TITLe:
BARK, THE "COTTONSEED" OF THE LUMBER INDUSTRY.

FOREWORD:

This paper is written with the intention of revealing some of the many ways in which the bark of many of our commercially important trees may be utilized as a means to achieve greater financial success in wood-using industries.
--R.H.R.
During the last hundred years, the world has seen a phenomenal change in a large number of industries. We have observed the development of the clothing industry from a state of individual manufacture in the home into the concentration of a nation's clothing manufacture in a relatively few great clothing mills. Almost before our eyes the meat packing industry has changed from a weekly slaughter by the local butcher, where only the better cuts of meat were saleable, to concentration in a small number of gigantic packing plants where everything is used but the squeal of the pig, and it is suspected by audiences of soprano opera star recordings that even this minor waste is no longer tolerated! We have seen the cotton industry abandon the wasteful discarding of cottonseed when they learned the financial possibilities of selling the valuable oil, fertilizer, and cattle feed which could be made from this, formerly useless, material.

But one industry has not advanced along with so many of its sister industries, namely, the lumber industry. Even in the present times of dubious prosperity we find the lumber mills sending thousands of cords of valuable wood and bark fibers to the burner in the form of slab and edgings, a total loss to their suffering owners. Thus, the lumber industry is struggling along in a misery of obsolescence, despite the fact that what little research has been conducted with the bark, alone, has disclosed almost limitless possibilities of lucrative usage. In the following pages some of the most interesting and significant uses of bark are discussed.
Medicine Manufacture:

One fairly important field of bark usage, about which one hears very little is that of medicine manufacture. In making medicine from bark, many of the volatile oils and oleoresins are extracted and mixed with various chemical compounds with a vast number of scientifically approved medicines resulting. In many cases, bark from which medicine is made comes from trees with commercial value for no other purpose, though there are many trees, such as black cherry, slippery elm, chestnut, and American ash, which supply valuable lumber in addition to bark of high medical value.

The chief reason we hear little of bark usage for medicinal purposes is that we are so far removed from the large eastern medicine laboratories and factories. At the present time there are open buying markets for medicinal bark in most of the large eastern cities of the United States with periodic or fluctuating prices quoted by the large medicine firms for the various species of desired barks. The collecting of bark to furnish this demand is still on a small scale, with ample supply from the easily accessible eastern forests, but with the development of more uses for bark and for more different species, it is no remote possibility that quite a substantial field for bark usage may be developed by medical science.

Ernst T. Stuhr in the Oregon State College Department of Pharmacology has done considerable investigation of bark and plant usage in medicine manufacture, and it is from one of his writings I obtained the information for the following:
MEDICINAL USES OF TREE BARK

The bark of the following trees is now used in the commercial preparation of medicine in the United States:

1. Abies balsamea—Expectorant, stimulant, antiseptic, astringent.
3. Alnus glutinosa—Febrifuge and astringent
4. Alnus rugosa—Emetic, alterative, astringent, bitter, tonic
5. Acer rubrum—Eyewash, poultice.
6. Anona glabra—Drastic cathartic
7. Aralia spinosa—Acrid, antiarthritic, alterative
9. Canella winterana—Tonic, stimulant, condiment, antiscorbutic
10. Castanea pumila—Tonic, astringent
11. Catalpa bignonioides—Anthelmentic, alterative
12. Colubrina reclinata—Hop substitute
13. Exostema caribaeum—Bitter, febrifuge, emetic
14. Fagus americana—Poultice, headache remedy, insecticide
15. Fraxinus americana—Febrifuge, diuretic, astringent
16. Larix laricina—Balsamic, antiseptic, astringent, diuretic
17. Liriodendron tulipifera—Febrifuge, stimulant, diaphoretic, dyspeptic relief
18. Magnolia acuminata—Febrifuge
19. Pinus strobus—Expectorant, antiseptic, astringent
20. Prunus serotina—Pectoral sedative, tonic, astringent, cough syrup, flavoring
21. Quercus alba—Astringent, tonic, haemostatic
MEDICINAL USES OF TREE BARK (Continued)

