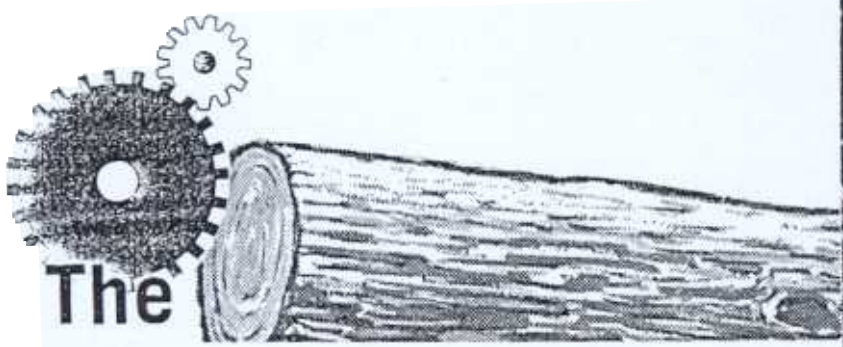
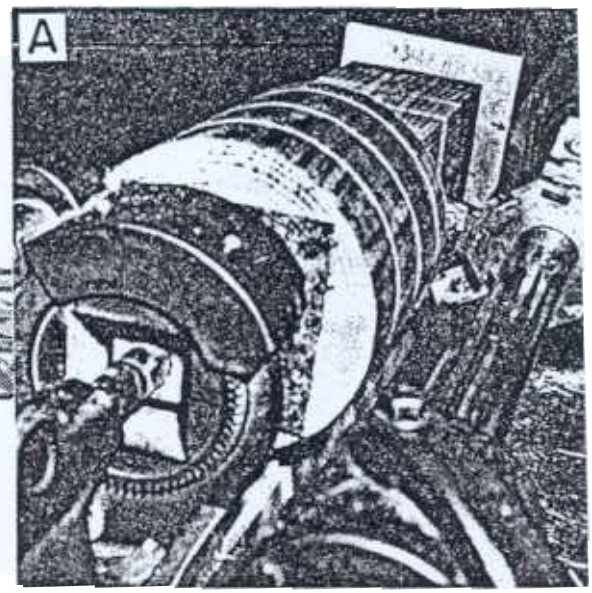


The Chipping Headrig:

A Major Invention of the 20th Century



Shown, left to right, are three prototype designs of the chipping headrig, developed in 1963 by Dr. Peter Koch, Chief Wood Scientist for Utilization of Southern Woods, Southern Forest Experiment Station.

A Key to the Utilization of the Total Tree

A square peg won't fit in a round hole but a square timber can be chipped out of a round log. It's simple, fast and efficient, with a chipping headrig.

Virtually every significant southern pine sawmill uses one of these amazing machines, busily making useful most of the wood in the tree, chipping some for paper and uncovering sawtimber where before there was only pulpwood. In short, it has chipped its own little niche in the hearts of southern timbermen.

The chipping headrig has done for the timberman what the electric shaver did for the American male. Just as the shaver pushed aside the straight and safety razors of an earlier era, the chipper has speeded up the process of breaking down raw timber resources into usable materials. To go a step further, the chipping headrig has provided a use for the "whiskers" of the industry, the edgings and slabs left as waste by conventional saws.

Simply described, the chipping headrig is a machine comprised of rotating cutterheads positioned along both sides and top and bottom of a conveyor belt carrying a log to resaws. As the chipping headrig operator adjusts the cutterheads for a really close shave, the rounded surface of the log is chipped away, leaving a log-length square timber. The whiskers are the chips. Instead of making sawdust as conventional sawing techniques would, the chipping headrig makes chips, a valuable commodity to anyone who happens to own a paper mill.

The chipping headrig kisses the log lightly on all four sides, exposing a minimum face of lumber, for example, four inches in width. The resulting flat-sided cant may then be sawn with band saws to yield boards and planks, some of which will still show irregular edges. The irregular edges are removed with the headrig's companion machine, the chipping edger. The headrig chips away at the log while the edger applies the chipping principle to any remaining irregular edges of the boards and planks.

In industry, "Time is money." For southern lumber manufacturers, the chipping headrig has meant timber can be fed through high-speed breakdown machinery at rates up to 300 feet-per-minute. Pioneer users of the chipping headrig often didn't understand that speed was one of its prime advantages and were slow to utilize the machinery required to feed the chippers at capacity rates. In recent years, however, special log handling equipment has been devised to satisfy the voracious appetites of chipping headrigs.

