Mechanical Utilization of Lumber Byproducts in the Pacific Northwest

by

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By His trials, God means to purify us, to take away all our self-confidence, and our trust in each other, and bring us into implicit, humble trust in Himself.—Horace Bushnell.

'Waste Is Waste'

Waste is too harsh a term. Applied to the lumber industry it has sparked a first-rate controversy between the private operators and the U. S. Forest service.

"Wood Waste in the United States," a forest service reappraisal report, contained some pretty frank statements. Replies from private loggers and sawmillers were irritated. From the West Coast Lumbermen's association the retort took, in essence, the following form:

If Midwest farmers aren't indicted because they don't use their cornstalks, why indict the lumber industry for its unused wood?

"Waste is waste," replies Dr. J. A. Hall, director of the Pacific Northwest forest and range experiment station, with headquarters in Portland.

Dr. Hall, in a statement, tells how coal tar was long a waste and a nuisance in coke manufacture, but became through research the basis of an enormous industry.

In California, the citrus industry increased its income millions of dollars a year with by-products from cull and previously wasted oranges and lemons. These by-products are citric acid, pectin, volatile oils, concentrated juices and specialties.

Director Hall then tells of time and money being spent on industrial utilization of corn cobs, pea vines, cull potatoes, cotton seed, low grade corn and wheat. He details:

"Zein, the protein waste from cornstarch manufacture and corn sugar processing, is the base for a new plastic industry and a shellac substitute. Corn steep liquor, an industrial nuisance and waste product of starch manufacture, is the base for the production of penicillin to which I owe my life and eternal gratitude."

A fiber is being made from chicken feathers now that someone "figured it took as much feed to make a pound of feathers as it did a pound of chicken."

In the lumber industry, incomplete utilization has marked the record in the woods and in the mills. This has been the story more than wilful waste. Had profits been visible from tops and "rejects," from slab and trimmings, it is quite likely that the loggers and millers would have sought returns from such a source as from the sale of dimension and finish lumber.

But the time has arrived when, with tree farms and sustained yield, more economical operation, new processes and products and more aggressive marketing are vital to the future of the industry.

That is the spirit in which leaders of the industry are beginning to study research and its rewards, the same rewards that have stabilized every other great American enterprise.

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I

THE NATURE AND AMOUNT OF SAWMILL WASTE AND BYPRODUCTS

Waste or Byproduct.

The Meaning of Waste. Waste has been an unfortunate word for the lumber industry. It has been loosely used for many years by both the lumberman and those who decry his practices. The lumberman has no desire and no intention to operate a wasteful business. Indeed his very survival demands that he adjust his production system continually to take advantage of new machines, new products, and new markets.

The Lumberman's Concept. The very abundance of his raw material forced him in the past to take only the best from the tree. He had no problem then. Those parts of the log that could not make good lumber were cast aside into the waste chute, carried out of the mill in the waste conveyor, and dropped into the cavernous maws of a giant waste burner.

Today that same waste falls into a waste chute, and is carried along a waste conveyor. The bark is picked out for bark powders. The clean wood is diverted to the pulp chipper. The clear slabs are processed for pickets, lath, and small dimension. The remainder is sent to the hog to become fuel for the powerhouse or the homes of the surrounding community. Yet to the man whose life-work has been the production of good, clean lumber, it is still waste.

The Layman's Concept. The man intent on making lumber discards the knotty end, the bark covered slab, the dozy board and thinks nothing of

calling it waste. It is of no further use to him. It will not make lumber. The public spirited conservationist looks up to the red cones of refuse burners and deplores to the world the fact that the nation's heritage is being squandered. The bureaucrat uses the word waste in a traditionally loose manner and brings the scorn of the nation's editors upon the shoulders of the lumber industry, its businessmen and its technologists.

In reporting the development of Weyerhaeuser's new bark product, "Silvacon", TIME magazine led off with this paragraph (36) :

> "The meat-packing industry brags that it uses all of the pig but the squeal. The lumber industry is different. It is so wasteful that a conservationist once growled, 'They use the squeal and throw away the pig.' No more than a third of a felled tree becomes lumber. The rest is left in the forest or is wasted at the sawmills."

Even followed with an excellent report on the benefits to be derived from the new discovery, this story is not an example of good public relations on the part of the lumber industry. Yet it is no more than can be expected from a disinterested magazine relying upon publications of the federal government for its information, publications in which the term waste is used in the traditional manner.

Forest Service Definition. From the Forest Service Reappraisal Report, "Wood Waste in the United States," we find this definition: "..... waste wood means wood material.....which does not appear finally in marketable products other than fuel wood, re-

gardless of whether it is economically or technologically feasible to utilize it (13)." From the same report we read "Over 40 percent of the total sawmill waste was burned to power the mills....." Certainly the lumberman that produces his lumber with this power does not consider this a wasteful practice, though he, too, may sincerely refer to the fuel burning beneath his boilers as waste.

SAF Defines Waste. In spite of traditional usage and in the interests of standard terminology with no hidden implications, the Society of American Foresters has given us this definition of waste:

> "Waste on a logging operation is that portion of the tree that has merchantable value, but is not utilized. Waste at a sawmill is that portion of the log having a merchantable value which is not utilized.
>
> "Merchantable is used to designate the portion of trees or stands which can be profitable marketed under given economic conditions (27)."

Columbia Mills of New York City, manufacturers of window shade rollers from soft pine, prefers the SAF definition. In its advertising for raw materials this company beseeches, "Don't burn your Profits!" Whether or not this material is waste depends entirely upon what the operator does with it. If he consigns it to the burner, it is waste. If he processes it for shade roller stock, it represents profits, provided only that his costs and the price at which he must sell will permit a profit.

Apologies And Explanations. In self defense an industry spokesman (17) reminds us that no

"Over 40 percent of the total sawmill waste was burned to power the mills....(13)."

Over 40 percent of the total wood not manufactured into lumber was burned to power the mills.

"Waste in the manufacture of veneer amounted to 110 million cubic feet, 99 percent of which was used as fuel (13)."

Byproducts in the manufacture of veneer amounted to 100 million cubic feet of wood, 99 percent of which was used as fuel.

"Mill waste supplies 13 million cubic feet of the annual consumption of 225 million cubic feet of pulpwood in the Douglas-fir sub-region of western Oregon and Washington (13)."

Sawmill byproducts supply 13 million cubic feet of the annual comsumption of 225 million cubic feet of pulpwood in the Douglas-fir sub-region of western Oregon and Washington.

COMPARE THE IMPACT OF THE ABOVE STATEMENTS. THE IMPLICATIONS OF MISUSE ARE AVOIDED BY SUBSTITUTING MORE EXACT MEANINGS FOR THE WORD WASTE.

industry has enjoyed integrated utilization of its natural raw material from the beginning. The lumber industry is continually searching for new ways and means to utilize more profitably these so-called waste materials. If someone were to discover a new means of achieving the new utilization, the industry would welcome his assistance and his "remuneration would be handsome."

Suggested Terminology. John E. Liersch, forester for Powell River Lumber Company, Vancouver, B. C., has suggested that the industry adopt the term small woods for all material that can be handled by the piece for further utilization, material that is too often termed waste (26). This suggestion has been picked up by the trade journals in their features on industry practices(50). To provide a parallel term for sawdust, hogged-wood, wood flour and bark powders, this paper will use the term fine woods. Together with the inclusive term, fuel woods, these expressions furnish a convenient means of classifying the further discussion of the sawmill byproducts that are being produced in our mills today.