22. Quercus velutina--Astringent, dye, eye poultice
23. Quercus virginiana--Astringent
24. Rhizophora mangle--Febrifuge, astringent
25. Rhamnus caroliniana--Laxative
26. Rhamnus purshiana--Tonic, laxative, bitter, sedative
27. Salix alba--Bitter, tonic
28. Salix nigra--Bitter, tonic, anaphrodisiac
29. Sassafras variifolium--Stimulant, aromatic, diaphoretic, rheumatic, flavoring agent
30. Swietenia mahogani--Bitter, astringent, febrifuge
31. Tsuga canadensis--Antiseptic
32. Tsuga mertensiana--Astringent
33. Ulmus fulva--Demulcent, emollient, nutrient, poultice, infusion, cough remedy, diarrhoeic

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Everyone is familiar with the use of several of the Oriental and tropical barks in the manufacture of medicine, flavoring extracts, and condiments, such as licorice, cinnamon, and quinine, but it does seem rather surprising that bark is actually usable for human food. In the twenty-first annual report of the U.S. Geological Survey, J.B. Liebig reported an encounter with pine bark-eating Indians in the southern part of Oregon. He stated that the Indians cooked the cork cambium layer in the Spring and considered it a delicacy, especially the inner bark of Pinus ponderosa. In several early histories of the western United States, the waste caused by Indians stripping bark for food is mentioned, and many of the tribes still make a practice of stripping Western red cedar bark, using the outer part for mats, beds, blankets, and ropes, and, by pounding the inner part into a pulp, mixing with whale oil, fish oil, or bear grease, shaping into loaves or pies, and baking the mixture to form a food, which they consider quite a delicacy.

The bark of sweet birch is actually pleasing to the taste after Spring growth, though, like other bark, very low in food value for human consumption. The bark of elm has food value for live stock, however, and it is recorded that for a considerable period during the War of 1812, a troop of cavalry kept its horses alive on elm bark.

Other novel uses, such as basket withes, carpet lining, bottle wrappers, and deadening felt have been devised for bark, but are of very minor importance.
Insulation:

Among the fields of commercially important bark usage, insulation is of greatest financial significance at the present time. One of the most remarkable achievements in the development of sawmill waste utilization is an insulation board which goes under the trade name of Fir-Tex. This is a board made from Douglas Fir slabs, consisting largely of bark, as mainly thinner slabs are used.

In the process of producing Fir-Tex, the slabs are put into a huge digester where acids separate the fibers and the whole resolves into a great pulpy mass. This is cleaned, treated, and put through rollers which compress the fibers into firm boards of set thickness. These are dried and then machined to suitability for one of a multitude of uses for which Fir-Tex is superior to most other materials.

The entire process of manufacture is not divulged, but the high efficiency of insulation, sound absorption, and strength, in addition to lightness and ease of handling and shipping is attributed to the crossing and interlocking of the wood and bark fibers, with resultant myriads of tiny dead air spaces. The efficiency of the product makes it possible to use relatively slight thicknesses, thus reducing freight charges, difficulty of handling, and f.o.b. price of the insulation board itself, as the company can naturally sell a thin piece for less than it can sell a piece requiring two or three times as much material to make.

In startling contrast with prevalent lumber manufacturing
and selling methods, the Fir-Tex plant contains an efficient research department which is constantly analyzing the product and its suitability for every conceivable purpose. The firm has employed reliable engineering companies to compute exact figures from careful tests of every important property of the insulating board, and it has these on hand to be placed in the hands of every prospective user of this or a similar product.

Some of the properties verified by test of Fir-Tex samples are:

1. Tensile strength—200 lbs. per square inch, \( \frac{1}{8} \) inch thick.

2. Absence of impurities—Due to methods of manufacture, the fibers have been made almost entirely free from fungus and bacterial infection. Tests in malt agar cultures and in other mediums favorable to spore growth have proved the fibers practically free from spores.

3. High porosity—the capacity for air and sound absorption, tested by water immersion, proved to be 15% greater than cork. This property makes its sound conduction proportionately less. Heat penetration tests showed it to be superior to cork for heat insulation, especially at extremely high or low temperatures.

4. Vapor absorption—tests resulted in a disclosure that the surfaces of the fibers gave Fir-Tex a high resistance to water absorption in a saturated atmosphere, averaging only 4\% by weight.

5. Odor emission—At commercially practical temperatures
it was found that it would impart no taint to eggs or dairy products, and that products having offensive odors could be stored in Fir-Tex containers without affecting dairy products stored in them after an interval of 24 hours.