The time-saving advantage is evident when one considers that during each minute of operation, five to fifteen 16-foot-long logs can travel in a steady end-to-end procession through a chipping headrig. This production contrasts sharply with that of a conventional sawmill carriage on which only one, at best two, 16-foot logs can be loaded, converted to timbers, and offloaded each minute.

Since a single operator can run the highly productive chipping headrig, it is evident that smaller, formerly less marketable logs can be profitably converted into lumber on the chipping headrig than would be possible with a conventional carriage. This simple fact has vastly expanded the amount of timber that can be classified as sawtimber instead of pulpwood.

Dr. Peter Koch, leader of the

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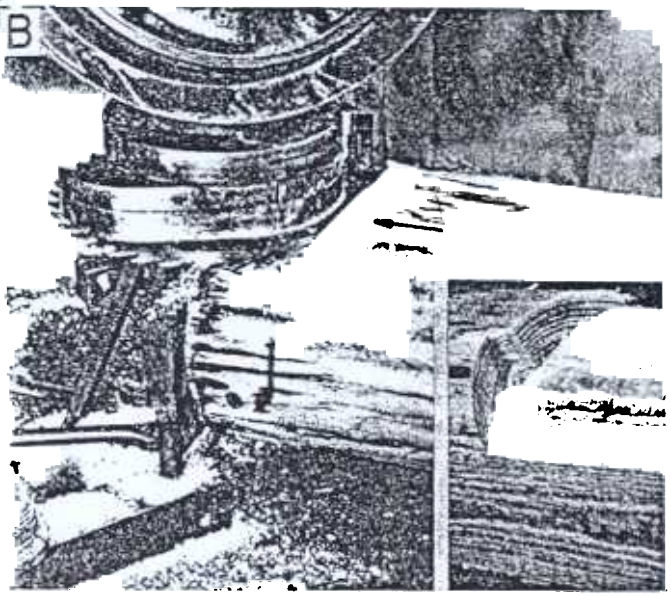
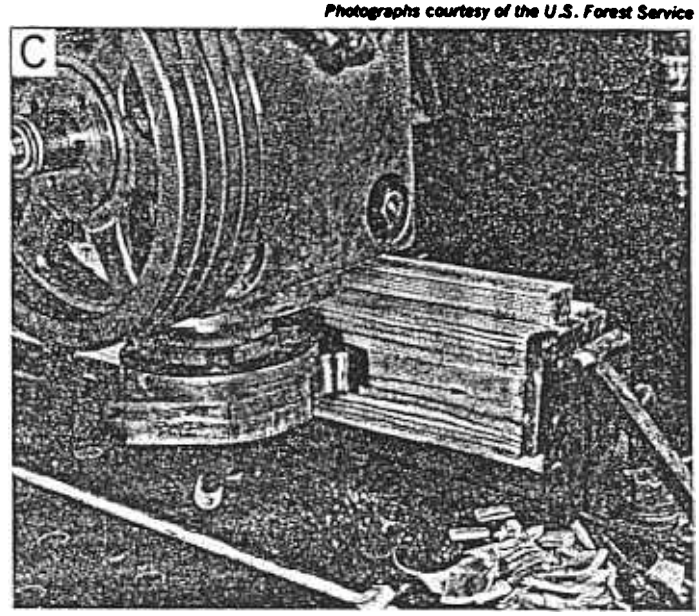
Photographs courtesy of the U.S. Forest Service



Model A. The shaping lathe, still under development but nearing the commercial stage, converts cordwood into cants and flakes (or pulpchips). The cants can be square or hexagonal for use as posts. The arrow indicates the point of contact between cam and cam follower—a device that determines the shape and size of cant. Cutterhead and cant revolve on separate axes; on the commercial model the cutterhead has the same length as the bolt so that machining is completed in a single revolution of the bolt. The commercial machine will process six hardwood or softwood bolts per minute.

Model B. The end-milling chipping headrig, designed for use with southern pines, chips (cuts) across the grain, producing chips with uniform length along the grain. The arrows indicate the movement of the log to the left as it is fed through the machine and the rotating direction of the cutterheads. End milling is similar to the action of a coffee cup base upon a saucer as the cup is rotated or spun with the hand. The sawblade, responsible for the sawdust near the base of the machine, later proved unnecessary and was eliminated.



Model C. Peripheral milling, approximately the action of a carpenter's plane, is shown. The cutterhead rotates in the same direction the log is fed through the machine. The length of the chips, a factor considered when chips are used for the manufacture of paper, is determined by the speed with which the log is fed through the chipping headrig and by the speed of revolution of the cutterhead.