Waste Still Possible. In making this substitution of terms it is not the intent to imply that there is no waste in the lumber industry. Lack of knowledge, lack of vision, lack of capital, or lack of productive capacity may send profits to the burner for many more years. It may be that other operators who claim there is no waste in their plant may be guilty of wasteful practices in not achieving the

highest utility value from their byproducts. Our objective is to substitute the formula, log yields lumber plus by-products, for the misconception that log yields lumber plus waste.

Waste and the Marginal Sawmill. High lumber prices and an unprecedented demand have brought many marginal mills into operation. In general, these mills have been characterized by a low lumber yield and a high volume of waste (19). As prices decline and stumpage becomes harder to obtain some of these mills will cease operations. Their intermittent cutting and low volume makes it mandatory for most of these mills to burn their slabs, edgings, and sawdust. The better utilization of this material is a challenge that is being met by federal, state, and private expenditures for research.

Mechanical Utilization. The sawmill operator is primarily a lumberman. Unless his mill and organization are very large, he cannot be expected to enter the many possible fields of chemical utilization of wood (7). The utilization of wood in its natural state changed only by mechanical processes is the more logical natural field of expansion for the lumberman.

It is a natural step for the millman to enter the fuel business as a wholesale or retail supplier of sawdust, hogged-wood, cordwood, or shortwood. Many of his present lumber customers may also buy such small wood products as lath, moulding, pickets, handle-stock, box-shock, car-strips, garden-stakes and the like.

Only a change in marketing is involved in supplying raw materials to associated industries such as chips and slabs for pulp, shavings for wood flour, and slabs and edgings for fiberboard. The sale of all these byproducts means that the primary product, lumber, may no longer have to bear the entire cost of forestry and logging.

Statistical Surveys of the Waste Problem.

Wilson's Report of 1944. The most recently published statistical summary of the sawmill byproduct problem in the Pacific Northwest is Sinclair Wilson's report, "Sawmill 'Waste' Developed, Used and Not Used in Oregon and Washington in 1944 (11)." Although this report is a summary of production during a war year, comparison with earlier studies in the same field show it to be a representative study. The data were collected by foresters of the federal service from actual production records of byproduct sales or from calculations based on known production. Estimates of volumes of byproducts were then converted into cubic foot units of solid wood content for ease in comparison.

The types of byproducts were segregated into the categories in which they are chiefly used and sold by sawmills. These are sawdust, shavings, hogged-wood, slabwood, edgings and shortwood.

A study of the tables of this report reveals that for the region as a whole nearly 40 percent of the total byproducts were used in the production of power for the mills themselves and for sale to private power companies. An additional 38 percent was sold by the mill for ultimate use as fuel in a local market or elsewhere. Approximately 2 percent was used in the production of chips for chemical wood pulp. Another 18.5 percent was destroyed in mill incinerators. The remainder fell into a miscellaneous category (see Table 1).

Nearly 52 percent of the material destroyed was slab-

wood and edgings. Sawdust, shavings, and hogged-fuel were used to the greatest extent in the production of power. Hogged-wood and short-wood comprised the bulk of material sold for fuel. Sales of wood for pulp were chiefly in the form of chips, although about 35 percent were in the form of slabs and short-wood (see Table 2).

A breakdown of Table 1 by districts reveals that the volume of wood used for domestic or industrial fuel is directly proportional to the population. As the distance from population centers increases, the proportion of wood byproducts sent to the burner also increases. Thus the utilization standards are lowest in southern Oregon. High utilization standards are found in the Puget Sound, Columbia River and Inland Empire districts, where there is a good market for wood fuel.

The Spokane Survey. A 1947 investigation of the waste wood situation in the Spokane region has shown that about 850 cords are produced daily. This amount is divided into the following categories:

Material	Amount in Cords
Slabs	150
Dry blocks	100
Hogged-fuel	100
Green sawdust	60
Resaw sawdust	40
Mill shavings	400

No definite utilization of all this material was revealed except for 80 cords of shavings used in production of wood flour and 60 cords of shavings used in production of Presto-Logs. Probably most of the remainder is used for in-

Table 1. Percent of Each Type of Sawmill Byproduct by Disposition, Oregon and Washington, 1944

Disposition	Sawdust	Shavings	Hogged Wood	Slabwood Edgings, etc.	Short Wood	Total
Used by mill						
Own power	53.0	50.1	36.1	1.2	-	34.9
Other power	8.1	6.7	9.0	.2	-	3.8
Sold by mill						
Fuel locally	21.7	18.2	32.6	17.3	81.4	30.7
Fuel elsewhere	3.5	3.2	15.2	6.4	14.3	7.6
Pulp	-	-	6.4	1.4	3.4	1.9
Misc.	-	-	-	4.0	.1	.6
Destroyed	13.7	21.8	.7	69.5	.8	18.5
Total	100.0	100.0	100.0	100.0	100.0	100.0

Table 2. Percent of Each Means of Disposition by Type of Sawmill Byproduct, Oregon and Washington, 1944

Disposition	Sawdust	Shavings	Hogged Wood	Slabwood Edgings, etc.	Short Wood	Total
Used by mill						
Own power	53.0	26.1	21.4	.5	-	100.0
Other power	48.3	21.0	30.4	.3	-	100.0
Sold by mill						
Fuel locally	24.7	10.7	20.9	7.8	35.9	100.0
Fuel elsewhere	15.9	7.7	39.4	11.5	25.5	100.0
Pulp	-	-	65.8	10.0	24.2	100.0
Misc.	-	-	-	98.7	1.3	100.0
Destroyed	25.7	21.4	.7	51.6	.6	100.0
Total	34.8	18.1	19.7	13.8	13.6	100.0

dustrial and domestic fuel without further processing. It is reported that there are at least 2500 sawdust burners in Spokane homes (22).

Canadian Study Summarized. According to a study by J. B. Prince and G. E. Bell, the course of byproduct utilization in Canada closely parallels conditions in the States (19). Their chief concern, as it is here, is to increase the lumber recovery from the log. Losses in sawdust run from 14 to 19 percent of the total cubic log volume. The point was made here that bandmills produce approximately 5 percent less sawdust than circular mills. The excessive loss at the trimsaw was also deplored and trimming to 1-foot increments was advocated.

Fuel wood is the most important single use for sawmill byproducts. At the larger mills most of this is burned to produce power. Some briquettes are made, but most sawdust and shavings are burned in the bulk form. White pine and spruce shavings are utilized to a limited extent for wood flour. Slabs and edgings are being used in increasing amounts in the production of chips for pulp mills.

II

CHARACTERISTICS OF MECHANICALLY PRODUCED SAWMILL BYPRODUCTS

Wood for Fuel.

Domestic. Although wood will always have some use for domestic fuel, the market for wood fuel is in a decline (13). The modern householder desires to be free of the dirt and drudgery which the use of most fuel involves, preferring instead to use the more automatic types of fuel such as oil and electricity. Even sawdust and hogged-fuel, which may be used in semi-automatic furnaces, requires large storage space and manual labor to fill the hoppers.

Competition from Electricity. A member of the farm extension service staff at OSC has stated that their demand for farm-home plans nearly ceased after the war, largely due to the fact that available plans in their files had kitchens designed for use of the wood-burning cook-stove. Activities of the Rural Electrification Administration in recent years have brought electricity within the reach of many more farm homes. Old kitchens are being remodeled to accommodate electric ranges. Most of the new building plans incorporate electricity for cooking purposes. Although the use of wood for heating purposes in rural homes will undoubtedly continue for many years, the farmer's wife has followed her city sister in demanding freedom from the calorific radiations of the wood cook-stove.

