

**WILLIAM  
NOYES**

HANDWORK IN  
WOOD

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*Handwork in Wood:*

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# William Noyes

## Handwork in Wood

### FOREWORD

This book is intended primarily for teachers of woodwork, but the author hopes that there will also be other workers in wood, professional and amateur, who will find in it matter of interest and profit.

The successful completion of the book is due chiefly to the untiring assistance of my wife, Anna Gausmann Noyes, who has made almost all of the drawings, corrected the text, read the proof, and attended to numberless details.

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# Chapter I.

## LOGGING

The rough and ready methods common in American logging operations are the result partly of a tradition of inexhaustible supply, partly of the fear of fire and the avoidance of taxes, partly of an eagerness to get rich quick. Most of the logging has been done on privately owned land or on shamelessly stolen public land, and the lumberman had no further interest in the forest than to lumber it expeditiously.

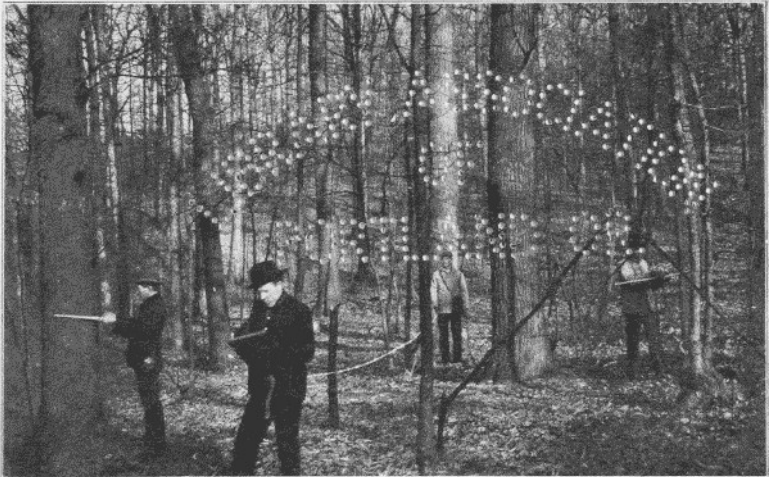


Fig. 1. Making a Valuation Survey.





## Fig. 2. "Blazes" on Trees.

Preliminary to the actual logging are certain necessary steps. First of all is *landlooking*. This includes the survey of the forest land for the purpose of locating good timber. Fig. 1. Most of the woodland has previously been roughly surveyed by the government and maps made indicating which parts are private land and which are still held by the government. The boundaries of townships, sections, quarter sections, eighties, forties, etc., are indicated by "blazes" on trees, Fig. 2, so that the "cruiser" or "looker" as he goes thru the woods can identify them with those on his oil paper map. The cruiser also studies the kinds and character of the trees, the contour of the ground, the proximity to streams,—all with the view to marketing the product. Acting on the information thus gained by the cruiser, the lumberman purchases his sections at the proper land office, or if he is less scrupulous, buys only enough to serve as a basis for operations. Enormous fortunes have been made by timber thieves, now respectable members of the community. As a further preliminary step to lumbering itself, the *tote road* and *camp* are built. The tote road is a rough road on which supplies for crew and cattle can be taken to camp from civilization.

It is barely passable for a team and a wagon, but it serves its purpose, and over it come more men and horses. Lumber for the floors and roofs of the shanties and for the rude pieces of furniture that will be needed, tarred paper to make

the roofs tight, a few glazed window sashes, a huge range and a number of box stoves, dishes and kitchen utensils, a little stock of goods for the van, blankets by the dozen and score, and countless boxes and barrels and bags of provisions.<sup>1</sup>

The *camp* itself, Fig. 3, is built of logs, roofed with plank, covered with heavy tar paper, and dimly lighted. There are usually five buildings,—the men's camp, the cook camp, the office, the barn, and the blacksmith's shop. Many camps accommodate from eighty to one hundred men. The men's camp is filled with bunks and is heated by a stove and in general roughly furnished. Cooking and eating are done in the cook camp, where the cook and his assistant, the "cookee," sleep. The office is occupied by the foreman, log-sealers and clerks. Here the books and accounts are kept, and here is the "van," stocked with such goods as will supply the immediate needs of the lumber jacks.

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<sup>1</sup> Hulbert: The Lumber Jack; Outlook, 76: 801, April 2, '04.



Fig. 3. Winter Logging Camp. Itasca County, Minnesota.

Before winter sets in the *main road* is built, Fig. 15, [p. 17](#), very carefully graded from the camp down to the nearest mill or railway siding, or oftener to the stream down which the logs are to be floated. This road has to be as wide as a city street, 25 feet. The route is carefully chosen, and the grade is made as easy as possible. Much labor is spent upon it, clearing away stumps and rocks, leveling up with corduroy, building bridges strong enough to carry enormous loads, and otherwise making it as passable as can be; for when needed later, its good condition is of first importance. This main road is quite distinct from and much superior to the tote road.

At intervals alongside the main road, small squares called *skidways* are cleared of brush and in each of them two tree trunks, "skids," are laid at right angles to the road. On these the

logs, when cut later, are to be piled. Back from the skidways, into the woods the swampers cut rough, narrow roads called *dray roads* or *travoy roads*,—mere trails sufficiently cleared of brush to allow a team of horses to pull a log thru.

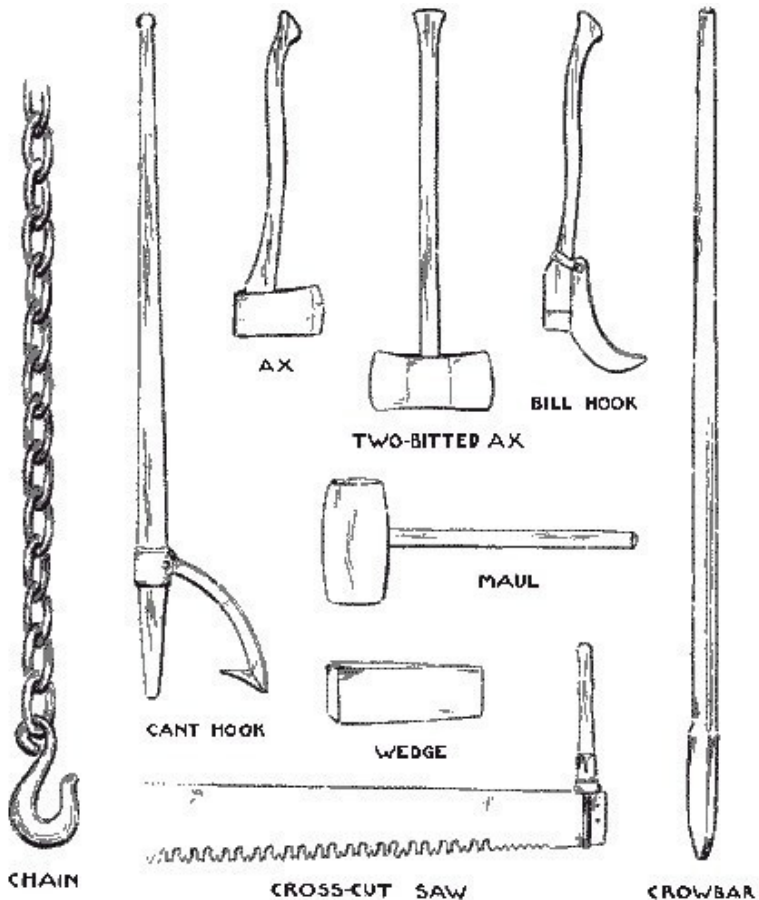


Fig. 4. Tools used in Logging.

All these are operations preliminary to the felling of trees.

The tools commonly used in logging are shown in Fig. 4. When everything is ready for felling, the "fitter" goes ahead *marking* each tree to be felled and the direction in which it is to fall by cutting a notch on that side. Then come the sawyers in pairs, Fig. 5. First they chop a deep gash on the side of the tree toward which it is to fall, and then from the opposite side begin cutting with a long, Tuttle-tooth, crosscut-saw. The saw is a long, flexible ribbon of steel, with handles so affixed to each end that they can be removed easily. The cut is made on the pulling stroke, and hence the kerf can be very narrow. As soon as the saw is well within the trunk, the sawyers drive iron wedges into the kerf behind it, partly to keep the weight of the trunk from binding the saw, and partly to direct its fall. Then the saw is pulled back and forth, and the wedges driven in farther and farther, until every stroke of the maul that drives them sends a shiver thru the whole tree. Just as the tree is ready to go over, the saw handle at one end is unhooked and the saw pulled out at the other side. "Timber!," the men cry out as a warning to any working near by, for the tree has begun to lean slightly. Then with a hastening rush the top whistles thru the air, and tears thru the branches of other trees, and the trunk with a tremendous crash strikes the ground. Even hardened loggers can hardly keep from shouting, so impressive is the sight of a falling giant tree.



Fig. 5. Felling Red Spruce with a Saw.

Adirondack Mountains, New York.



Fig. 6. Sawing Logs into Lengths.

All this seems simple enough in outline, but the actual execution requires considerable skill. Trees seldom stand quite vertical, there is danger of lodging in some other tree in thick woods, and it is therefore necessary to throw trees quite exactly. Some men become so expert at this that they can plant a stake and drive it into the ground by the falling trunk as truly as if they hit it with a maul. On the other hand, serious accidents often happen in falling trees. Most of them come from "side winders,"

i. e., the falling of smaller trees struck by the felled trees.

After "falling" a tree, the sawyers mark off and saw the trunk into log lengths, Fig. 6, paying due attention to the necessity of avoiding knots, forks, and rotten places, so that some of the logs are eighteen feet, some sixteen feet, some fourteen feet, and some only twelve feet in length. Meanwhile the swampers trim off the branches, Fig. 7, a job requiring no little skill, in order that the trunk may be shaved close but not gashed.



Fig. 7. Trimming off Branches of Spruce.

Adirondack Mountains, New York.



Fig. 8. Hauling Spruce Logs to the Skidway.

Adirondack Mountains, New York.

This finishes the second group of operations, the felling. Next the logs are *dragged* out to the dray roads, Fig. 8. A heavy pair of tongs, like ice-tongs, is attached to one end, and the log is snaked out by horses to the skidway. If the log is very heavy, one end is put on a dray. By one way or another the log is dragged out and across the two parallel skids, on which it is rolled by cant-hooks to the end of skids toward the road way. If other logs already occupy the skids, each new log as it arrives is piled on the first tier. As the pile grows higher, each log is "decked," that is, rolled up parallel poles laid slanting up the face of the pile, by means of a chain passed under and over the log and back over the pile,

Fig. 11. A horse hitched to the end of the chain hauls up the log, which is guided by the "send-up men" with their cant-hooks.

Once piled the logs are "*scaled*," that is measured in order to compute the number of board feet in them, Fig. 9. The scaler generally has an assistant, for logs in large piles must be measured at both ends in order to determine which is the top, the body of the log being out of sight. When measured each end of the log is stamped with a hammer with the owner's mark, by which it can afterward be identified. Here the logs rest and the felling and skidding continue until deep snow falls and then the sleigh haul begins.