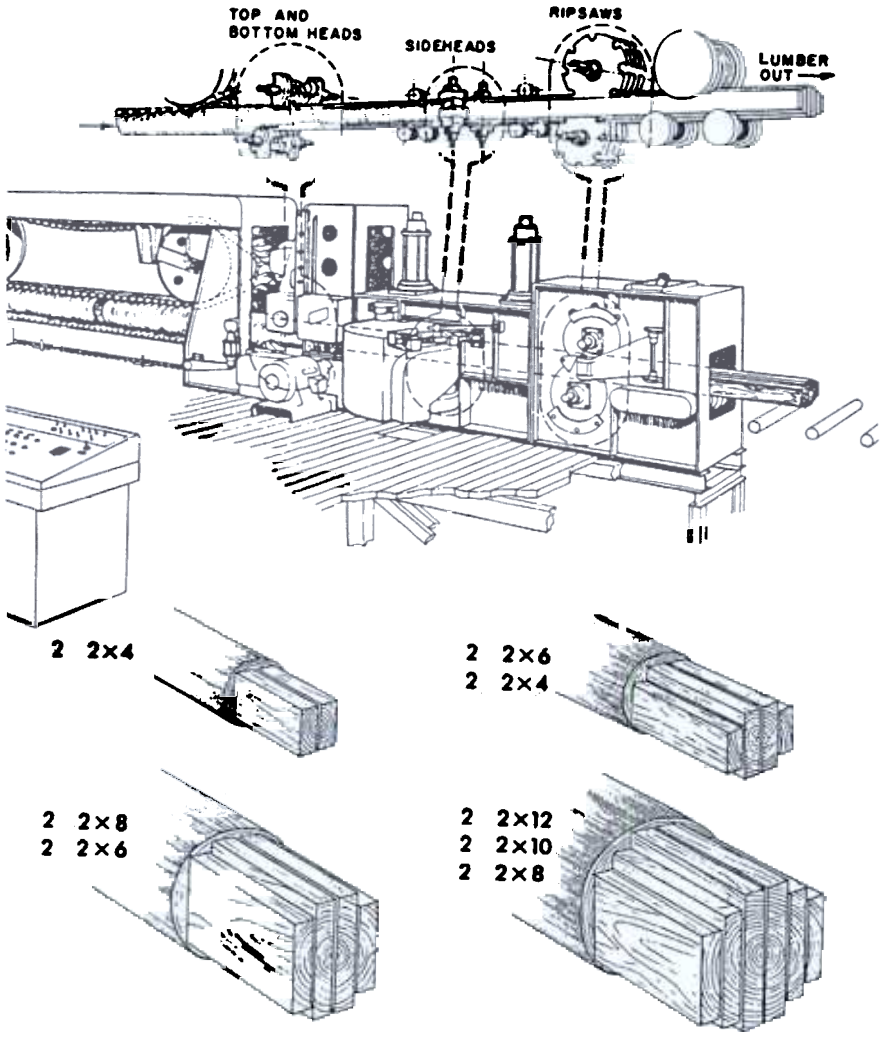
Forest Products Utilization Research Project at the Southern Forest Experiment Station, U. S. Forest Service, has been closely associated with the development and commercial application of the chipping headrig principle. His 1954 doctoral thesis and early experiments were instrumental in gaining acceptance for the revolutionary advances in wood utilization and procurement spawned by this new concept. Early prototypes he designed were progenitors of many of today's commercial models.

"There are two great advantages of the chipping headrig over other methods of processing tree stems," Koch said during a *FORESTS & PEOPLE* interview. "First there is the simplicity and rapidity of continuous feed, with its inherent low labor input. Tree-length stems are fed rapidly and straight-on into the mouth of the chipper. The knife blades slash the outer periphery of the stem, spitting out chips for the pulpmills and a squared beam of timber to be resawn into 1-inch and 2-inch lumber. Where previously there were slabs of wood left from each stem, now there are chips to be used in the manufacture of paper.

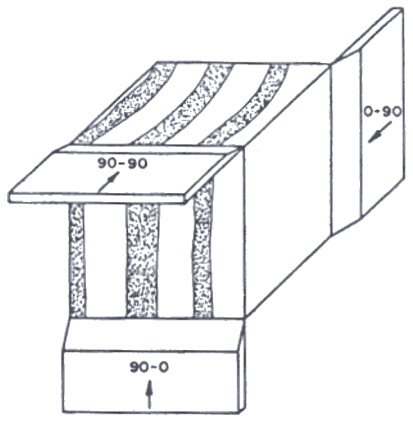
"The second great advantage is that the chipping headrig makes virtually no sawdust. Sawmills using the older, conventional methods of log breakdown and sawing converted as much as 23 per cent of the log volume into sawdust, a commodity of minimal value. Systems using the chipping headrig for breakdown reduce this loss to approximately 5 per cent. Less sawdust also means less materials going to the burner and consequently less potential for air pollution. The chipping headrig also eliminates the dangerous tasks of handling slabs and edgings. Conveyor systems are simpler and mill length can often be reduced."