Hogged-Fuel and Sawdust. Hogged-fuel and sawdust in mixture are desirable domestic fuels in comparison with solid wood. They are burned in stoker type furnaces and water heaters and require less

tending. Compared with oil and electricity, hogged-fuel is cheap. No serious competition with electricity has as yet developed, since hogged-fuel is not convenient for kitchen use and electricity is in most localities too expensive and scarce to use for heating purposes.

However, the required storage space in the home is considerable, the fire hazard may not be ignored, and the labor necessary to fill bins and fuel-hoppers is time-consuming to the house-holder. The bulky nature of this fuel is also a problem to fuel dealers. Many of their customers are unable to store a season's supply in their basement and require frequent service during the heating season. To meet this seasonal demand, the dealer must store huge quantities in the open during slack-order seasons. The availability to markets is another factor limiting the use of this type of fuel, as it cannot compete with other fuels if burdened with excessive handling and transportation costs.

Slab and Short-wood. For local use slab-wood and short-wood is a principal fuel source for low-income families. The same limiting factors apply here as for hog fuel and sawdust.

"Pres-to-Logs", The Wood Briquette. A successful addition to wood fuels introduced in 1930 is the "Pres-to-Log", a pressed-wood briquette 12 inches long, 4 inches in diameter and weighing about eight pounds (4). The specific gravity of the briquette is about 1.3. Heat value of these briquettes is the same as for air-dry

wood, about 8,250 B.t.u.'s per pound. The annual production as of 1945 was about 200,000 tons from 55 machines operating in the Pacific coast states, Idaho, and Montana (2). Individual machine capacity is 4,000 tons of dry refuse per year under continuous operation (4). Machines are leased by the manufacturer, Wood Briquettes, Inc. of Lewiston, Idaho, thereby protecting local distributing territories.

The essential elements of the "Pres-to-Logs" machine are the pressing screw, the die, and the pressure regulating cylinder (4). Presses operate automatically. Cohesion of particles is obtained by application of pressure up to 165,000 pounds, high enough to destroy the elasticity of the wood. Materials used are dry shavings from planing mills. However, some installations use green sawdust and shavings by quick partial drying with steam heat, flue gases, or by the Raymond Flash Dryer using oil or natural gas (4).

A machine for producing stoker-type briquettes was put into operation in Spokane in the spring of 1947. It is claimed that this machine operates profitably on 5 to 10 tons of waste a day (46). These small briquettes are produced in a manner similar to the larger size product. The round rod formed by the press is cut into nut coal size by a revolving cutter head. This product should greatly increase the size of the wood briquette fuel market (47).

"Pres-to-Logs" are used in homes, apartments and restaurants where a clean, light-weight fuel is desirable. Prices to the consumer (1945) range from $7.50 to $9.00 per

ton (2). Logs manufactured in Salem now (1948) cost seven cents apiece in Corvallis or about $17.50 per ton. Coal in Corvallis now costs $19.00 per ton.

The standard product may not be transported economically for long distances; however, the specialty item of logs chemically treated to give colored flames in a fireplace will bear heavier freight charges.

Institutional Use. Hogged-wood is a desirable fuel for institution heating plants providing the truck haul from the mill is relatively short. It lends itself easily to automatic stoking and feed. One fireman is generally necessary to keep the fuel flowing evenly into the feed conveyors. Limitations on storage space limit the storage of a very big supply to carry over in case of plant shutdowns for vacations or labor difficulties.

Production of Electric Power. Nearly all large sawmills develop their own power from sawmill waste -- sawdust, shavings and hogged-wood (11). Portable sawmills and small mills of the semi-portable type generally use purchased electric power or power generated by diesel or gas reciprocating engines. Steam engines operating on wood fuel are neither as portable nor as efficient as the diesel and gas engine. Most of these small plants have no dry kiln requiring steam heat to make steam generation necessary.

Wilson (11) states that the great majority of mills

develop their own power from sawmill waste, but that the number of mills buying all or part of their power appear to be increasing. A few develop power from fuel oil and gasoline. Nearly 6 percent of the total byproducts in the region are used in developing electric power for sale through local companies. In the last year a critical power shortage has developed in Oregon due to over-selling industrial and domestic electricity, and an inadequate supply of hydroelectric capacity.

Small Woods.

In planning for complete utilization at the sawmill, one of the first steps is to provide for further processing of slabs and edgings for box-shook, small dimension stock, and lath. On the average, about 3 percent of the solid wood content of all developed sawmill waste may be utilized in this manner (1).

Slabs for Siding. During the war several small sawmill operators have developed a flat-grain log-cabin siding from their slabs. Although this is a war-born product developed to satisfy emergency shortages, there is no doubt that such a product might prove suitable in normal markets. The disadvantages of flat-grain siding in Douglas-fir are well known. However, for rustic treatments and with special finishes, this product may continue to enjoy a specialty demand similar to that developed for our knotty pine boards.

Southern Pine Experiments. As a part of its research and development program, the Southern Pine Inspection Bureau ran an experiment on slab utilization in 1942. The mill selected was average size, producing about 60 M per shift from small logs. Nearly 1200 feet of slabs were pulled during an eight hour shift, kiln dried and run to 1X6 Log Cabin Siding. Nearly half of the material graded B&B, the remainder about equally divided between C, D and No. 2. Lengths included 4-to 14-feet in 2-foot increments. Apparently, the mill crew was not told of the objects of the study, for the inspector commented that most of the usable

slabs were accumulated during the first three hours of the test run. This might indicate that there was a certain amount of carelessness on the head rig in permitting an excessive amount of slabs. Certainly if the mill is not able to recover material from slabs, every precaution should be taken to minimize its development. If such a utilization program were an accepted part of the mill production, the cooperation of the sawyer would increase the material suitable for recovery by slabbing to avoid large knots and by cutting to a thickness that would dress to a 4-quarter or 5-quarter working (6).

Slab Siding for The Pre-fabs. On the west coast the principal development of slab siding has been in connection with the prefabricated housing program. Material developed by the small mills is of structural thickness, up to 4½ inches, and is usually in eight foot lengths. Cores of the logs are developed into 2x4's and other structural lumber.

Lath. Bryant (1) states that in normal times lath manufacture has not been a very profitable sideline. However, mills producing dimension and other construction material have no problem in disposing of their lath, as retail lumber dealers find it convenient to buy a variety of stock from one producer. During the war years lath was in short supply, as mills lacked the labor necessary for processing. Good demand for wood lath is apt to continue for several years, as there is still a tremendous need for

residential building in this region and in normal market areas.

Dimension Stock or Squares. Closely allied to the production of lath as a sawmill byproduct is the manufacture of squares as stock for handles, blinds, chair rounds and other small wood items. This product is being handled in a variety of ways in the western mills. Some plants conform to past practice and turn out only the rough piece to their customer's specifications. When this market first came into being, most of the concerns supplied were in eastern manufacturing centers. The present trend is toward more and more final processing by plants located near the mills. In line with this trend, some mills are themselves entering this field of secondary manufacture and are selling a finished product.