Fig. 9. "Scaling" Logs on the Skids.



Fig. 10. Making an Ice Road by Flooding.



Fig. 11. Decking Logs on Skidway.

For this the main road is especially prepared. First the road is carefully *plowed* with an immense V plow, weighted down by logs. To the plow are attached fans. Only an inch or two of snow is left on the ground by this plow, which is followed by another special plow to gouge the ruts, and by a gang of "road monkeys" who clear the road thoroly. Then follows an immense tank set on runners and holding perhaps seventy-five barrels of water, and so arranged as to flood the road from holes in the bottom of the tank, a sort of rough road sprinkler, Fig. 10. The sprinkler goes over the road again and again until the road is covered by a clear, solid sheet of ice often two feet thick, extending from the skidways to the banking grounds. This ice road is one of the

modern improvements in logging. Once finished, these roads are beautiful pieces of construction with deep, clear ruts. They have to be constantly watched and repaired, and this is the work of the "road monkeys." If possible the road has been made entirely with down grades but some of these are so steep that a man must be prepared with sand or hay to check too headlong a descent.



Fig. 12. Loading a Sled from a Skidway.



Fig. 13. A Load of Logs. Flathead County, Montana.

When all is ready the sleigh haul begins. Piling on the sleighs or bobs, Fig. 12, is similar to piling on the skidways, but more difficult, for the load has to be carefully balanced, Fig. 13. Chains bind the loads but the piling is only too apt to be defective, and the whole load "squash out" with a rush. It is a time of feverish activity. The sprinklers are at work till after midnight, the loaders are out long before daylight. The blacksmith is busy with repairs, the road monkeys work overtime, and the cook works all the

time. "Everybody works." The haul itself is full of excitement. The ponderous load of logs, weighing anywhere from eight to thirty-five tons has to be conducted largely by its own momentum down this glassy road. If a horse fall nothing can save its life. If the runners get out of the ruts, the whole load, driver and all, is likely to be upset. It is an extremely hazardous job, Fig. 15.

As each load comes down to the *banking grounds*, Fig. 14, or log dump, it is stopped opposite long parallel skids. The wrapping chains are unhooked and the lower log on the skid side is worked out with cant-hooks till the whole load flattens out. The logs are then "decked" on immense piles, sometimes a mile long and filling the whole river from bank to bank. A decking chain 300 feet long is sometimes required to roll the logs to their proper places. Here the logs rest till the spring freshets come. This completes the transportation by land.



Fig. 14. Banking Grounds.

With the coming of the spring thaw, the river bed is filled with a freshet of water which seizes and carries the logs down stream. Many on the banks, however, have to be started on their way, and this is called "breaking out the roll ways." They often start on their water journey with a great crash.



Fig. 15. The Sleigh Haul.



Fig. 16. Sacking the Rear.

Now comes *the drive*, an arduous and often perilous task. Some of the men are stationed along the shores to prevent the logs from lodging or floating into bays or setbacks. Some stand at the heads of bars or islands, where with pike poles they shove off the logs that might stop there and form a jam; others follow "sacking the rear" to clean out such logs as may have become stranded. This "sacking the rear" takes most of the time, Fig. 16. While "on the drive" men often work fourteen hours a day, a good part of the time up to their waists in ice water. Their boots

are shod with "caulks," or spikes, to keep them from slipping on the logs, and they carry either pike poles or peaveys, Fig. 17. The latter are similar to cant-hooks, except that they have sharp pikes at their ends. So armed, they have to "ride any kind of a log in any water, to propel a log by jumping on it, by rolling it squirrel fashion with the feet, by punting it as one would a canoe; to be skilful in pushing, prying, and poling other logs from the quarter deck of the same cranky craft." Altho the logs are carried by the river, they have to be "driven" with amazing skill and bravery.



Fig. 17. Log Driving on the Ausable River.

The climax of hardship and courage is reached when a "jam" is formed, Fig. 18. Sometimes one or two logs are caught in such a way as to be locked or jammed and then soon other logs begin to accumulate behind them, till the whole river is full of a seemingly inextricable mass. Sometimes these jams can be loosened by being pulled apart, one log at a time. A hundred men can pull out an amazing number of logs in a day. The problem always is to set free or cut out certain "key" logs, which lock the whole mass. Following is a description by Stewart Edward White of the breaking of such a jam:

The crew were working desperately. Down on the heap somewhere, two logs were crossed in such a manner as to lock the whole. They sought those logs.

Thirty feet above the bed of the river six men clamped their peaveys into the soft pine; jerking, pulling, lifting, sliding the great logs from their places. Thirty feet below, under the threatening face, six other men coolly picked out and set adrift one by one, the timbers not inextricably imbedded. From time to time the mass creaked, settled, perhaps even moved a foot or two; but always the practised rivermen, after a glance, bent more eagerly to their work. \* \* \* Suddenly the six men below the jam scattered. \* \* \* holding their peaveys across their bodies, they jumped lightly from one floating log to another in the zig-zag to shore. \* \* \*



Fig. 18. Log Jam. Adirondack Mountains, New York.

In the meantime a barely perceptible motion was communicating itself from one particle to another thru the center of the jam. \* \* \* The crew redoubled its exertion, clamping its peaveys here and there, apparently at random, but in reality with the most definite of purposes. A sharp crack exploded immediately underneath. There could no longer exist any doubt as to the motion, altho it was as yet sluggish, glacial. Then in silence a log shifted—in silence and slowly—but with irresistible force \* \* \* other logs in all directions up-ended. \* \* \*

Then all at once down by the face something crashed, the

entire stream became alive. It hissed and roared, it shrieked, groaned, and grumbled. At first slowly, then more rapidly, the very fore-front of the center melted inward and forward and downward, until it caught the fierce rush of the freshet and shot out from under the jam. Far up-stream, bristling and formidable, the tons of logs, grinding savagely together, swept forward. \* \* \*

Then in a manner wonderful to behold, thru the smother of foam and spray, thru the crash and yell of timbers, protesting the flood's hurrying, thru the leap of destruction, the drivers zigzagged calmly and surely to the shore.

Sometimes cables have to be stretched across the chasm, and special rigging devised to let the men down to their dangerous task and more especially to save them from danger when the crash comes.



Fig. 20. Splash-Dam.



Fig. 21. Logs in Boom. Glens Falls, New York.

In case such efforts are unavailing, it is necessary to "shoot" the jam with dynamite. Another device resorted to where the supply of water is insufficient is the *splash-dam*, Fig. 20. The object is to make the operator independent of freshets, by accumulating a head of water and then, by lifting the gates, creating an artificial freshet, sufficient to float the timber down stream.



Fig. 22. A Sorting Jack.

Thus by one means and another, the logs are driven along until caught by a boom, Fig. 21, which consists of a chain of logs stretched across the river, usually at a mill. Since the river is a common carrier, the drives of a number of logging companies may float into the mill pond together. But each log is stamped on both ends, so that it can be sorted out, Fig. 22, and sent into the boom of its owner.

## MECHANICAL METHODS IN LUMBERING

The operations described above are those common in the lumber regions of the northeast and the Lake States. But special conditions produce special methods. A very effective device where streams are small is the flume, Fig. 23. This is a long wooden trough thru which water is led, and the logs floated end on. It is sometimes many miles long; in one case in California twenty-five miles.

In the South where there is no snow, logs are largely brought out to the railway or river by being hung under immense two-wheeled trucks, called slip-tongue carts, drawn by mules, Fig. 24. The wheels are nearly eight feet in diameter.



Fig. 23. Six Mile Flume. Adirondack Mountains, New York.

Some kinds of wood are so heavy that they will not float at all, and some sink so readily that it does not pay to transport them by river. In such cases temporary railways are usually resorted to.



Fig. 24. Hauling Logs by Mules. Oscilla, Georgia.

On the Pacific coast, where the forests are dense, the trees of enormous size, and no ice road is possible, still other special methods have been devised. On so great a scale are the operations conducted that they may properly be called engineering feats. Consider for a moment the size of the trees: red fir ranges from five to fifteen feet in diameter, is commonly two hundred fifty feet high, and sometimes three hundred twenty-five feet high. The logs are commonly cut twenty-five feet long, and such logs often weigh thirty to forty tons each, and the logs of a single tree may weigh together one hundred fifty tons. The logging of such trees requires special appliances. Until recently all the improved methods were in forms of transportation, the felling still being done by hand with very long saws, Fig. 25, but now

even the felling and sawing of logs in the forest is partly done by machinery.



Fig. 25. A Twenty-Five Foot Saw used for Crosscutting Big Logs.



Fig. 26. Hauling Big Logs by Donkey Engine.

To work the saw, power is supplied by a steam or gasoline engine mounted upon a truck which can be taken readily from place to place. As the maximum power required is not over ten-horse-power, the apparatus is so light that it can be moved about easily. The saw can be adjusted to cut horizontally, vertically, or obliquely, and hence is used for sawing into lengths as well as for felling.

*Falling beds.* Since the weight of a two hundred fifty foot fir is such that if the impact of its fall be not gradually checked the force with which it strikes the ground may split the trunk, a bed for its fall is prepared by the swampers. Usually piles of brush are placed as buffers along the "falling line" so that the trunk will strike these. If the tree stands on the hill side, it is thrown up hill,

in order to shorten the fall.

After the felling comes the trimming of branches and knots and "rossing" of bark, to lessen the friction in sliding along the skidway.

*The skidway.* By the skidway in the Puget Sound region is meant a corduroy road. This is constructed of trunks of trees ranging from a foot to two feet in diameter. These are "rossed," that is, stripped of their bark and laid across the road, where they are held in place by pegs driven into the ground, and by strips spiked upon the tops of the logs. If possible they are laid in swampy places to keep the surface damp and slippery. At turns in the road, pulleys are hung, thru which the hauling cables pass. The skidway runs to the railway siding or water's edge. Over these skidways the logs are hauled out by various means. Formerly "strings" of oxen or Percheron horses were used, but they are now largely superseded by some form of donkey engine, Fig. 26. These are placed at the center of a "yard."

Yarding is the skidding of logs to the railway or water way by means of these donkey engines. Attached to the donkey engine are two drums, one for the direct cable, three-fourths to one inch in diameter and often half a mile long, to haul in the logs, the other for the smaller return cable, twice as long as the direct cable and used to haul back the direct cable. At the upper end of the skidway, when the logs are ready to be taken to the railway or boomed, they are fastened together, end to end, in "turns" of four or more. The direct cable is attached to the front of the "turn",

and the return cable to the rear end. By winding the direct cable on its drum, the "turn" is hauled in. The return cable is used to haul back the end of the direct cable, and also, in case of a jam, to pull back and straighten out the turn. Instead of a return cable a horse is often used to haul out the direct cable. Signaling from the upper end of the skidway to the engineer is done by a wire connected to the donkey's whistle, by an electric bell, or by telephone.

Sometimes these donkey engines are in relays, one engine hauling a turn of logs to within reach of the next one, which passes it on to the next until the siding is reached.