6. Heat conductance—these tests gave a result of 0.31 B.T.U. conducted per hour per square inch per inch of thickness per degree F.

Most of the tests of Fir-Tex samples have been conducted by R.W. Hunt & Co., a reliable Chicago engineering firm, and they are accepted by competitors as authentic.

With facts to support them, the Fir-Tex people advocate their product for the following uses, with the given reasons for their suitability for these purposes:

1. Heat insulation—for use as sheathing, subroofing, sub-flooring, refrigerator walls, and for lining refrigerated or high-temperatured rooms, railroad cars, and vessels, or elsewhere when a constant temperature is desired.

2. Insuring tight construction—to eliminate drafts, reduce external sound, and to facilitate saving of fuel and medical bills which may result from loose construction.

3. Construction material—for use outside of studding, as plaster base either in sheet or in lath form, as partition for basement and attic rooms, and as finish, for when glue sizing is applied, Fir-Tex has a smooth surface, for painting and varnishing.

4. Fire stoppage—this material only chars and will not carry flame, so is recommended for sheathing and other general building purposes to prevent spreading of fire.
5. Sound insulation—Being 15% more porous than cork, Fir-Tex is proportionately more impervious to sound conduction, so it is recommended for home and hospital construction. This porosity enables it to absorb more sound than almost any other solid material, and so renders it extremely suitable for lining factories and radio studios, to reduce mechanical clatter and reverberation in the first case and to reduce instrumental and vocal echo in the other case.

6. Box construction—strength, hygienic properties, and imperviousness to odors recommend it for use in boxes, particularly for shipping eggs and dairy products. Its easy workability is an asset in this field, also.

One of the biggest factors in the favor of the Fir-Tex people is the cheerful cooperation with which their advertising agency dispenses information, and this should be the path followed by every lumber merchandiser and seller of by-products.

In the field of insulation, Douglas fir is rivalled by Redwood bark (from Sequoia sempervirens), the only other bark of major use for this purpose. The following information, taken from an article in the October "Timberman" of 1929 indicates the financial possibilities of using shredded redwood bark.

In 1924 the Eureka Fibre Co. was organized by C.H. Brown and his two sons for the purpose of utilizing the bark of the redwood commercially. Shredded redwood bark is a loose, fibrous material, made by partially disintegrating the raw, natural bark. Untreated in any way, it is shipped in wire-bound bales of approximately 220 pounds per bale of 17 cubic feet.
capacity, and is ready upon unbaling to form a protective coating once more. The Eureka Fibre Co. is equipped to ship 250 tons of bark per month.

As an insulation material it is used in the same manner as granulated cork, sawdust, shavings, and other loosely-applied insulation materials, and its value lies not only in its natural resistance to heat conductance, but also in its many natural merits as an insulator which tend towards perfection in insulation material, both in efficiency, and in economy. A test conducted at the Gebhardt Laboratories in Chicago shows shredded redwood bark to have a very high insulation rating, especially when compared on a basis of weight per cubic foot of material.

Further tests which have been carried out on the scene of usage, rather than in the laboratory, in order to get actual working understanding of the product have produced results not found in any other insulation material. It is a general rule that any loose form of insulation will attract moisture and that if water is allowed to come in contact with any part of the insulation, the capillary action progresses until the entire wall has been moistened and lowered in efficiency and durability. The tests of this nature have shown that by submerging a section of wall filled with shredded redwood bark for a period of three weeks, the fibres above the water line retain their original lack of moisture. It has also been demonstrated that this material will give up moisture after submersion readily, showing very low affinity for water.
The reason for the natural moisture resistance of redwood bark is the natural result of the conditions under which the tree grows. It is the function of the bark to prohibit evaporation as much as possible so that moisture stored in the tree from the roots during the rainy winter months in northern California may be retained throughout the long drought of the summer. Besides being water resistant, redwood bark, even in the shredded form, is highly fire resistant and will not smolder or carry fire. It has no odor whatever, and its high tannin content renders it absolutely vermin proof. The bark has not been known to become musty.

One of the most significant tests of redwood bark was the instance when the Union Ice Company's plant at San Jose, California, caught on fire. The fire was actually prevented from penetrating the walls of one area by the redwood bark, and the resistance to heat transfer and deterioration from moisture showed that the insulated wall was reliable for perfect ice house service many times longer than any equally efficient wall of a comparable cost of construction.