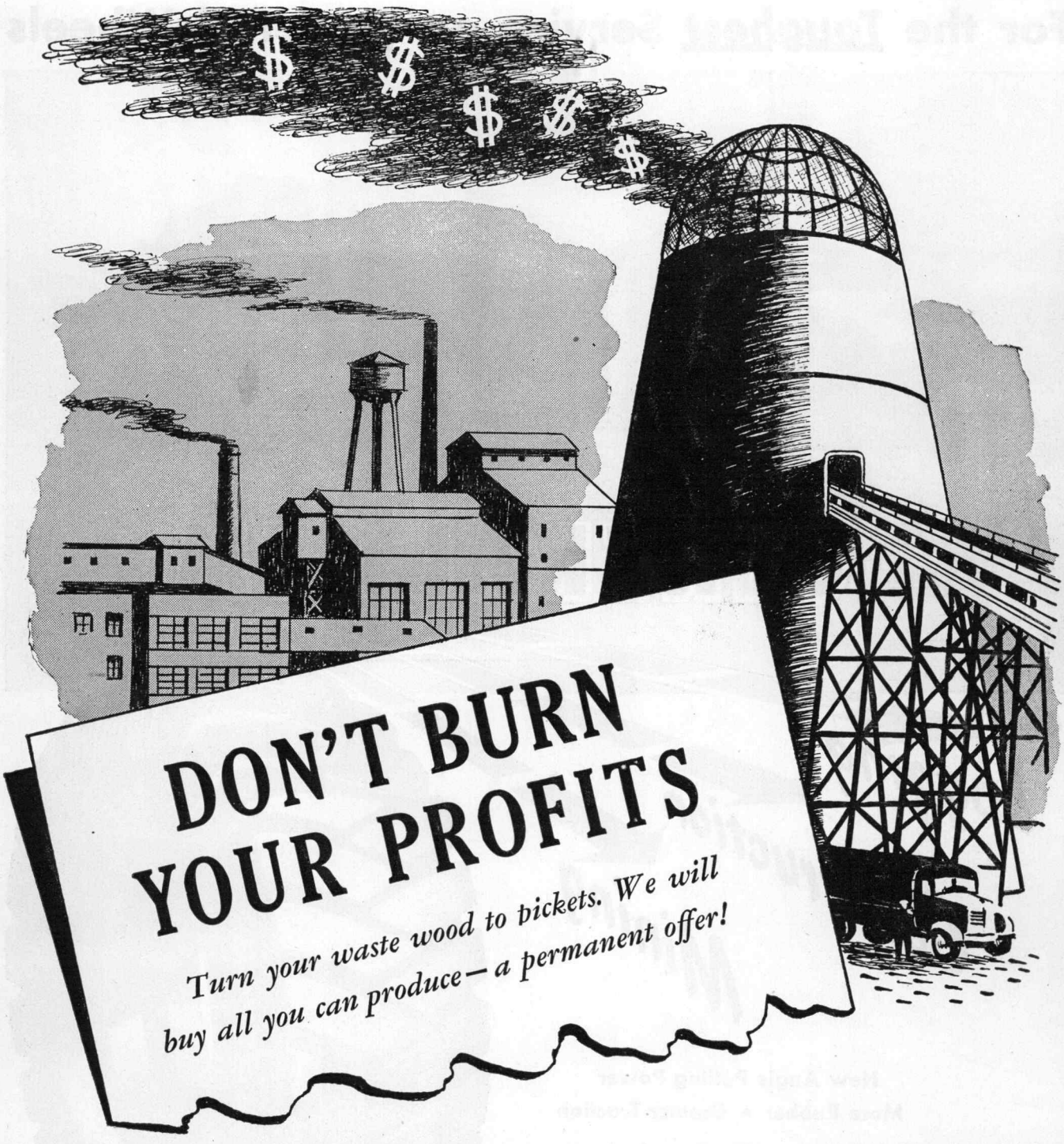
The Linscott Method. One of the outstanding producers and processors of this type of material in Oregon and Washington is the Linscott Manufacturing Company of Centralia, Washington. This company operates 20 separate waste recovery mills at sawmills throughout the two states. Using a lath machine, a saw bolter, a small edger, and an equalizer unit or an upright resaw for resawing and ripping, a typical unit has been able to recover approximately 2400 to 3600 bf of clear, short-length stock per day from waste taken off the conveyor of 100,000 bf capacity mill. The recovered stock is cut to specified size, bundled, and shipped to the Centralia

plant (43). There the stock is kiln dried and manufactured into such items as blind rails, dowels, venetian blinds, furniture dimension, laminated furniture cores, mop and broom handles, curtain stretcher parts, ironing boards and many other specialty items. All lengths are utilized. From a 15/16" round may come 14" chair stretchers, and 12" kitchen-sink plunger handles (23). The centralized plant utilizes over 22 million feet of shorts, slabs and edgings per year (33).

Pine for Window Shade Rollers. The Brooks-Scanlon mill at Bend processes their slabs and edgings very thoroughly. Three head-rigs send a large volume of clear slabs through a slasher into a conveyor from which workmen select the stock for recovery. Their entire output goes into squares for roller blinds. All lengths may be used by the manufacturer of this item. The recovery plant has an automatic length sorter which saves a great deal of manual labor.

Apparently the eastern manufacturer of the roller blinds is experiencing some difficulty in acquiring adequate supplies of pine stock. Full page ads have appeared several times during 1947 with an urgent appeal for rough pine pickets, full 1x1 and full 1 1/8x1 1/8, lengths to 16 to 48 inches and 6/4 squares in lengths from 20 to 48 inches.

Finished Handles From Oregon Purchasing its handle stock from the Coos Bay Lumber Company and from mills in Gardner and Reedsport, a secondary manu-



DON'T BURN YOUR PROFITS

Turn your waste wood to pickets. We will buy all you can produce—a permanent offer!

Is your mill today burning slabs, edgings and similar waste? If so, you're burning good potential profits. Because from these waste materials, you can make pickets. And we will pay top prices for your entire output of square rough pine pickets—full 1″ x 1″ and full 1⅛″ x 1⅛″ in sizes all the way from 16 to 48 inches; also full 1½″ x 1½″ in sizes from 20 to 48 inches.

We use pickets to make window shade rollers. We are one of America's largest window shade manufacturers; so you can count on a steady demand from us.

Your present lath machines, too, can be profitably converted to picket production: less and less lath is being used in postwar buildings. And remember: the standard lath length is 36 inches, whereas we buy pickets in all sizes from 16 to 48 inches!

If you are already making pickets, we're ready to start buying at once.

URGENT! We have 2 big factories to supply—in Minetto, New York; and Saginaw, Michigan. Our proposition will surely interest you.

WRITE TODAY TO: PURCHASING AGENT,

COLUMBIA MILLS, INC., 225 FIFTH AVENUE, NEW YORK 10, N. Y.

facturing plant in Coos Bay, Oregon, now produces one million broom, brush, and mop handles a month. Employing 30 to 35 workmen, the plant performs these operations: cutting to shape, drilling, kiln drying for 48 hours, sanding, and grading. This huge production fills 12 to 15 cars (28). The Wheeler Manufacturing Company of Corvallis is another post-war secondary manufacturing plant that has specialized in producing handle stock.

Box-Shook. Supplying wooden boxes for shipment of fresh produce within and from the Pacific Coast truck gardens and orchards is an established business. Many pine mills have box factories in connection with their milling operations to utilize short stock, trims and low-grade lumber. Douglas-fir is suitable for certain types of boxes (48), but the emphasis in the Western region has been on white fir and hemlock for shook production.