Fig. 27. Steam Skidder at Work. Grant County, Arkansas.

Where there are steep canons to be crossed, a wire trolley may be stretched and the great logs carried over suspended from it.

In the South a complicated machine called a steam skidder, Fig. 27, equipped with drums, booms, etc., is much used both for skidding in the logs and then for loading them on the cars. It is itself mounted on a flat car.

An improvement on this is the locomotive boom derrick which is widely used both on the Pacific coast and of late in the Lake Superior region. It is a combined locomotive, skidder

and loader. Its most unique feature is that it can be lifted off the track so as to allow flat cars to run underneath it. This feat is accomplished thus: A device, which is something like that used in elevating the bodies of coal wagons, lifts the engine several feet above the rails. Then steel legs, which are curved outwardly, are lowered until the shoes which are attached to them rest on the outward end of the railroad ties. The truck of the locomotive is then folded up under it out of the way and cars can run under it, the curved legs giving plenty of clearance. The derrick attached is of the breast type, the two legs being firmly fastened. When anchored the engine can be used either for skidding or loading. For skidding, there are two cables, one being run out while the other is being wound on its drum.



Fig. 28. Log Train, Humboldt County, California.

In loading, the machine is located so that the empty car will be directly in front of it, and then the logs are lifted up and placed on the car by the derrick. When the car is loaded the machine can either move on to the next car, or pull it under itself into place. With the help of four men it can load from 125,000 to 150,000 feet of timber in a day. By means of the cable it can make up a train, and then by lowering the truck and raising the legs out of the way, it is converted into a locomotive and hauls the train away to the mill or railway station at the rate of three or four miles at hour.

As forests are cut away along the water courses, railways have to be resorted to more and more, Fig. 28. This has had a stimulative effect on the logging business, for now the logger is independent of the snow. On account of the steep grades and sharp curves often necessary in logging railways, a geared locomotive is sometimes used, Fig. 29. It can haul a train of twenty loaded cars up a twelve per cent grade. The geared engine has also been used as a substitute for cable power, in "yarding" operations. The "turns" of logs are drawn over the ground between the rails, being fastened to the rear of the engine by hook and cable. This has proved to be a very economical use of power and plant.



Fig. 29. Donkey Engine Yarding.

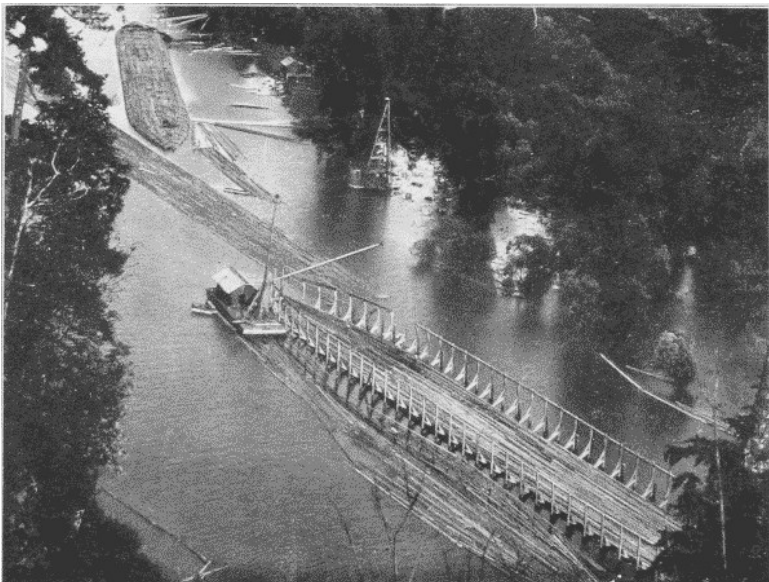


Fig. 30. Giant Raft. In the background is a completed raft;

in the foreground a cradle in which a raft is being built.

Another method of traction where the woodland is open enough is with a traction engine. The ones employed have sixty to one hundred horse power. The great logs may be placed on wood rollers, as a house is when moved, or the logs may be hauled in on a low truck with broad wheels. The "tractor" hauls the log direct to the railway if the distance is not too great.



Fig. 31. Snow Locomotive. Takes the place of 12 teamsters and 12 horses. Minnesota.

In Northern Michigan a "snow locomotive," Fig. 31, is coming into use, which has tremendous tractive power, hauling one hundred to one hundred fifty tons of lumber over snow or ice. It moves on runners, but there is between them a large cylinder armed with teeth. This cylinder can be raised or lowered by the operator as it moves over the surface of the ground. The teeth catch in the snow or ice, and since the cylinder is heated by the exhaust steam, it melts and packs the snow for the trucks following it. The drum is six feet in diameter, with walls an inch and a half thick, and it weighs seven tons. It is used in all sorts of places where horses cannot go, as in swamps, and by substituting wheels for runners it has even been used on sand.

In the Canadian lakes there has been devised a queer creature called an "alligator," a small and heavily equipped vessel for hauling the logs thru the lakes. When its operations in one lake are finished, a wire cable is taken ashore and made fast to some tree or other safe anchorage, the capstan on its forward deck is

revolved by steam and the "alligator" hauls itself out of the water across lots to the next lake and begins work there.

The greatest improvement in water transportation is the giant raft, Fig. 30. When such a raft is made up, logs of uniform length are placed together, the width of the raft being from sixty to one hundred feet and its length, one thousand feet or more. It may contain a million board feet of timber. The different sections are placed end to end, and long boom sticks, i. e., logs sixty to seventy feet long, are placed around them to bind the different sections together, and finally the whole mass is heavily chained. Such a raft has been towed across the Pacific.

## LOGGING

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## Chapter II.

# SAWMILLING

The principal saws in a mill are of three kinds, the circular, Fig. 32, the gang, Fig. 33, and the band, Fig. 34. The circular-saw, tho very rapid, is the most wasteful because of the wide kerf, and of course the larger the saw the thicker it is and the wider the kerf. The waste in sawdust is about one-fifth of the log. In order to lessen this amount two smaller saws, one hung directly above the other, have been used. One saws the lower half of the log and the other the upper half. In this way, it is possible to cut very large logs with the circular-saw and with less waste. The circular-saw is not a perfectly flat disc, but when at rest is slightly convex on one side and concave on the other. This fullness can be pushed back and forth as can the bottom of an oil-can. When moving at a high rate of speed, however, the saw flattens itself by centrifugal force. This enables it to cut straight with great accuracy.

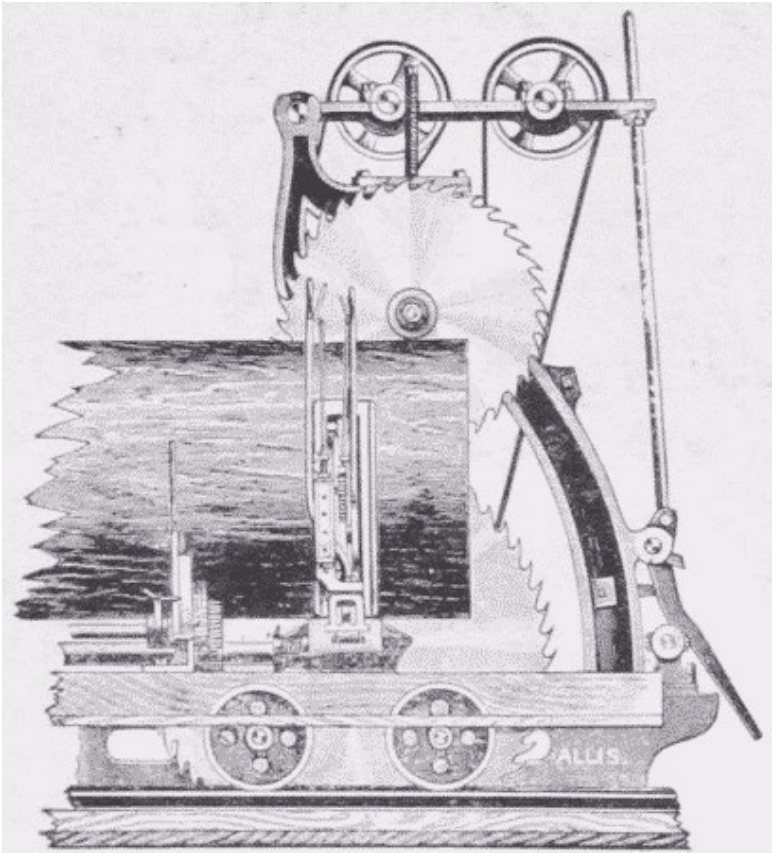


Fig. 32. Double Circular-Saw and Carriage.

A gang-saw is simply a series of straight saw-blades set in a vertical frame. This has a reciprocating motion, enabling it to cut a log into a number of boards at one time. It has this drawback,

that it must cut the size of lumber for which it is set; that is, the sawyer has no choice in cutting the thickness, but it is very economical, wasting only one-eighth of the log in sawdust. A special form is the flooring gang. It consists of a number of saws placed one inch apart. Thick planks are run thru it to saw up flooring.

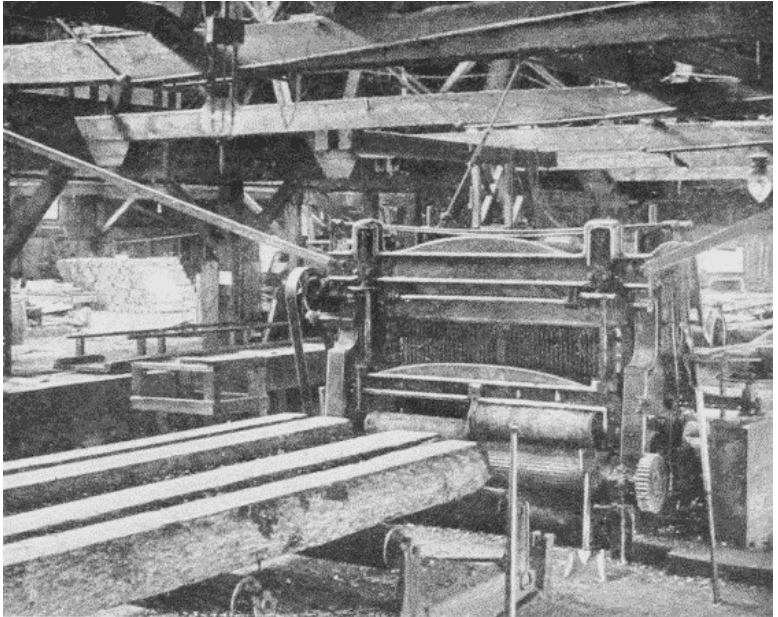


Fig. 33. Gang-Saw.

