another as far as possible in every major forest area in order to realize maximum values from timber of the species, size, quality, and cost that will be available.

We must have stabilized rather than migratory industry, which leaves in its wake receding land values, declining timber production, falling employment and earning power, and shrinking tax revenues in the exploited areas.

By meeting modern demands efficiently, forest industry and forest ownership can look forward to a continued place of major service in the Nation's economic life.