Fall Creek Utilization. A new box-cover mill began operation in the fall of 1946 in connection with the Fall Creek Lumber Company. This plant processes both wood waste from the mill and wood-logs from the logging operation. The manufacture of box covers with a slicer-type machine is their specialty. Bolts are steamed for three hours before slicing. After cleats are stitched on, the covers are kiln-dried and bundled for shipment. Production is 34,000 covers per eight-hour day (29).

Ends From Low-Grade Shook. Other machinery has been developed to produce box ends from

knotty material. Three or more pieces are joined and glued in the machine. The weaker material forms the center section in which the grain runs at right angles to the outside pieces. Edge grain for more secure nailing is thus provided on all four sides of the box end. It is claimed that such a box is stronger than one piece made out of better grade shook.

Recovery at Shevlin-Hixon. The Shevlin-Hixon Company of Bend, Oregon, is not so much concerned with find ways of converting waste wood material to utility, as it is in converting a utility product to one of higher utility. This plant operates on a 100 percent utilization basis. Lower grades of material for which no better use has been found are burned to produce electric power for the mill and for the local power company. Production of pine boxes form an important part of their output. Machinery has recently been added to their recovery facilities at the dry chain. Two new equalizers cut orange box and lug shook from 5/4 and 6/4 rough trims orginally 6 feet to 11½ inches in length (37). Material thus recovered formerly had only fuel utility.

Box Factory at Mt. Jefferson. A one-man sash gang saw was installed in the box factory of the Mt. Jefferson Lumber Company to mill low-grade boards and small timbers into special industrial stock. The capacity of the machine is 12,000 feet per 8-hour shift. Flat grain cleat strips for boxes are cut from material salvaged (25).

Slabwood for Pulp Mills. Conveniently located near saw-

mills, the Westminster Paper Company has doubled its output with the addition of machinery to process slabwood. The slabs are loaded from conveyors into 3-cord skips at the sawmill. Hyster straddle trucks deliver the loaded skips to the pulp mill. There the 4-foot slabs are barked and cut into 2-foot lengths. Bark and sawdust are used to fuel the pulp mill's power-plant. This addition brings the daily capacity of the mill to 30 tons of groundwood pulp. Four pocket grinders are used to reduce the blocks (53).

Fine Wood Products.

After the scavenging of slab and edgings for small dimension stock there is still a lot of solid wood on the waste conveyor which may be used to advantage for purposes other than fuel. Particularly is this true when the logs are barked prior to their breakdown in the mill. This makes the mill-deck cleaner and more efficient, and will provide much more usable waste than is now possible.

Chips for Paper Pulp. Much greater use of Douglas-fir chips for production can undoubtedly be made. In 1944 sales of chips for pulp amounted to nearly 2 percent of total by-products. In that year the demand for pulpwood was sharp. The distance from pulpmill to sawmill, costs of removing bark, and present small sulfate-pulp producing capacity were the limiting factors in this type of utilization (11).

Need for Integration. Our lack of integration of sawmill with pulpmill has led to much of our inadequate use of wood, according to the recent Forest Service survey (13). The possibilities in this direction are indicated in the example of Sweden, who in 1937 made 25 percent of its pulp from sawmill byproducts representing 90 percent of the material developed, excluding bark and sawdust. Our future development depends upon results of research into new pulping processes for our native timber species and upon the relative economies of producing pulp from sawmill byproducts as compared with forestry-grown, round pulpwood.

Steps toward Integration. Some of the larger lumber mills have already taken steps toward integration by entering the pulp field as producers. In addition to utilizing sawmill byproducts, these plants also make use of smaller logs and pulp species taken from their own logging operations. One large British Columbia mill has erected a sulfate mill with an annual capacity of 50,000 tons (19).

Weyerhaeuser Integrated Plants. The Weyerhaeuser mill at Longview, Washington, makes good use of a part of their lumber byproducts in the form of pulp chips. As the logs in their fir mills are not barked, workmen must select clean material from a refuse conveyor and route it to a pulp chipper. Until quite recently these chips were conveyed by belt to a barge in the Columbia River to be sold to a sulfate pulp mill just across the river at St. Helens, Oregon. The company has now added a sulfate unit to their pulp mill which formerly utilized only the hemlock and true fir by the sulfite process. Material for the sulfite mill was principally hydraulically-barked logs reduced in a new Sumner whole-log chipper. Eventually the company plans to bark all logs prior to processing.

In line with this policy the same company has announced plans for a sulfate pulp and container board plant to be built at Springfield, Oregon, in conjunction with their new sawmill. The plant capacity will be 150 tons per day. Full capacity operation will require purchasing a part of their raw ma-

terial from other sawmills. The announcement included this statement by the company's president, J. P. Weyerhaeuser, Jr., "Unbleached sulfate container board offers the most suitable means of utilizing wood residue (Douglas-fir) that develops incidental to lumbering and sawmill operations (54)."

Chips on The Open Market. Pulp chips are produced by other mills for sale on the open market. This type of undertaking has been most successful where cheap transportation was available or where pulp mills were already located nearby. The Willamette Valley Lumber Company mills at Foster and at Dallas have disposed of their surplus wood in this manner. Many producers were forced to abandon this field during the war due to the price restrictions under OPA. Since the end of price control, market prices have again permitted sawmills to supply this market profitably. An increase in this utilization may be possible through cooperative marketing, or through middlemen that provide the service of concentration from small producers and of a regulated flow to the pulp mills.

Shavings for Wood Flour. A shortage of wood flour due to restrictions on imports from Scandinavia during the war has fostered the development of wood flour plants in the United States. Four such plants have been put into operation in the Pacific Northwest by Specialty Wood Products Company (40). The plants at Longview, Portland, and Albany each operate in conjunction with one sawmill.

Wood Flour From Matchwood. The company's newest plant at Spokane obtains its raw material from several mills manufacturing matches from white pine, located within a short radius. Trucks from the match factories deliver the shavings daily. An earth-filled ramp with turn-around at the top enables the trucks to back into the dumping shed and unload into a hopper. From there the shavings go through a heavy-duty Gruendler hammer mill, which breaks up the shavings and any small bits of block material that might be left in the load. Fans blow the material into the storage bins to be fed into the fine mill. Here a battery of three Gruendler mills reduce the shavings to powder to pass an 80 mesh screen. Each mill is powered by a 150 hp General Electric induction motor. From the mill house the flour is conveyed through overhead pipes to the storage bin in the sacking and shipping warehouse (55).

Wood Flour from Sierra Pines. The Forest By-Products Company was organized to utilize the byproducts of the Placerville Lumber Company at Smith Flat by processing them into wood flour. The plant has a capacity at present of 25 tons of wood flour per shift. The raw material is blown directly by cyclone from the planer mill to the storage bins of the wood flour plant. This company eventually expects to process slabs, edgings, sawdust, and logging waste. Objectionable resins in the pine woods are removed by treatment with a battery of infra-red lamps during the milling process (41).

Fiberboard. Fiberboard is one of the most promising mechanical uses of mill waste (3). Many new and very useful products have been and are being developed in this branch of utilization. Hardboard rivalling sheet-metal in the production of durable goods such as deep freezers and refrigerators, acoustic boards for ceiling and wall finish in business offices and all commercial establishments where noise reduction is desirable to increase worker efficiency, facings for plywood, interior finish in low-cost construction, insulation board for frame construction -- all these are in use at the present time. Continued research is developing new uses and new processes. One laboratory has developed a wallboard that may be rolled like linoleum. Another board has been developed that is fireproof (15). Improved bonding materials and the use of lignin plastics promise to bring about further advances in this field.