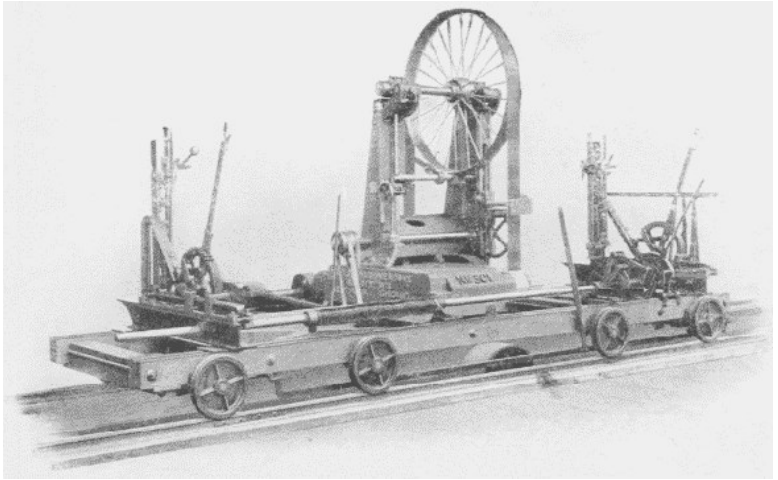


Fig. 34. Band-Saw.

The band-saw is fast displacing the other two, wherever it can be used. It cuts with great rapidity and the kerf is narrow. When first used it could not be depended upon to cut straight, but by utilizing the same principle that is used in the circular-saw, of putting the cutting edge under great tension by making it slightly shorter than the middle of the saw, it now cuts with great accuracy. Band-saws are now made up to 12 inches wide, 50 feet long, and run at the rate of 10,000 feet a minute. They are even made with the cutting teeth on both edges, so that the log can be sawed both going and coming. This idea was unsuccessful until the invention of the telescopic band-mill, Fig. 35. In this the entire mechanism carrying the wheels on which the band-

saw revolves can be moved up and down, so as to bring the point where the saw leaves the upper wheel as close to the top of the different sized logs as possible.

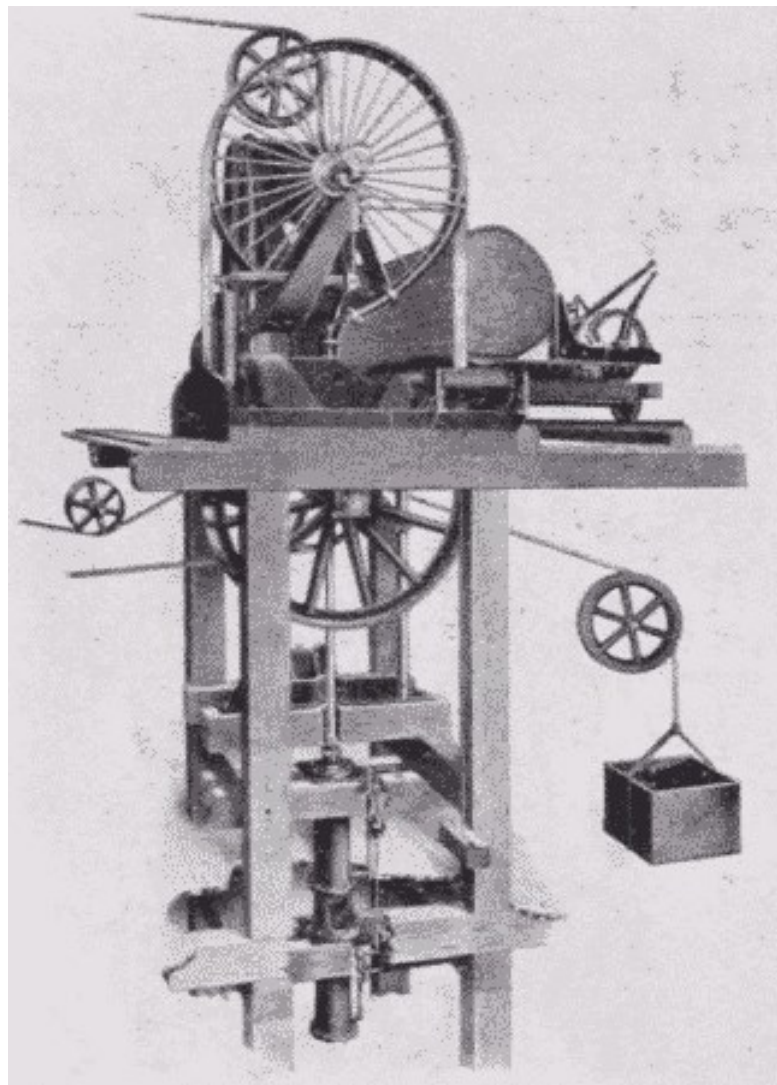


Fig. 35. Double-Carrying Telescopic Band-Mill.



Fig. 36. Jack-Ladder, with Endless Chain. Mill in raised position for large log.

The usual modern mill is a two story building, Fig. 37, built at a convenient locality both for receiving the logs and for shipping the lumber. Whether the logs arrive by water or by rail, they are, if possible, stored in a mill-pond until used in order to prevent checking, discoloration, decay, and worm attack. From the pond they are hauled up out of the water on to a "jack-ladder," by

means of an endless chain, provided with saddles or spurs which engage the logs and draw them up into the second story on to the log slip, Fig. 36.



Fig. 37. Two-Story Mill at Virginia, Minnesota, Showing Jack-Ladders and Consumer.

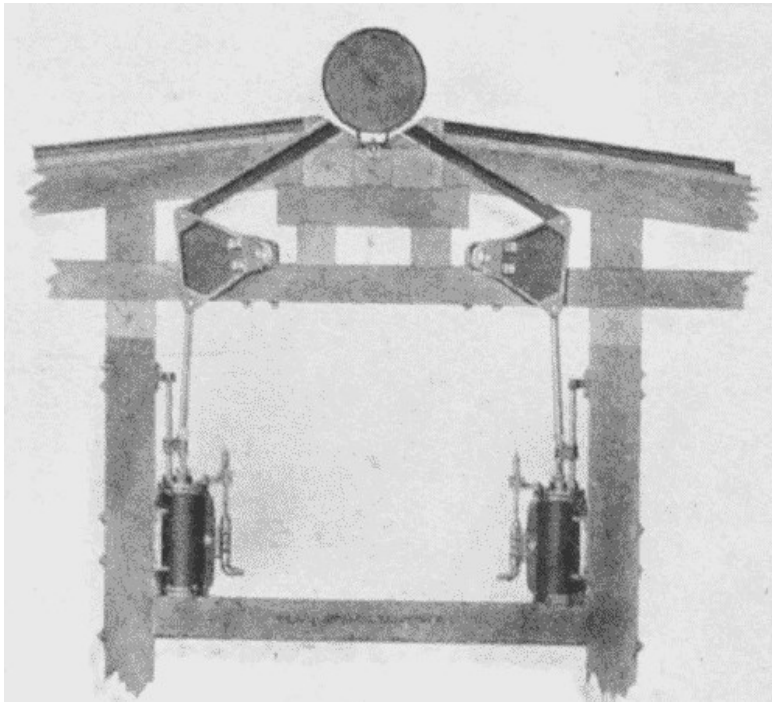


Fig. 38. Log-Flipper.

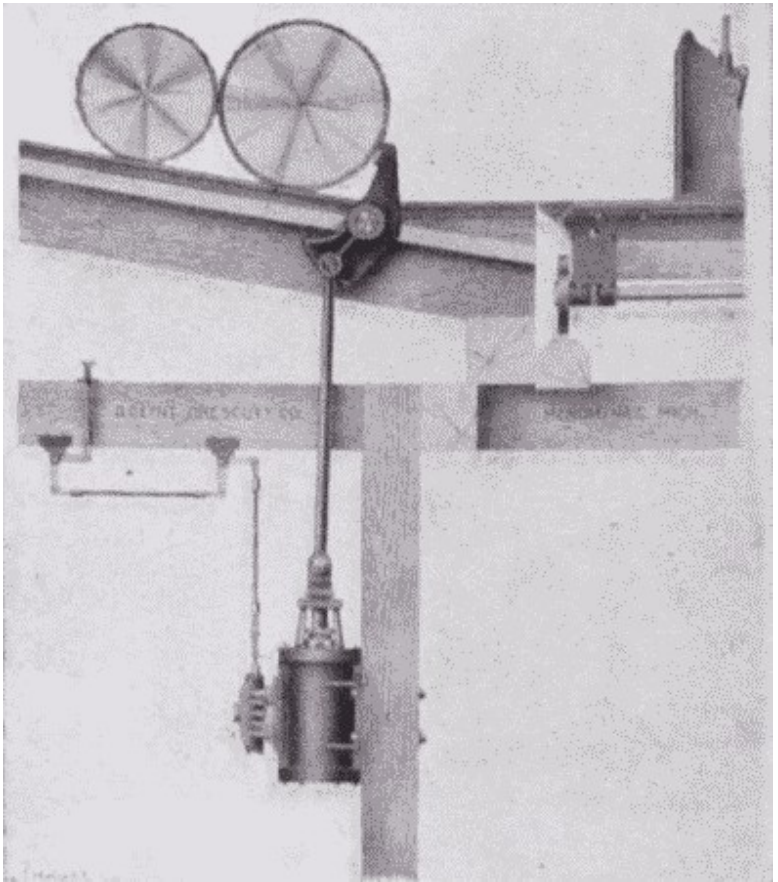


Fig. 39. Log-Stop and Loader. By letting steam into the cylinder, the projecting arm revolves, rolling one log over onto the carriage and holding the next one till wanted.

After the logs have entered the mill, they are inspected for stones lodged in the bark, and for spikes left by the river men, and then measured. Under the log-slip is the steam "flipper" or "kicker," Fig. 38, by means of which the scaler or his assistant, throwing a lever, causes the log to be kicked over to one side or the other, on to the log-deck, an inclined floor sloping toward the saw-carriage. Down this the log rolls until stopped by a log-stop, or log-loader, Fig. 39, a double-aimed projection, which prevents it from rolling on the carriage till wanted. This stop is also worked by steam. By letting the steam into the cylinder which controls it, one log is rolled over on the carriage and the next one held. The log on the carriage is at once "dogged," that is, clamped tight by iron dogs, the carriage is set for the proper cut, and moves forward to the saw which cuts off the first slab. The carriage is then "gigged" or reversed. This operation offsets the carriage one-eighth of an inch so that the log returns entirely clear of the saw. In the same way two or three 1" boards are taken off, the dogs are then knocked out, and the log canted over half a revolution. This is done by means of the "steam nigger," Fig. 40, a long, perpendicular toothed bar which comes up thru the floor, engages the log, and turns it over till the sawn side comes up against the knees of the carriage. The log is dogged again and a second slab and several boards are taken off. The log or "stock" as it is now called, is 10", 12", 14", or 16" thick; the "nigger" then gives it a quarter-turn, leaving it lying on a sawn side. It is dogged again, and all sawn up except enough to make a few

boards. This last piece is given a half-turn, bringing the sawn side against the knees, and it is sawn up. Each board as it is sawn off is thrown by the board-flipper or cant-flipper,<sup>3</sup> Fig. 41, on to the "live rollers," which take it to the next process. Another log comes on the carriage and the process is repeated.

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<sup>3</sup> A "cant" is a squared or partly squared log.