The shredded bark is easily placed in service, as one man can place from 150 to 200 pounds per hour in a wall. No tamping is required, other than to insure absence of vacant pockets in the wall.

It is obvious that insulation is a great field for the use of redwood bark, as well as Douglas fir, and it is very probable that in the years of future building construction, some such insulation will be a staple necessity.
Tannin:

Another great use of bark at the present time is as a principal source of the world's tannin supply. It is significant that, although at the present time leather manufacturers cannot find a substitute for vegetable tannin in the production of many grades of leather, 90% of the vegetable tannin used in the United States is imported. It is astounding that a nation with such vast supplies of the most suitable species of trees, producing bark of high tannin content, should neglect the tannin extracting industry to such an extent that foreign nations can pay ocean freight, labor costs of producing, import duty, loading and unloading, and still undersell the American product. There are several movements under way, however, to improve methods of tannin extraction, especially on the West coast, where the abundance of such species as Hemlock, Douglas fir, Tanbark oak, and Redwood are of sufficient abundance to insure a source of tannin supply for a century.

The chief requirements to be met are to secure the bark as cheaply as possible and to prepare it for tannin extraction with little cost of labor and machinery, and then to remove the tannin from the bark in an efficient manner without having high freight charges added in intervening processes. With these aims in view, one very efficient method has been devised and will probably become of wide-spread use in the future.

This method advocates the following: The bark is secured at the mill where the logs are being used for the wood only.
The logs are first brought on to an auxiliary log deck, where a series of hollow spuds remove the bark with highly-compressed air as the log is revolved around them. The log is then sent to the mill deck and the bark is dropped into a chute carrying it to a kiln or series of kilns adjacent to the mill on the side nearest the auxiliary log deck. From the chute, the bark goes to a series of conveyor chains running alternately lengthwise in the kiln, as diagrammed on page 12. A very high kiln temperature, usually over 200° Fahrenheit, is recommended, as well as close spacing of the conveyor chains and a high rate of air circulation.

It has been the custom in the past to air-dry bark for a long period before tannin extraction. Recent investigation has disclosed that the yield in Western hemlock, and probably in all other barks, is increased by drying at high temperatures immediately after peeling. This increase is due to the small amount of deterioration of tannin due to high temperature as compared to the extensive loss of tannin through souring in the process of air drying. By experiment an actual increase of 14% of tannin by weight has resulted from rapid drying. The quality of the resulting tannin is believed to be as good.

This method of drying Western hemlock bark has been encouraged by the Bureau of Chemistry and Soils in connection with the U.S. Department of Agriculture.

The chief merit of this system, as can be seen in the diagram, is the simplicity, low labor cost, and ease of determining resultant moisture content by regulating the speed
of the conveyor chains. By using a very low speed, the size of the kiln and the number of conveyors used can be materially reduced. It is possible that the final cost of the tannin might be reduced by baling the bark immediately after drying and save more by reduction of freight than the amount of added labor cost through requisite hand loading of baled bark. There might be a greater expense by this method incurred at the tannin extraction plant through enforced
mechanical separation of the bark following tight baling, however. It is very probable, though, that the adoption of efficient collecting, drying, and shipping of the bark is the key to the vital reduction of tannin cost so flagrantly needed at the present time.

Here is another instance of research with the aim of improving the production of American tannin, as quoted from an article in the Paper Trade Journal of March 31, 1932:

"Arrangements have been made with several timber owners in the state of Washington to furnish 20-ton lots of properly dried hemlock bark, which will be used in making yield tests on a commercial scale at an extract plant in northern California. Both liquid and solid hemlock bark extracts will be produced in large lots and shipped via the Panama Canal to the East where the liquid extract will be further tested and processed by several available commercial methods for producing dry powdered extracts."

In the above-mentioned project, actual tanning with subsequent scientific analysis of the resultant grade of leather and suitability of various types of tannin for each grade of leather will be conducted for a sufficient length of time to make the results of reliable commercial significance. It is the purpose of the plant conducting the experiment to publish all its results as soon as it obtains reliable information from its work. In place of our present condition of importing most of our tannin, many investigators believe that in the near future we will be in a position to export
more tannin than we find it necessary to import, and that in a relatively short time, we will eliminate importing of tannin.