Simpson Produces Insulating Board. Believing that wood fiberboard was their answer to the better utilization of the byproducts of their sawmill and veneer plant, the Simpson Logging Company of Shelton, Washington, is now producing 300,000 square feet of insulating board per day. Even material once used as fuel for the boilers is being converted to a quality building product. Oil and purchased hydroelectric power have nearly replaced wood fuels in supplying the power requirements of their mills. Only knots, bark and rot are left.

Wood for this process is first chipped and then steamed

in digesting tanks. From the digester the chips go to mechanical pulpers adjusted to produce three different grades of pulp. These grades are then blended according to formula. Chemicals are added for sizing, bonding, and preservation from decay and insects. From this final mix the fiber pulp passes through a fourdrinier for forming into a continuous board.

As the board passes from this machine it is cut to length and painted on one side. Drying for 1½ hours in a continuous Coe dryer brings the boards down to an equilibrium moisture content. Trimming to 4x8 panels, inspection, and packaging for shipment complete the production process (50).

Chapco Hardboard. The first small scale hardboard plant in America is the Chapman Manufacturing Company of Corvallis, Oregon. Until early 1948 their raw material was four foot green Douglas-fir slab. The slabs were steam-treated and hand-barked before defibering in an Allis-Chalmers Defiberizer.

This machine has cutting elements made up of two cylindrical rotating heads, each having 6500 teeth attached by means of rods to the head. As the head rotates, centrifugal force causes these needles to swing out and maintain a position parallel to the head radius. The wood is placed in two compartment hoppers over the heads. As the hopper reciprocates, the tips of the needles rake the wood off parallel to the grain direction. Two 40 hp motors drive the

heads and one 10 hp motor moves the hoppers. Coarseness of fiber and quantity are controllable. An air stream picks up the fiber from the defiberizer and carries it through a hammer mill to storage tanks (20).

This company is now converting from use of slabwood to use of wood chips purchased from a nearby sawmill. Chips will be reduced to fiber in an Asplund "Defibrator". Result of this change-over will mean increased production through an increase in fiber production.

The Asplund Defibrator. A mechanical process used at some board mills was developed in Sweden, a country which has been very progressive in the development of a fiberboard industry during the past twenty years. The Asplund "Defibrator" process for hardboard can be economically operated at a capacity of only 10,000 tons per year (18). It thus requires far less raw material than does cellulose manufacture by Kraft or sulfite methods. Continuous handling of boards from the press to saw cutters by mechanical methods helps to keep down labor requirements. Power consumption for this process is comparatively low, requiring about 400 kwh per 2,000 for all plant uses. Whether the process will prove economical in this country on such a small scale in competition with mass produced boards must be proved.

Outlook for Fiberboards. There have been several other recent developments in hardboard manufacture, but few of the new processes are in commercial

production. The bottleneck has been procurement of hydraulic presses costing from $30,000 up. The Northeastern Wood Utilization Council advises that a lumberman with a few tons of sawdust should not attempt to go into wallboard production. This business requires substantial capital and considerable mechanical engineering knowledge. However, it is a market for sawmill byproducts that the lumberman and his community might well investigate.

According to the Forest Service Report (13) national production of fiber building board increased slowly from 80,000 tons in 1935 to 180,000 tons in 1940. In 1941 production rose rapidly to nearly a million tons and then stabilized just over a million tons for the duration of the war. Postwar demand for building materials has attracted considerable industrial interest in the production of boards. The three processes briefly discussed are the principal means of reducing wood to fiber without the use of chemicals. There is a need for a less expensive type of reduction mill if the small sawmill operator is to enter this field as a producer (21).

Filler Fibers. Mechanically produced fibers are being used to an increasing extent as fillers in such products as rolled roofing, building felts, and composition shingles. Pre-war wood fiber content of such products was only 10-15 percent. Now up to 50 percent of the fiber content may be from wood (13). Roofing companies usually reduce wood slabs and edgings in their own plants; however, there is no reason

why the material could not be manufactured at the sawmill and marketed in a manner similar to wood flour. A standardized grading procedure would be helpful in making wood fiber a marketable commodity.

Sawdust for Fillers. There are many well known uses for wood sawdust. Several new processes are making use of this primary byproduct in its raw state as fillers in plastic and cement products. The chief problem in this type of utilization is to seal the sawdust from air and water so that it will not swell and shrink with changes in moisture. A successful product of this type must have dimensional stability.

Sawdust Worth More than Lumber. A development project now being sponsored in Eugene by a group of sawmill operators promises to make sawdust worth more than lumber. Essentially a filler for a secret-process plastic, the sawdust is being converted experimentally into products of high utility such as fireplace tile and substitute metal products. The plastic has a marble-like finish and may be colored to suit the product. The plastic and sawdust are mixed and poured into molds in a manner similar to concrete. An exothermic reaction takes place in the mold, reaching a peak temperature near the boiling point of water. Sample fireplace tiles made of this material exhibit heat-resistant and shatterproof properties superior to the standard product. The material also has desirable insulating properties.

Raw Material for Plastic Industry. A prominent Alabama lumberman is promoting a process to produce a plastic chemically from sawdust and small woods. Although this is not a true mechanical utilization, it is mentioned here because of its possibilities for increasing utilization by small sawmill operators. The process is available under a licensing plan. A 5-ton unit will utilize the sawdust from a 50 M capacity bandmill or a 35 M circular mill. Initial investment would be about $35,000, plus $10,000 for grinders should other wood be utilized. The machinery is standard make with the exception of two patented pieces. Multiple units are desirable to provide for flexibility in operation. The promoter claims that the process is applicable to all species (42). The plastic made from Douglas-fir sawdust should be as saleable on Portland markets as the southern pine product is in Mobile.

Sawdust Filler In Flooring. A non-structural floor with the wearing properties of hardwood has been made of a mixture of oak sawdust, asbestos and binding chemicals. These materials are mixed and poured at the building site, being troweled-on in a manner similar to finishing cement. The floor may be sanded and varnished as any wood floor (45). This particular product is manufactured in the east. Similar products are being manufactured in this region. This type of flooring is finding particular application in those radiant heating installations where a concrete surface is not desirable.

Bark as a Byproduct. Relatively little has been done to raise the utility value of the bark from the log. Redwood bark has found a market as insulating material. A small amount of hemlock bark is being used for its tannin content. With the addition of barkers to the sawmill, this portion of the log may easily be segregated from the wood, permitting higher utility for the wood and a concentrated supply of bark for further processing. For the bark of pine, fir and hemlock, the best type of processing apparently is grinding and segregation of the ground bark according to size of particles and chemical nature. Partial milling yields a friable product that has favorable possibilities as a soil conditioner. There is still much to learn about bark and its possible uses.

"Silvacon", the Bark of the Fir. Under the war-born need for a supply of native cork, the combined research efforts of state and federal laboratories and the world's biggest lumber firm, Weyerhaeuser Timber Company, were focussed on utilization of Douglas-fir bark. Ground bark powders now marketed under the trade name, "Silvacon", was the result. In his announcement of the product's peacetime success in the spring of 1947, the company president stated that he expected "Silvacon" to add $10,000,000 a year to his gross business, about a 15 percent increase (36).

This product utilizes the 12 percent of the log that previously had only fuel utility. Present facilities at Longview utilize only the bark from peeler logs, producing

about 75,000 pounds in 24 hours of operation. Five grades of bark particles are separated from the ground bark. These grades are here listed by identification number (31):

No. 508 - spindle-shaped bast fibers.