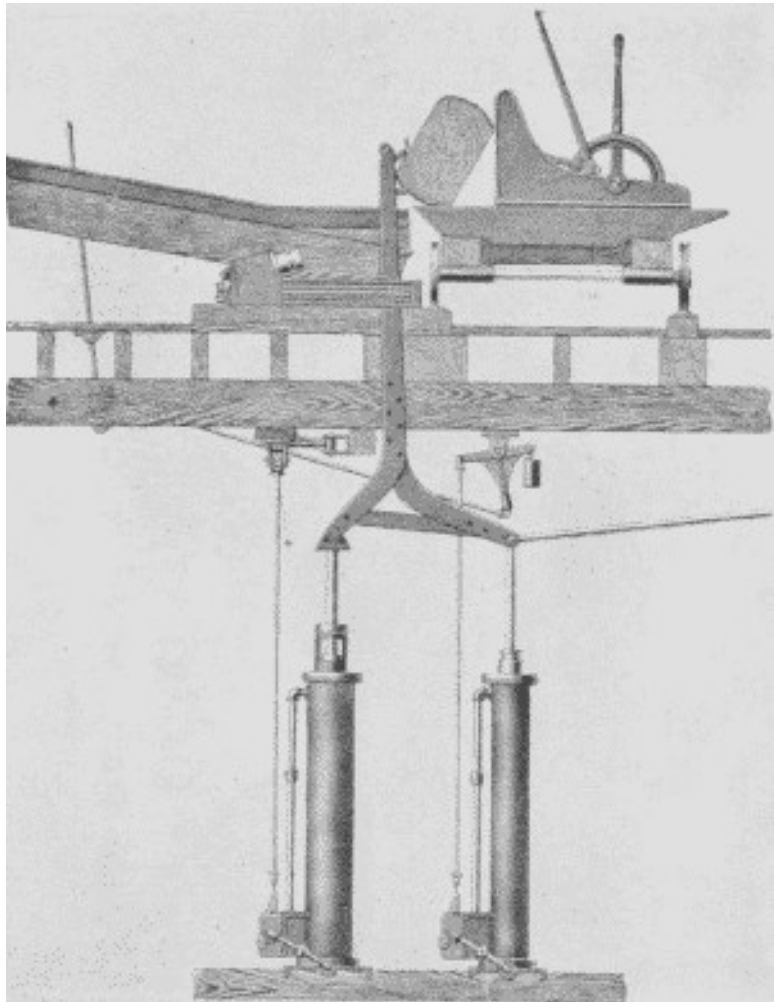


Fig. 40. The Steam Nigger.

The toothed bar turns the log over into the desired position.

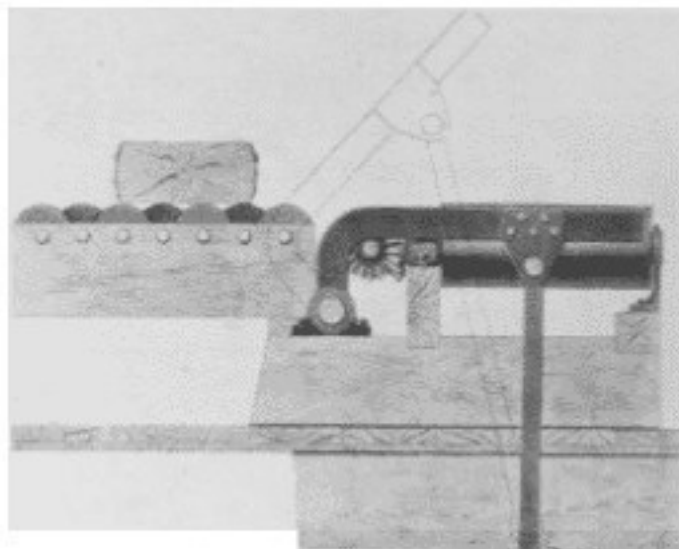
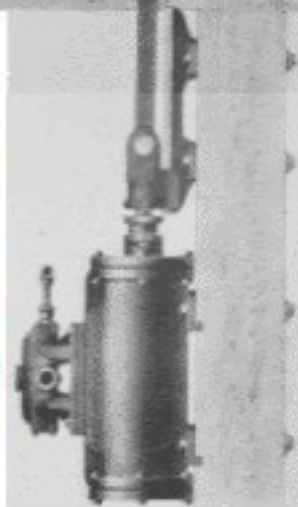


Fig. 41. Steam Cant-Flipper. This machine is used to move cants, timber, or lumber from five rollers to gangs, band resaw mills, or elsewhere. The timber is discharged upon skid rollers, as shown, or upon transfer chains.



The saw-carriage, Fig. 42, is propelled forward and back by a piston running in a long cylinder, into either end of which steam can be turned by the operator.

As the sawn boards fall off the log, they land on "live," that is, revolving rollers, which carry them along at the rate of 200 to 250 feet a minute. Stops are provided farther along to stop the boards wherever wanted, as at the edger, Fig. 43, or the slasher. From the live rollers the boards are transferred automatically, Fig. 44, by chains running at right angles to the rollers and brought within reach of the edger man. About one-third of the boards of a log have rough edges, and are called "waney." These must go thru the edger to make their edges parallel. The edger man works with great speed. He sees at once what can be made out of a board, places it in position and runs it thru. From the edger the boards are carried to the trimmer, which cuts the length. The lumberman's rule is to "cut so that you can cut again." The so-called 16' logs are really 16' 6". The trimmer, Fig. 45, now trims these boards to 16' 1", so that if desired they can still be cut again. The trimmer may be set to cut at any desired length according to the specifications.

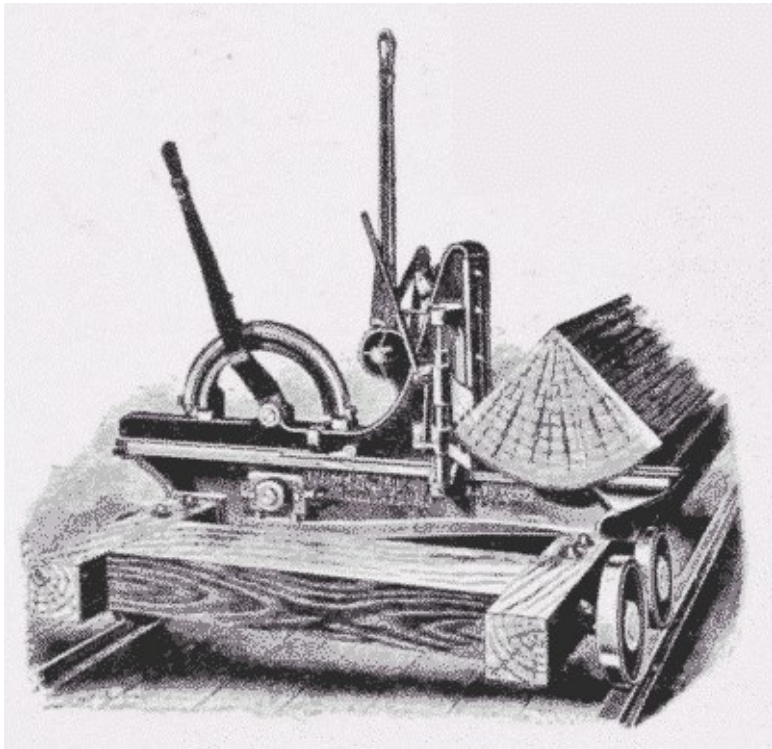


Fig. 42. Log-Carriage, holding quartered log in position to saw.

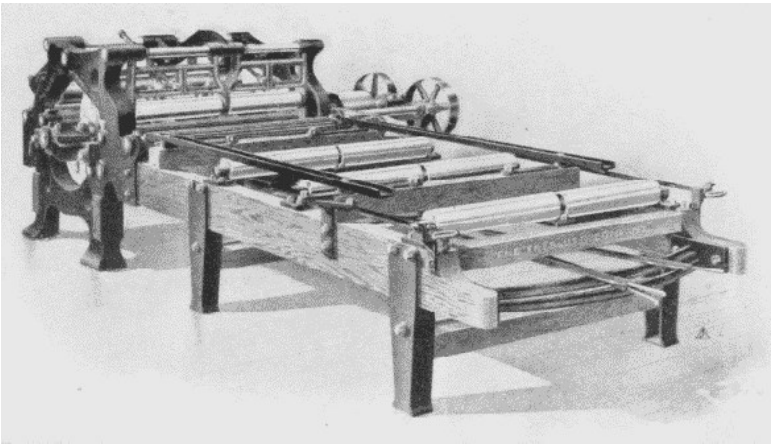


Fig. 43. Double Gang Edger. This machine trims off the rough edges of the "waney" boards by means of the four saws in the main frame of the machine.

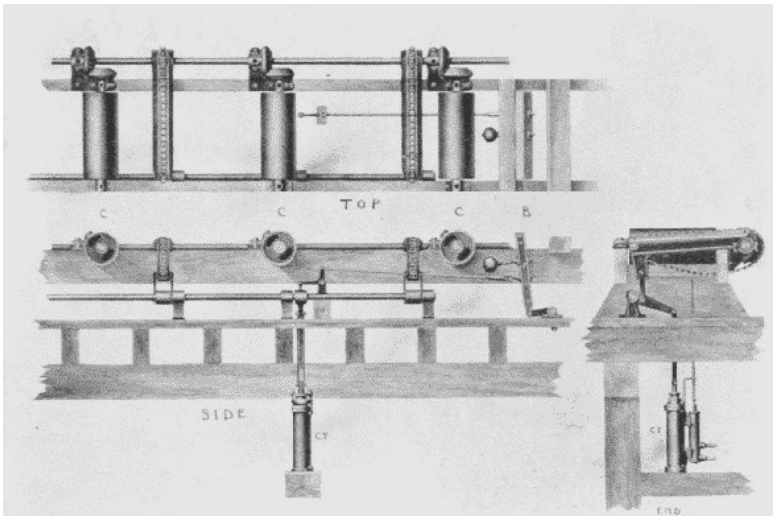


Fig. 44. Automatic Steam Transfer for Timber, Lumber and Slabs. The boards are carried along by the cylinders, CCC, until they hit the bumper, B. This movement admits steam to the cylinder, CY, which raises the revolving chains or skids, which transfers the stock sidewise to other live rollers as required.

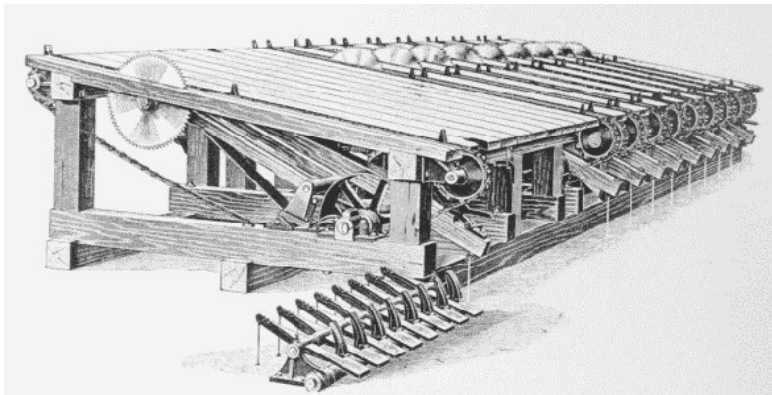


Fig. 45. Automatic Gang Lumber-Trimmer. It may be set to cut automatically to any desired length.