There are basically three different types of chipping headrigs, Koch explained. The first cuts with the grain, the cutterhead revolving in the same direction the tree stem is moving through the chipper. In a second type, the blades cut across the grain in an end-milling configuration. Both types have been commercially developed for use with southern pine. The third type, the shaping-lathe headrig, is being studied and developed by Koch for use with hardwoods. The wood stem revolves slowly, as if on a veneer peeler, while the cutting blades revolve in the opposite direction, making flakes rather than chips. The flakes are used to manufacture exterior structural flakeboard, a product which will eventually compete in price and function with the sheathing grades of plywood used under roof shingles.

With all three types of chipping headrig, it is economically feasible to convert logs as small as 5¼ inches in diameter into 4 by 4 cants. From such cants, the manufacturer can make two 2 by 4's where previously there was only fiber for pulp and paper. The 2 by 4's are worth approximately four times the value of the same 5¼-inch log converted to chips.



Shown is one of several commercial chipping headrig models. This particular model uses peripheral milling action. At the bottom, ripping and profiling patterns available for different size logs are shown. Properly applied, the chipping headrig can recover all of the lumber available in a log.



The three different tool actions of the three chipping headrig designs are illustrated above. The numbers shown with each cutting edge indicate the angle the cutting edge makes with the grain (first digits) and the angle between the cutter movement and the grain (second digits). The cutting edge shown at the bottom (90-0) is the tool action of peripheral milling; directly above (90-90), the end milling action; and to the right, upper edge (0-90), the shaping lathe action.

Veneer cores left over from the manufacture of pine plywood are the most conspicuous examples of increased wood values realized through the chippers. "A pine core 5¼ inches in diameter and eight feet long," Koch said, "is worth approximately 21 cents in chips for pulp. The same core is worth 87 cents, perhaps even more, when made into two 2 by 4's. The difference between 21 cents and 87 cents is 66 cents, two thirds of a dollar. If the average plant produces a 1,000 such cores a shift and runs for three shifts a day, the day's total is 3,000 cores. At 87 cents a core, the output of the chipping headrig is worth at least $2,610. Converted entirely into pulp chips, those cores would have a value of only about $630, for a net difference of $1,980 per day in favor of the chipping headrig."

The chipping headrig has not only changed the value of trees, it has also changed the outlook and language of foresters. Forest landowners, sawmillers and paper and plywood manufacturers may come to suffer from a form of Future Shock because of the advent of the chipping headrig. The time is already past when an observer can stand at the side of the road, watching the logging trucks passing by with their cargoes, and classify one as a load of sawtimber, the next as pulpwood. Instead, each tree seems destined to become a source for many products despite the size of its stem.

Another radical change may be in the offing. An adjustment in traditional procurement practices of the sawmiller, the paper and plywood manufacturers may be necessary, Koch said. A cooperative "Tree Sharing" system between the three would entail the sawmiller logging the lands of all, regardless of the ownership. The larger logs would be diverted to plywood mills for veneer manufacturing. The sawmiller would keep all the smaller logs, using his chipping headrig for breakdown to lumber. The sawmiller would also receive veneer cores from the plywood plant for conversion into 2 by 4's. The paper manufacturer would receive all the chips from the sawmill and veneer waste from the plywood manufacturer. To further sweeten the pie for the paper and plywood manufacturers, they would be freed from all logging responsibilities, according to Koch's plan.

Utilization of the Total Tree has become an increasingly important aspect of forest conservation in light of increased demand upon a diminishing supply of available timber. The economical conversion of all parts of the tree into useful wood·

(continued on page 36

Dr. Koch inspects a slash pine tap root pulled from the ground like a carrot. If pulpmills harvested tap roots, as well as stems, pulpwood yield for each acre of pine plantation could be increased about 20 percent.

Chipping Headrig—

(continued from page 20)

derived products is a major goal of many researchers. Development of the chipping headrig is but one step in this grand plan, Koch explained during a 1971 address to the International Union of Forestry Research Organizations.