No. 472 - 20 percent cork, 40 percent lignified fiber, 40 percent powder.

No. 412 - cork and lignified fibers.

(These three used in plastic moulding.)

No. 383 - flake-like cork (20 percent of production).

(Use: soil conditioner and smoke-house fuel.)

No. 490 - fine powdered amorphous material (10 percent).

(Use: resin filler for plywood bonding.)

"Silvacon" products are not the final answer to the bark utilization problem. Great opportunities exist for further research and product development. Only the bark from old-growth Douglas-fir is being used at the present time. The bark from second-growth and top logs does not have the same properties.

Chapco Soil Conditioner — In connection with its fiberboard plant, the Chapman Manufacturing Company of Corvallis annually accumulated a large supply of fir bark. This bark was permitted to season in the open and was then ground into fairly large particles. Heat treatment was then given to kill any weed seeds that may have collected on the bark during seasoning. This product was marketed for the home gardener as Chapco sterilized soil conditioner. Quantity producers might dispose of this type of material in truckload lots to local farms.

III

MARKETING OF BYPRODUCTS: POTENTIALS AND PROBLEMS

Market Potentials.

A profitable solution of the marketing problem for wood byproducts other than fuel will provide a needed incentive for more intensive utilization. Success at Fall Creek, at Omak, and at Centralia is pointing the way for other operators. Statistics show that most of the utilized byproducts at the present time are being used for fuel. That this use does not bring the greatest return to the operator is forcibly shown by this illustration from the Wooden Box Institute (56):

Waste wood as fuel is worth $3.50 per M.

Waste wood as box ends is worth $80.00 per M.

Although only one-tenth of one percent of the total material developed in the mill is suitable for box ends, similar value comparisons may be made for most of the remainder.

Markets Are New. To lumberman producers many of the markets for wood byproducts are new. Some of the markets are competitive with lumber. Others, such as the market for wood flour, were dominated by European imports before the war. Disruption of normal trade during the war years stimulated development of producing units in this country. Retention of these markets depends upon maintaining a favorable cost and a superior product.

Expanding Local Markets. Government forest economists expect the population expansion of the west to provide a market for many of our lumber byproducts (13). The combination of big local markets and concentrations of material

for processing near these markets provide an incentive to greater utilization efforts. Western communities are awakening to their opportunities for secondary manufacture and are building new values into our finest crop before sending it to market.

Product Promotion. Several methods of promoting new products have been used in this region. A license arrangement with the owner of equipment patents offers the best opportunity for the small producer to take advantage of large scale advertising and cooperative marketing. The success of "Pres-to-Logs" under the controlled promotion and marketing plan suggests similar control for other products. Chapco hardboard is to be produced under license in other parts of the country. The use of a standard trade name for the product permits advertising on a national scale.

Association sponsored promotion would be desirable in the fiberboard field. The plywood association has done a great deal for its members, not only in promotion but also in product and market research. Western producers could well band together either in a separate association or as a subsidiary group under the lumberman's association.

The large vertical corporations, such as Weyerhaeuser and Long-Bell, with line yards and contract outlets conduct individual product promotion efforts. Long-Bell in particular has pioneered in the fabrication of useful merchandise from lumber byproducts. End-grain flooring and laminated panels are examples of their efforts (29). Weyerhaeuser products

such as "Silvacon" and raw pulp are sold to industrial processors, requiring promotion only to a selected market.

Prefabricated Wood Parts. The primary producer has an opportunity to build up his business, his outlets and his consumer service by prefabrication of shop lumber and small woods. Parts may be dried and finished to the buyer's specifications, thus affording savings to the buyer on transportation of material he would not be able to use. Freight charges on this type of lumber is no more per unit weight than on rough green lumber, except to the northeast. For efficient operations a mill operator should have three classes of orders: long cuts, medium widths and lengths, and short and narrow cuts (14). The Western Forest Industries Association operates to assist small lumber operators produce for this market.

Transportation.

The largest cost factor in the use of sawmill byproducts for industrial raw materials is transportation. Until a definite value arises through better utilization practices and scarcity, the cost of sawdust, slabs, edgings and trims at the mill is nominal. Lumber, in most cases, still bears the entire cost of the logs to the mill. The byproducts may have fuel replacement value, but in many cases mills are now operating with purchased or diesel-generated electric power. To be assured of low cost raw material, the independent processor of sawmill byproducts must locate his plant as close to the mill or mills as possible. Close integration of plant facilities and maximum processing in the vicinity of the sawmill must be the plan for the large corporation.

Review of fuel transportation. Methods of transporting wood fuel may be easily applied to the transportation of fine and small wood for other uses, such as raw materials for chemical processing.

Early in the war, Tower of the Oregon Forest Products Laboratory reported on the comparative costs and production of fuel from sawmill refuse (9). Although his cost figures are not valid at this time, they do afford a comparative study of handling and transport costs.

Comparison of Handling Costs. The loading and unloading costs of sawdust and hog fuel, for example, were found to be about ten cents per unit by

machine handling and about seventy-five cents per unit where some hand labor was involved. The typical mill stores fine wood and small wood fuel in overhead bins, from which trucks or special rail cars can be quickly loaded by gravity. A trap-door along one whole side of the storage bin seems to be the most efficient type of opening to prevent hang-ups that cause delay in loading. Blockwood and planer-wood handled in this manner may be loaded for about one-third the cost of hand-loading. Actual truck loading time for 4-foot slabwood may be cut from 30 minutes per cord to 5 minutes per cord by pre-loading in racks. This system is particularly useful where slabs are used green from the mill and may be unloaded from the racks directly into production processing. (Where slabwood must be stored for any length of time for seasoning, steel-strapped unit-bundles would be a possibility).

Comparison of Transportation Costs. Sawdust and hogged fuel are moved by truck, by specially-braced, roofless box-cars, and by barge. Tower's analysis showed barge transportation to be most economical on distances greated than ten miles. Rail transportation must compete with trucks on distances less than forty miles. Truck transportation was further subdivided into four load-size classifications. The 1-unit truck is only economical for local urban deliveries up to 5 miles. The $2\frac{1}{2}$-unit truck and 4-unit truck-trailer were more economical than rail shipments at radii of less than 13 and 17 miles respectively. The 9-unit truck-trailer offered the most economy for land transport

under forty miles. The mobility, maneuverability, and flexibility of truck transport often influence the decision to haul by truck instead of by rail over marginal distances where there are competing rail lines.

Packaged and Bundled Shipments. Fine woods that are reduced at the mill such as wood-flour and barkpowders are usually sacked for shipment. Sacks provide easy individual handling for the consumer and a convenient weight unit for use in further manufacturing. In train, truck, and warehouse the sacks may be palletized for machine handling (41). One firm (55) has experimented with compressed bales in shipping wood flour. If the receiving companies have equipment to reduce the bales to flour again an appreciable freight saving can be made, as box cars may then be filled to their weight capacity.

Small woods may be tied with twine, wire, or steel straps depending upon the handling method. For manual loading and unloading of furniture and toy-stock in box cars, small twine-bound bundles are satisfactory. Machine-handling by crane or fork truck will make bundling by wire or steel strap necessary. These larger bundled units are loaded and unloaded more quickly and may be easily stored for further seasoning or to await re-manufacture.

Examples of Long Distance Shipments. Quality of raw material, demand for the product, and available transportation may greatly increase the distance one would expect sawmill byproducts could profitably be transported.