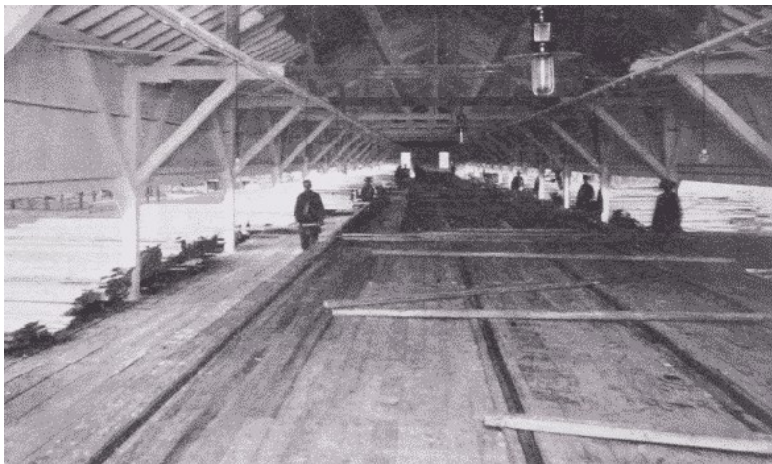


Fig. 46. Lumber Sorting Shed. Virginia, Minnesota.

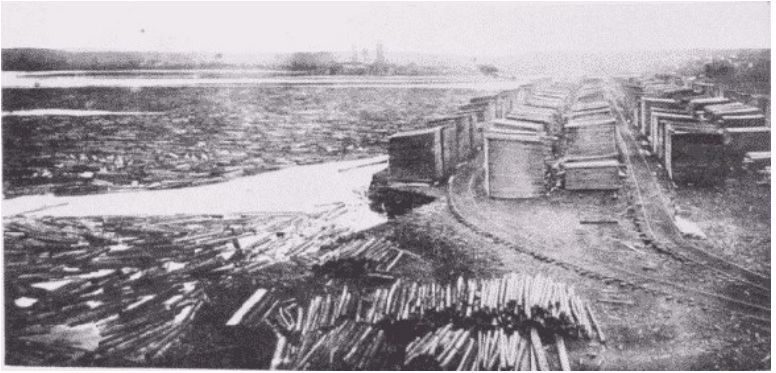


Fig. 47. Wood is carefully and regularly piled in the seasoning-yard.

The boards are now graded as to quality into No. 1, No. 2, etc., Fig. 46, and run out of the mill, to be stacked up in piles, Fig. 47. Big timbers go directly from the saw on the rolls to the back end of the mill, where the first end is trimmed by a butting-saw or cut-off-saw which swings, Fig. 48. The timber is then shoved along on dead rolls and the last end trimmed by the butting-saw to a definite length as specified, and shoved out.

One of the most remarkable features of the modern mill is its speed. From the time the log appears till the last piece of it goes racing out of the mill, hardly more than a minute may have elapsed.

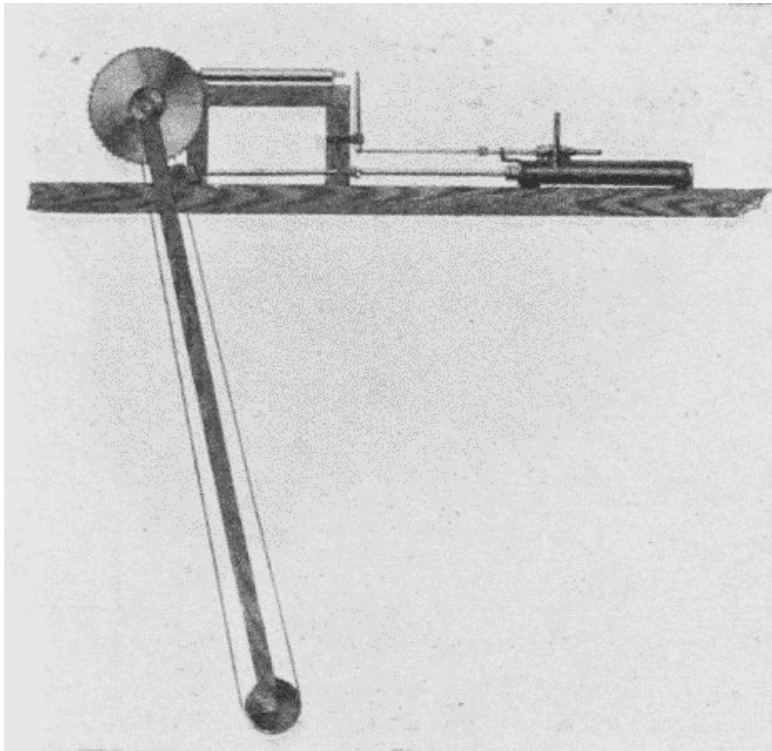


Fig. 48. Cut-off-Saw. This saw trims the ends of timbers.

A large part of the problem of sawmilling is the disposal of the waste. The first of these is the sawdust. In all first class mills, this together with shavings (if a planing-mill is combined) is burned for fuel. It is sucked up from the machines and carried in large tubes to the boiler-room and there is mechanically supplied to the

fires. The slabs, once considered as waste, contain much material that is now utilized. From the live rolls, on which all the material falls from the main band-saw, the slabs are carried off by transfer chains, and by another set of five rollers to the "slasher," Fig. 50, which consists of a line of circular-saws placed 4' 1" apart. This slasher cuts up the slabs into lengths suitable for lath or fence-pickets, Fig. 49. Or they can be resawn into 16" lengths for shingles or fire-wood.

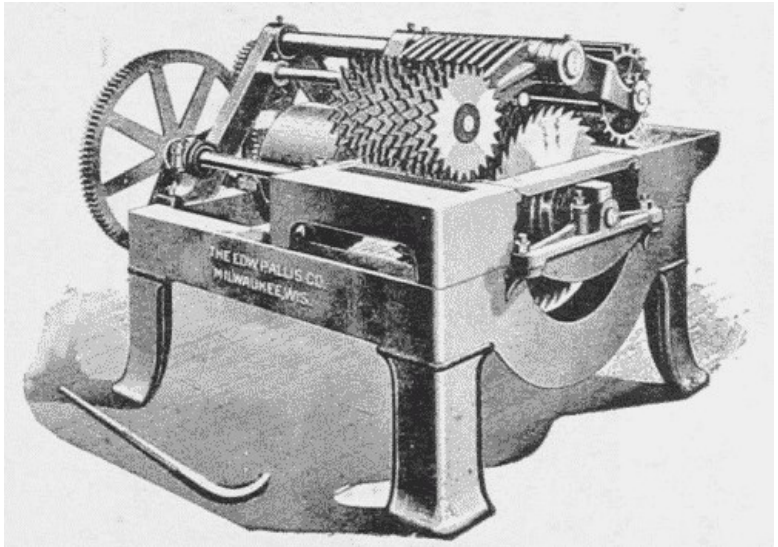


Fig. 49. Ten Saw Gang Lath Bolter. This machine cuts up material lengthwise into laths.

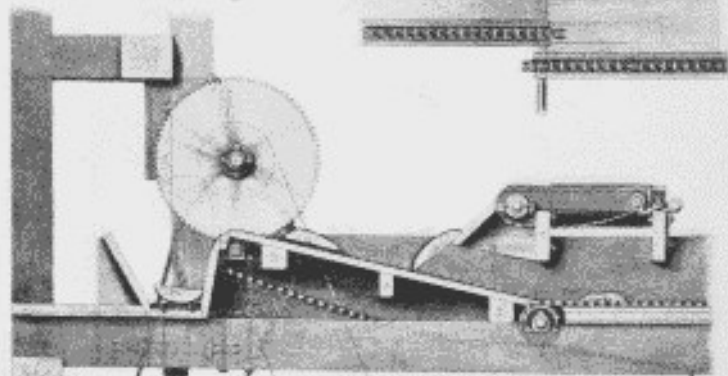
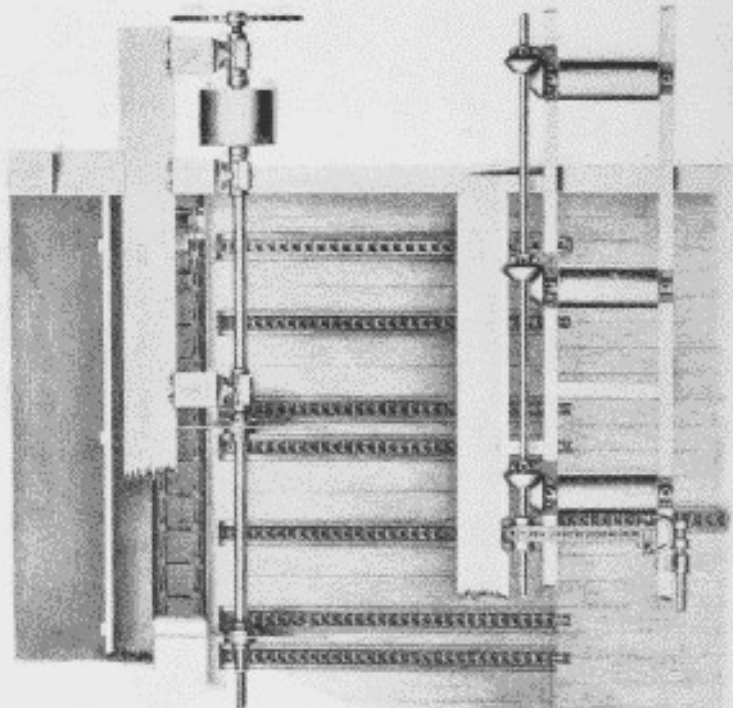


Fig. 50. Slab-Slasher. This machine cuts up the slabs into lengths suitable for lath or fence-pickets.

From the "slasher" the 4' 1" lengths are carried on by traveling platforms, chains, etc., to the lath-machines, Fig. 51, where they are sawn up, counted as sawn, bound in bundles of 100, trimmed to exactly 4' in length and sent off to be stored. The shingle bolts are picked off the moving platforms by men or boys, and sent to the shingle-machine, Fig. 52, where they are sawn into shingles and dropped down-stairs to be packed. Shingle-bolts are also made from crooked or otherwise imperfect logs.

Of what is left, a good part goes into the grinder or "hog," Fig. 53, which chews up all sorts of refuse into small chips suitable for fuel to supplement the sawdust if necessary. Band-saws make so little dust and such fine dust that this is often necessary.