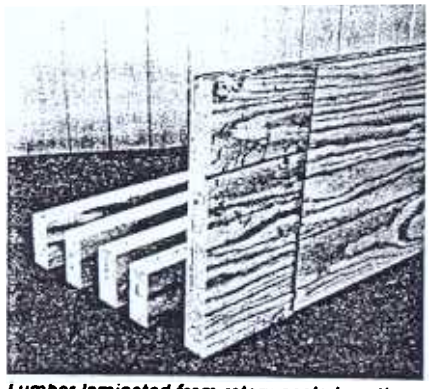
"Logs converted into veneer and then into plywood generally yield even higher value than those converted into lumber. However, veneer manufacturing is usually profitable only if the logs are 12 inches or larger in diameter. This fact, together with the special capabilities of the chipping headrig, has resulted in a new pattern of utilization for southern pine. In the new tree-processing centers, lower portions of the stem 12 inches and larger are converted into veneer for plywood. The intermediate portion of the stem, 6- to 12- inches in the diameter, is converted into lumber by the chipping headrig. Tops too small for the chipping headrig are chipped entirely for the pulpmill. Thus, all portions of the stem are used to recover maximum value."

Koch has pushed back a few personal frontiers as well as those standing in the way of total timber utilization. He has traveled across the Andes Mountains to the Peruvian headwaters of the Amazon. He piloted an aircraft more than halfway around the world from South America across Africa to Shanghai and has taken a 1,000-mile solo canoe trip north on the Yukon River to the Arctic Circle in Alaska. But he sees ever greater frontiers beyond the chipping headrig, frontiers he can find right in the wood utilization laboratory of the Alexandria Forestry Research Center. He can see the day when there will be a use for every scrap of wood in the forest.

"The chipping headrig cut labor costs and provided rapid machining of small logs. It eliminated a lot of sawdust. But it didn't improve the lumber yield of the small logs. Lumber laminated from rotary-peeled veneer may be the answer to this problem.

"At present, we produce only 42 cubic feet of saleable dry-sized lumber out of a log which contains a 100 cubic feet of wood. With lumber laminated from veneer, a process currently under development, we may be able to increase the output to 60 cubic feet for the same input. In the process visualized, one-quarter-inch-thick veneers are first dryed. Then 6 layers are bonded together to form laminated slabs one- and a-half-inches thick, four-feet wide and 64 feet long. These large slabs are then cross-cut to length, e.g., 16 feet, and ripped to width, e.g., 8 inches, to yield lumber that is stronger and more uniform than conventionally sawn lumber. Conventional sawing of lumber creates sawdust and planer shavings of low value. The rotary peeling and laminating process eliminates these low-value residues. Again, the core of the veneer-peeled log can be run through a chipping headrig for conversion to lumber."

Further in the future, but under intensive investigation, is utilization of pine tree roots.



Lumber laminated from rotary-peeled southern pine veneer is twice as strong as lumber sawn from the same class of logs; moreover, yield of laminated wood is 50 percent greater than that of sawn wood. Commercial application of this concept will be another giant step toward better utilization of each tree.

"Looking at the total tree, a shocking amount of the tree's volume, the root system, is still left in the forests after conventional harvesting," Koch said. "Considering the total weight of a 22-year-old slash pine, 4% is needles, 3.5% is the branches and their bark while 5% is the stem measuring less than 4 inches in diameter. The rest of the stem minus its bark is 59% while the bark peeled from this major stem portion is 12.5%. The remaining 16% is the part people never see and which most never realize is there, the massive root..

"The 16 per cent ordinarily left in the ground is more than 25 per cent of the wood volume in the main stem. Recent temporary pulp mill curtailments, and even closures due to lack of wood, highlight the importance of this extra 25 per cent. Preliminary field tests of root removal systems have been promising. In a contemplated but yet untried approach, the main root would be severed from the lateral roots just beneath the ground's surface, leaving most of the laterals to help prevent erosion. The bulk of the tap root would then be pulled up like a carrot and cleaned of dirt. Root wood is lower in density than stem wood. The fibers are longer, larger in diameter and have thinner walls than stem wood. Chemically, both types are much the same. In short, root wood should be usable in the manufacture of paper."

Use of the Total Tree, every bit of wood fiber between the root tips and the crown, is the last frontier Koch and his scientist colleagues will cross in their research. Fifty-one percent of the softwood timber used in the United States by the year 2000 will come from the South. With the chipping headrig under their belts, lumber laminated from veneer in an advanced state of development and root utilization underway, the scientists will likely reach their project objective: "By 1980 to invent processes that will double the 1963 product tonnage economically recoverable from each southern pine tree."