Tide-water Barge Haul. Low cost water haul by barge makes it possible for the tidewater mills of British Columbia to sell western hemlock slabs or chips to the big pulp mills on Puget Sound (19). Transportation companies act as the middlemen in this particular trade, concentrating the hemlock byproduct from many small producers to provide an even flow of raw material for the paper mills. This may only be done on a much smaller scale in communities dependent upon land transportation.

Redwood Fibers For Roofing. The preference of a San Francisco roofing manufacturer for redwood fibers for his product has given a Eureka mill a chance to market barked slabs and edgings (44). Shipments are made in carloads of about 21 cords with material in 4-foot lengths. Special demand enables the South Bay Lumber Company to ship a low value product 300 miles by rail.

Processing Prior To Shipment. Initial processing by the sawmill or by leased salvage rights increases the value of the mill byproduct and makes a larger marketing area possible. Bundled small-wood, particularly for handles, pickets, and lath, may bear shipping charges even to eastern manufacturers. These products have been discussed previously, in the case of the Linscott Manufacturing Company of Centralia, Washington and the Columbia Mills of New York City.

IV

EXAMPLES OF BYPRODUCT UTILIZATION

The Small Mill.

The small sawmill operator produces an increasing proportion of the annual lumber production of this region. His utilization problems are perhaps the most difficult to solve, particularly if the sawmill is of the portable variety and the operation one of liquidation. Permanent mills based on assured sustained-yield forestry will be able to justify additional expenditures for byproduct processing even though the daily lumber capacity be small. Far-sighted lumbermen are adjusting their production to a sustained-yield program as rapidly as possible.

The Dierks' Plan for Integration. A southern Oregon family group are promoting an integrated industrial area based on the output of their 50 M capacity sawmill. Brother and sister, Ben and Edna Dierks own and operate the sawmill. Brother Fred Dierks has built a custom planing mill on adjacent property, and a third brother, William, owns a site for another utilization plant.

Sawdust and shavings have been accumulating during the two years of operation, for the Dierks have been hoping that someone would be interested in utilizing this material. Salvage material from the sawmill is processed for handle and moulding stock and short-wood fuel. Another firm is beginning production of box-shook from low-grade stock and suitable small woods in the same area.

The Dierks estimate that they now have capacity to utilize 60 to 75 percent of all slabbed material. Yet the

raw material for 40,000 square feet of fiberboard is daily blown onto the sawdust pile (30).

Utilization at 90 M Capacity Mill. This medium size mill is arranged so that all small woods are carried by conveyor out of the front of the sawmill for further manufacture and processing. Wood for lath stock and 36-inch shutter stock are pulled from the conveyor in the lath department. In one shift, four men process about 215 bundles of specialty stock. The remainder is still utilized for fuel in 16-inch lengths. Approximately eight truckloads are produced daily (39).

The Large Mills.

Large volumes of byproducts, adequate capitalization, sustained-yield forestry, and a well-informed management have given the large, corporate lumber organizations ample opportunity to develop utilization sidelines. Expenditures on research departments have been justified.

Solution at Potlatch. Potlatch Forests, Incorporated is one of these progressive concerns. "Pres-to-Logs" were originally developed and sponsored by this company. Their processing of slabs and edgings is an equally impressive achievement.

At their Clearwater mill a production sorter for their small woods permits two men to sort out 180-190 M feet per month of usable stock from the refuse conveyor. Material is pulled from the conveyor and dropped onto one of six belts, which carry the pieces to the proper load rack. The second man stacks and moves out the full loads. This arrangement has permitted a threefold increase in salvage with no increase in labor.

This sorter represents the type of problem continually being studied by this concern. Economy in handling and in processing equipment is their objective. They feel that present equipment is too costly. For example their investigations have shown the feasibility of drying edgings for molding stock, provided proper machinery is developed for shaping (56).

Reclaimed material goes into a wide variety of box-

shook for fruit, vegetable, and other containers. Also produced are wood-parts, mouldings, stickers, lath, shade slats, toy material, garden stakes, and low grade pallets.

Long-Bell's Longview Integration. For many years the Long-Bell Lumber Company has practiced full utilization of small woods. The smallest piece saved is $\frac{1}{2}$ x 1 3/8 x 13$\frac{1}{2}$ inches. Ends of dimension stock go through several steps to become end-grain flooring. Other small pieces are glued into panels (51). This year they have declared their intentions of processing sawdust and shavings to products of higher utility than fuel. They are now erecting a pilot plant for fiber utilization studies (34).

Canadian Mill Sets the Pace. The only recorded report of a whole log barker now operating at a sawmill in the Douglas-fir region concerns the plant of Bloedel, Stewart and Welch, Limited, at Port Alberni, British Columbia (35). Integration with a sulfate pulp mill enables them to dispose of barked refuse for pulp chips. Chips are produced at the sawmill and are carried to the pulpmill by a trough-type belt conveyor 3500 feet long. Closer utilization of the lumber or sawed products of the log has created more than 50 new jobs since the beginning of their utilization program.

Processed Fuel at Everett. The refuse burner at the Weyerhaeuser mill at Everett, Washington, became obsolete as recently as December 1946. It has since been dismantled. The presence of a large local market for "Pres-to-Logs" made this a logical solution to their disposal problem. Their

plant now produces 30,000 briquettes daily. Storage at the mill for 900 units of fuel permits the local demand to be served on a cash-and carry basis (32).

V

CONCLUSIONS

The present controversy between private lumber operators and the United States Forest Service over the subject of wood waste is undoubtedly a phenomenon of our regional transition from a forest policy of liquidation to one of sustained yield. The man who sees what should be done and hasn't been done is unnecessarily critical, because our utilization is not perfect. Inasmuch as this criticism needles the less progressive companies into improving their utilization, it is justified. However, those operators who have worked long and hard to improve their particular use program have been unfairly branded in the publicity releases accompanying the publication of the federal report on wood waste. Their objections were a natural reaction.

The use of wood for fuel is of real importance only near the mill towns. There enormous quantities are consumed to produce power, light and heat. However, the use of wood for fuel may prove to be a false economy, particularly if more valuable use can be made of these sawmill byproducts. Oil, gas, and electricity, although more expensive initially, have many advantages over wood in convenience and efficiency.

Marketing and remanufacture of lumber byproducts is an important item to the management of large sawmills. Smaller mills have not been as aware of the advantages to be gained by complete utilization of the log, nor as able to economically apply known practices. Marketing problems for these concerns might be solved on a cooperative basis or by individual enterprise on the part of wholesale lumber mer-

chants. It is certain that a great deal can be done to develop new products, machinery, and manufacturing methods that will enable the small producer to benefit from the byproducts of lumber.

Individual communities in lumber-producing regions can do a great deal to aid the lumbermen and themselves by encouraging the establishment of industries using lumber byproducts. Much more processing of wood can and should be performed in the Pacific Northwest. If burners are operating in the vicinity of any lumbering center, it is not only bad practice by the producer, but should not be permitted by the community unless all possibilities for utilization of the material have been thoroughly investigated and proven unsound economic ventures.

Planned integration with pulp mills operating in each lumbering center will provide economic utilization of more logging waste and sawmill byproducts. Removal of the bark at the sawmill by hydraulic or pressure-bar barkers will permit cleaner mills and more efficient utilization. Pulp mills use this machinery and have developed it to a high degree. Studies in a sawmill using this equipment should be undertaken to demonstrate its advantages to the industry.

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