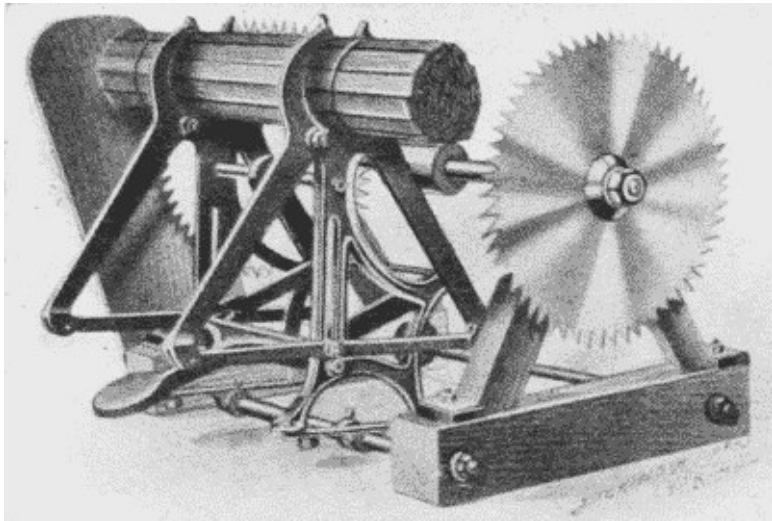


Fig. 51. Combination Lath-Binder and Trimmer. With this machine the operator can trim the bundles of lath simply by tilting the packing frame over from him causing the bundles to pass between the saws, thereby trimming both ends at one movement.

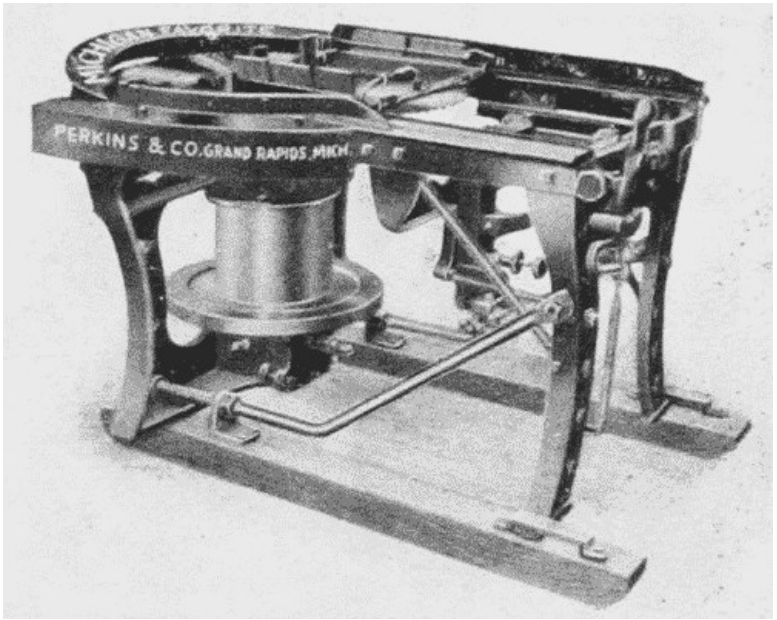


Fig. 52. Hand Shingle-Machine. This machine is used in Sawmills in which it is desired to utilize slabs and trimmings by sawing shingles therefrom, or to saw shingles from prepared bolts.

If there is any refuse that cannot be used at all it goes to the scrap-pile, Fig. 54, or to the "consumer," the tall stack shown in Fig. 37, see [p. 33](#).

Boards ordinarily sawn from logs are "slash-sawn," i. e., they are tangential or bastard, each cut parallel to the previous one.

By this process, only the central boards would be radial or "rift" boards.

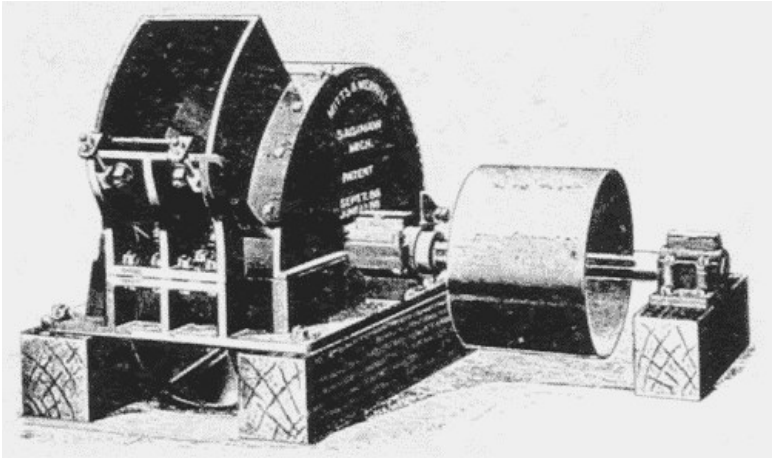


Fig. 53. Edging grinder or Hog. It cuts any kind of wood into coarse or fine chips suitable to be handled by chain conveyor or blower.

But, for a number of reasons, radial boards are better. They warp less because the annual rings cross the board more evenly. Yellow pine flooring that is rift-sawn is more valuable than slash-sawn, because the edge of the annual rings makes a more even grain, Fig. 55. Where slash-grained flooring is used, the boards should be laid so that the outside of each board will be up in order that the inner rings may not "shell out."

In sawing oak for valuable furniture or trim, the log is first "quartered" and then the quarters sawn up as nearly radially as is desired. There are various methods of cutting quartered logs, as illustrated in Fig. 56.

In making staves for water-tight barrels, it is essential that they be cut radially in the log, in order that the staves be as non-permeable to water as possible.

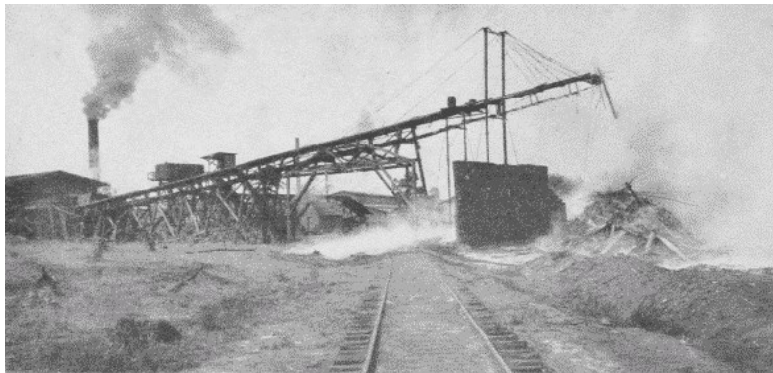


Fig. 54. Scrap-Pile. Oscilla. Georgia.

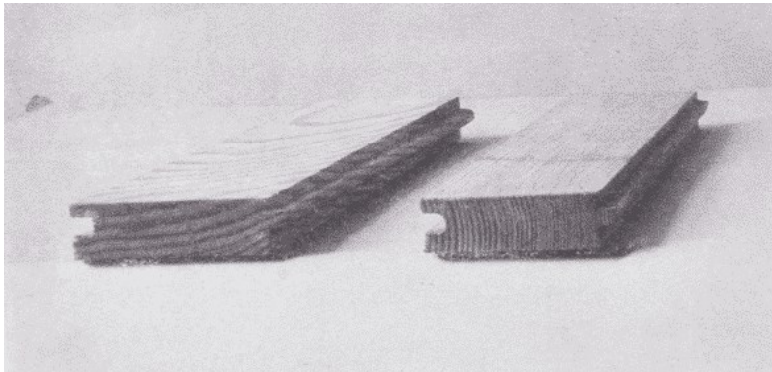


Fig. 55. Slash-Grain and Comb-Grain Flooring.

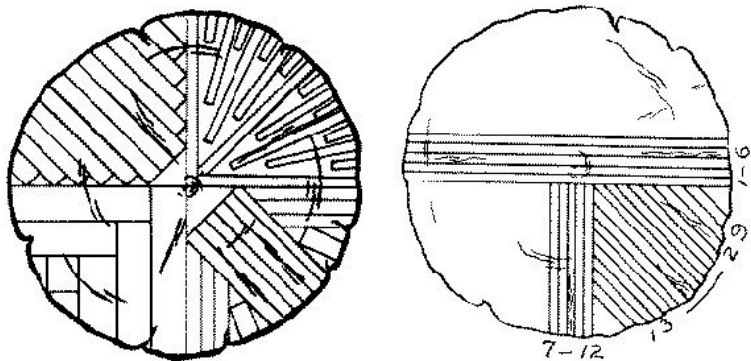


Fig. 56. Methods of Sawing Quartered Logs.

# SAWMILLING

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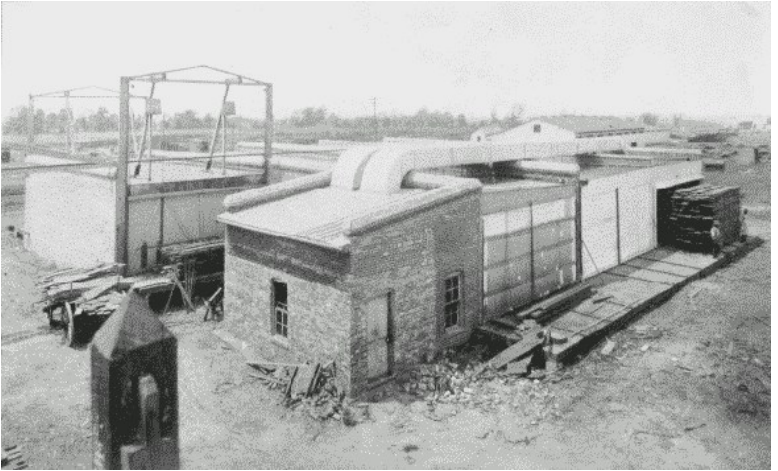


Fig. 57. Lumber-Kiln.

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<sup>4</sup> For general bibliography see [p. 4](#).

## Chapter III.

# SEASONING

The seasoning of wood is important for several reasons. It reduces weight, it increases strength, it prevents changes in volume after it is worked into shape, and it prevents checking and decay. Decay can also be prevented by submergence and burying, if by so doing logs are kept from fungal attacks. The piles of the Swiss Lake dwellings, which are in a state of good preservation, are of prehistoric age. Wood under water lasts longer than steel or iron under water. But for almost all purposes wood has to be dried in order to be preserved. The wood is cut up, when green, to as thin pieces as will be convenient for its use later, for the rate of drying depends largely upon the shape and size of the piece, an inch board drying more than four times as fast as a four inch plank, and more than twenty times as fast as a ten inch timber.

There are various methods of seasoning:

(1) Natural or air-seasoning is the most common, and in some respects the best. In this method, the wood is carefully and regularly piled in the seasoning-yard, so as to be protected as far as possible from sun and rain, but with air circulating freely on all sides of the boards, Fig. 47, see [p. 38](#). To accomplish this, "sticking" is employed, i. e., strips of wood are placed crosswise close to the ends and at intervals between the boards. In this way

the weight of the superposed boards tends to keep those under them from warping. The pile is skidded a foot or two off the ground and is protected above by a roof made of boards so laid that the rain will drain off.