**Fuel:**

Though the suitability of bark for fuel purposes has been recognized in industrial fields for nearly a century, the general public is just beginning to realize its value for domestic usage. In fact, it has been popular preference in the past to purchase fuel wood without bark, if possible, though people are fast learning the folly of such practice. The following is a quotation from the U.S. Department of Agriculture bulletin concerning the use of Wood for Fuel:

"In a number of species the bark has a higher heating value than other parts of the tree. In the Northwest, Douglas fir bark is often a principal source of fuel in firing donkey engines. The bark of shagbark hickory has a high fuel value and burns with intense heat, but with much crackling. In the case of many woods, such as the cedars, the bark has a comparatively low fuel value and leaves a large proportion of ash."

Many of the large eastern hemlock mills have derived their power for many years almost entirely from the bark of their hemlock logs. This is usually peeled off by hand on the log deck or removed by a cone "rosser", and then is hogged and sent to the press. This powerful hydraulic press removes approximately 40% of the water and leaves the bark suitable and fairly efficient for fuel and is sent to the boilers.

The acceptance of bark by the fuel-using public has been
convincingly demonstrated recently in this region by the fact that fuel dealers have had no trouble in disposing of their entire stocks of Douglas fir bark at $4.50 per cord, even in these subnormal times. For many decades it has been common practice for small sawmills to obtain the intense heat of their blacksmith shop forges by burning dry bark.

The practice of pressing and baling bark for fuel gives every indication of becoming an important industry, as the process is being improved, and the baled bark represents much more condensed fuel value than wood. The heating value of bark averages about 1000 B.T.U. per pound higher than that of dry wood, and following high-pressure baling, the bark is of greater density and consequently requires much less space per unit of heating value than that required by wood. Thus it becomes more economical to ship bark than to ship wood in its ordinary form for fuel purposes.

**Special Uses:**

In addition to insulation, medicine, tannin, and fuel, bark is also found suitable for several specialized uses. One of the most strikingly apparent wastes encountered is the practice of dumping as rubbish the hemlock bark remaining after tannin extraction, and from logs used in the manufacture of paper pulp, as the bark is generally rossed off in this latter industry and is to be found almost free from other materials.

Along the line of securing fuller utilization of materials that are being wasted or used inefficiently, perfection of the use of hemlock bark is decidedly in demand. At the present
time, besides the utter waste of the bark, much of it is used for fuel while containing 65% of its weight in the form of water, and this furnishes a weak competitor for bituminous coal which sells for several times the price of bark. Thus, the price of bark is forced to remain so low that the costs of drying, shipping, and storing tend to practically eliminate profit.

Mr. Kress of the U.S. Forest Products Laboratories at Madison, Wisconsin, has worked out some very successful solutions of the problem of hemlock bark utilization. His experiments have concerned the reduction of the bark to pulp with the intent of making paper specialties. In his early experiments he tried chemical reduction of the bark, but this method, while possible, required a prohibitive expenditure for an adequate supply of chemicals. He finally adopted as most successful the simple mechanical reduction in a beater, with subsequent Jordaning to secure fineness of texture and combination with filler.

In this process, the water-soluble coloring matter is leached out in the beater, leaving the reddish fibers. These are mixed with rag stock, requiring from 25-30% by weight, of rag fibers, then put through another beater, and, when run through a standard Fourdrinier paper machine, become a heavy, strong grade of reddish paper. This paper is very readily impregnated with asphalt and when treated with this substance, makes a good, heavy, serviceable roofing paper of high grade, ranking with the best felt base roofing.
The manufacture of roofing paper from hemlock bark is yet in its primary stages, but it promises to become a lucrative means of disposing of a material heretofore literally wasted, and as roofing paper retails at $6-$12 per hundred pounds, according to the distance shipped to market, it is no small opportunity for the enterprising mill man to materially increase his profits. This is all the more true, when one considers that the roofing paper is composed mainly of the cheap bark fibers, the rag filler and asphalt together amounting to less than 50% by weight of the finished product. Naturally, the profit to be expected depends upon the efficiency of the manufacturing, transporting, and retailing methods used, but it is clear that there is opportunity for substantial profit.

Besides being suitable for roofing paper, hemlock bark has been proved very suitable for wall paper. To make this product, the bark is reduced in the beater, Jordaned, and mixed in another beater with 20-30% of unbleached sulfite pulp. This wall paper is of a dark reddish color and compares very favorably in appearance and workability with the expensive oatmeal paper so extensively used. In fact, it can be printed more satisfactorily than the oatmeal paper, its chief handicap being the impossibility of producing light colors.

Manufacture of wall paper from hemlock bark can be very readily introduced to any hemlock-consuming paper mill, especially using the sulfite process. Similarly, the manufacture of roofing paper can be introduced into any paper mill, the ready access of asphalt being the principal deterrent.
There is little doubt that in the near future the progressive paper manufacturer will realize that, unless he avails himself of the potential market for these and other similar products made from the hemlock bark (and possibly the bark of other pulp conifers) which he has been wasting, his competitors who are using their bark will be selling their paper cheaper than he can afford to sell his, and yet realizing greater profits than he.

It is reasonable to suppose, also, that with the increase of bark utilization by paper mills, there will be built up a substantial market for bark that will be lucrative to the saw-mill man, as the ability to substitute hemlock bark fibers for expensive rag stock means a potential field of investment of millions of dollars in bark fibers.

**Potential Uses:**

From the nature of the bark of many of our commercially important Western trees, it is reasonable to suppose that some time in the future there will be developed a great number of new uses. Some of these will require either chemical or mechanical disintegration and processing of the bark, while many will undoubtedly use the bark in its natural state, the only change being in cutting the irregular strips of bark into pieces of uniform size for convenience in shipping and utilizing. As has been pointed out in the previous discussion, the functional requirements of bark on living trees are fundamentally those of relative imperviousness to moisture, to protect the trees from excessive transpiration, and it is
this property, secured through abundance of enclosed air spaces, that adapts bark in its natural state to efficient insulation for heat, also.

In the form of square or oblong sheets of uniform size and thickness, the bark of Western yellow pine and Douglas fir, as well as some of the thinner barks such as that of Western red cedar and hemlock, should be readily used to increase the efficiency and living comfort of all types of building construction in the form of sheathing, subflooring, and filler for double wall construction. These barks, as well as some of the thinner barks such as that of Western red cedar and hemlock, should be efficiently usable for sound insulation, applied to the walls of industrial rooms and radio studios, and for increasing the heat efficiency of many specialized products, as refrigerators, kilns, railroad cars, and other types of construction where loss of heat is expensive.

With the development of cheaper and more efficient bleaches and dyes, the importance of paper manufacture from bark will increase to a great extent, both in the form of wallpaper and in the form of wrapping paper of several grades. The increase in freight rates and price of wood pulp will accelerate this development of paper manufacture from bark fibers, and the high price of rag fibers will continue to encourage the substitution of bark fibers, especially in the manufacture of roofing paper. Besides the development to be expected in these fields, there is a likely prospect for development of great financial importance in the field of
medicine manufacture, as the basic healing properties of bark oleoresins are now recognized by medical science, and yet comparatively little research has been conducted in this line.

In short, there is an almost unlimited realm of possibility in the future development of bark usage, and every discovery of this type should tend to increase the value of bark, and, consequently, the value of stumpage and logs.

Some one has remarked that, when all uses of bark have been disclosed, the bark may, with all probability, prove to be of more value than the lumber in the log. Whether this be true or false, it is hourly being impressed on the lumberman that unless something is done soon to compensate for the inroads of substitutes on lumbering profits, the sheriff will be inscribing "Sold for Taxes" on the office door of his mill.

The present situation finds the lumberman faced with the necessity of shipping his lumber so far to the market that the freight cost is commonly greater than the f.o.b. mill price. At the same time, we notice that the substitutes are being made of cheap, untaxed materials, relatively near to the consuming area, and we realize that with the possibility of applying high-speed methods to nearly every phase of the substitute manufacture, there is little difficulty in their underselling the freight-handicapped lumber.

It becomes apparent that, unless freight costs are lowered to a considerable extent, an unreasonable hope with the railroads in their present condition, the progressive lumberman will have to resort to more complete utilization of his
logs and efficient utilization of all wood and bark products to remain solvent. The competition against this great industry will demand a fractional cent for every fiber of bark on the log, and the wasteful mill will find itself forced from the field!
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