Fire-wood is best dried rapidly so that it will check, making air spaces which facilitate ignition, but lumber needs to be slowly dried in cool air so that the fibers may accommodate themselves to the change of form and the wood check as little as possible. Good air-drying consumes from two to six years, the longer the better.

(2) Kiln-drying or hot-air-seasoning is a much more rapid process than air-seasoning and is now in common use, Fig. 57. The drying is also more complete, for while air-dried wood retains from 10% to 20% of moisture, kiln-dried wood may have no more than 5% as it comes from the kiln. It will, however, reabsorb some moisture from the air, when exposed to it.

The wood of conifers, with its very regular structure, dries and shrinks more evenly and much more rapidly than the wood of broad-leaved trees, and hence is often put into the kiln without previous air-drying, and dried in a week or even less time.

Oak is the most difficult wood to dry properly. When it and other hardwoods are rapidly dried without sufficient surrounding moisture, the wood "case-hardens," that is, the outer part dries and shrinks before the interior has had a chance to do the same, and this forms a shell or case of shrunken, and often checked wood around the interior which also checks later. This

interior checking is called honeycombing. Hardwood lumber is commonly air-dried from two to six months, before being kiln-dried. For the sake of economy in time, the tendency is to eliminate yard-drying, and substitute kiln-drying. Kiln-drying of one inch oak, takes one or two weeks, quarter-sawn boards taking one and a half times as long as plain-sawn.

The best method of drying is that which gradually raises the temperature of both the wood and of the water which it contains to the point at which the drying is to take place. Care is therefore taken not to let the surface become entirely dry before the internal moisture is heated. This is done by retaining the moisture first vaporized about the wood, by means of wet steam. When the surface is made permeable to moisture, drying may take place rapidly. Curtains of canvas are hung all around the lumber on the same principle that windows in newly plastered buildings are hung with muslin. The moisture is absorbed on the inner surface of the curtain and evaporates from the outer surface. Improvements in kiln-drying are along the line of moist air operation. In common practice, however, the moist air principle is often neglected.

There are two methods in operation, the progressive method and the charge method. In the progressive, the process is continuous, the loads going in at one end of the kiln, and out at the other, the temperature and the moisture being so distributed in the kiln, that in passing from the green to the dry end, a load of lumber is first moistened, then heated, and finally dried out. In

the charge system, the process is intermittent, one charge being removed before a new one is admitted. This gives the best results with high grade lumber for special uses.

A modification of hot-air-seasoning is that which subjects the wood to a moderate heat in a moist atmosphere charged with the products of the combustion of fuel.

(3) Small pieces of wood may be effectively seasoned by being boiled in water and then dried. The process seems to consist of dissolving out albuminous substances and thus allowing freer evaporation. Its effect is probably weakening.

(4) Soaking in water is sometimes used as a good preparation for air-seasoning. Previous soaking hastens seasoning. River men insist that timber is improved by rafting. It is a common practice to let cypress logs soak in the swamps where they grow for several months before they are "mined out." They are eagerly sought after by joiners and carpenters, because their tendency to warp is lessened. Ebony is water-soaked in the island of Mauritius as soon as cut. Salt water renders wood harder, heavier, and more durable and is sometimes applied to ship timbers, but cannot be used with timbers intended for ordinary purposes, as the presence of salt tends to absorb atmospheric moisture.

(5) Boiling in oil is resorted to for special purposes, both for preservation and to give strength. For example, the best handscrews are so treated. The oil also prevents glue from sticking, the most frequent cause of injury to handscrews.

(6) There are a number of "impregnation" methods of

preserving timber, and their practice is spreading rapidly. Of the various preservative processes, those using coal tar creosote and zinc chloride have proved most efficient. The purpose is to force the preservative into the pores of the wood, either by painting, soaking, or putting under pressure. Such impregnation methods double or treble the life of railway ties. It is now being used with great success to preserve electric wire poles, mine-props, piling, fence-posts, etc.

Wood preservation has three great advantages, it prolongs the life of timbers in use, reduces their cost, and makes possible the use of species that once were considered worthless. For example, the cheap and abundant loblolly pine can be made, by preservative methods, to take the place of high priced long-leaf pine for many purposes.

## **PRACTICAL SUGGESTIONS FOR STORING LUMBER**

Under the hasty methods prevalent in the mill, very little wood comes to the shop well seasoned, and it should therefore be carefully stored before using, so as to have the fullest possible air circulation around it. Where the boards are large enough, "sticking" is the best method of storage, i. e., narrow strips of wood are placed at short intervals between the pieces which are piled flat. The weight of the boards themselves helps to prevent warping. Boards set upright or on edge are likely to be distorted

soon. It is often wise to press together with weights or to clamp together with handscrews boards that show a tendency to warp, putting the two concave sides together. Then the convex side is exposed and the board may straighten thus: Fig. 58. By wrapping up small boards in paper or cloth in the intervals between work on them, they may be kept straight until they are assembled.

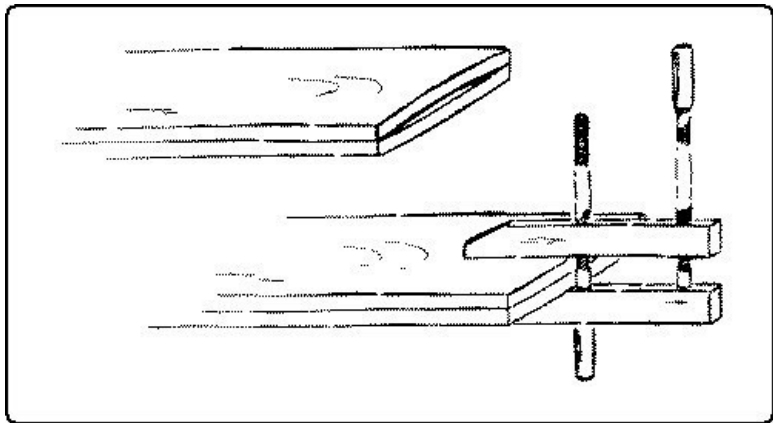


Fig. 58. Clamping up Boards to Prevent Warping.

Another precaution to take is to be sure to plane both sides of a board if either is planed, especially if the board has been exposed to air-drying for some time.

## WOOD MEASUREMENTS

Lumber is a general term for all kinds of sawn wood. Logs may be sawn into timber, that is, beams and joists, into planks, which are 2" to 4" thick, or into boards which are from  $\frac{1}{4}$ " to  $1\frac{3}{4}$ " thick. These may be resawn into special sizes.

Lumber is measured by the superficial foot, which is a board 1" thick, 12" wide, and 12" long, so that a board 1" thick, (or  $\frac{7}{8}$ " dressed) 6" wide and 12' 0" long, measures 6' B. M. (board measure). Boards 1" or more thick are sold by the "board foot" which is equivalent to 12" square and 1" thick. Boards less than 1" thick are sold by the square foot, face measure. Dressed lumber comes in sizes  $\frac{1}{8}$ " less than sawn lumber. Regular sizes are:

$\frac{5}{8}$ "	dressed to	$\frac{1}{2}$ "
$\frac{3}{4}$ "	dressed to	$\frac{5}{8}$ "
1 "	dressed to	$\frac{7}{8}$ "
$1\frac{1}{4}$ "	dressed to	$1\frac{1}{8}$ "
$1\frac{1}{2}$ "	dressed to	$1\frac{3}{8}$ "
2 "	dressed to	$1\frac{7}{8}$ "

Any of these may be dressed down to thinner boards, or resawn on a special band-saw.

In ordering it is common to give the dimensions wanted, in the order of thickness, width, and length, because that is the order in which dimensions are gotten out. E. g.:

6 pcs. quar. oak,  $\frac{7}{8}$ "  $\times$  6"  $\times$  3'0"

2 pcs. quar. oak,  $\frac{3}{4}$ "  $\times$  7 $\frac{1}{2}$ "  $\times$  15"

If a piece wanted is short the way the grain goes, the order would be the same, thus:  $\frac{3}{4}$ "  $\times$  11" (wide)  $\times$  6" (long). That is, "long" means the way the grain runs. It is always safe to specify in such a case. It is common when small pieces are ordered to add one-quarter to the cost for waste.

In large lots lumber is ordered thus: 800' (B. M.) whitewood, dressed 2 sides to  $\frac{7}{8}$ ", 10" and up. This means that the width of any piece must not be less than 10". Prices are usually given per "M," i. e., per 1000 ft.: e. g.: basswood may be quoted at \$40.00 per M.

When thin boards are desired it is often economical to buy inch stuff and have it resawn.

Some lumber is also ordered by the "running" or lineal foot, especially moldings, etc., or by the piece, if there is a standard size as in fence-posts, studs, etc. Laths and shingles are ordered by the bundle to cover a certain area. 1000 4" shingles (= 4 bundles) cover 110 sq. ft. with 4" weather exposure. 100 laths (1 bundle) each  $\frac{1}{4}$ "  $\times$  1 $\frac{1}{2}$ "  $\times$  4'0" cover about 150 sq. ft.

There are several methods of measuring lumber. The general

rule is to multiply the length in feet by the width and thickness in inches and divide by 12, thus:  $1" \times 6" \times 15' \div 12 = 7\frac{1}{2}$  feet. The use of the Essex board-measure and the Lumberman's board-measure are described in Chapter 4, [pp. 109](#) and [111](#).

## THE SEASONING AND MEASURING OF WOOD

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# **Chapter IV.**

## **WOOD HAND TOOLS**

The hand tools in common use in woodworking shops may, for convenience, be divided into the following classes: 1, Cutting; 2, Boring; 3, Chopping; 4, Scraping; 5, Pounding; 6, Holding; 7, Measuring and Marking; 8, Sharpening; 9, Cleaning.

### **1. CUTTING TOOLS**

The most primitive as well as the simplest of all tools for the dividing of wood into parts, is the wedge. The wedge does not even cut the wood, but only crushes enough of it with its edge to allow its main body to split the wood apart. As soon as the split has begun, the edge of the wedge serves no further purpose, but the sides bear against the split surfaces of the wood. The split runs ahead of the wedge as it is driven along until the piece is divided.

It was by means of the wedge that primitive people obtained slabs of wood, and the great change from primitive to civilized methods in manipulating wood consists in the substitution of cutting for splitting, of edge tools for the wedge. The wedge follows the grain of the wood, but the edge tool can follow a line determined by the worker. The edge is a refinement and improvement upon the wedge and enables the worker to be

somewhat independent of the natural grain of the wood.

In general, it may be said that the function of all cutting tools is to separate one portion of material from another along a definite path. All such tools act, first, by the keen edge dividing the material into two parts; second, by the wedge or the blade forcing these two portions apart. If a true continuous cut is to be made, both of these actions must occur together. The edge must be sharp enough to enter between the small particles of material, cutting without bruising them, and the blade of the tool must constantly force apart the two portions in order that the cutting action of the edge may continue.

The action of an ax in splitting wood is not a true cut, for only the second process is taking place, Fig. 59. The split which opens in front of the cutting edge anticipates its cutting and therefore the surfaces of the opening are rough and torn.

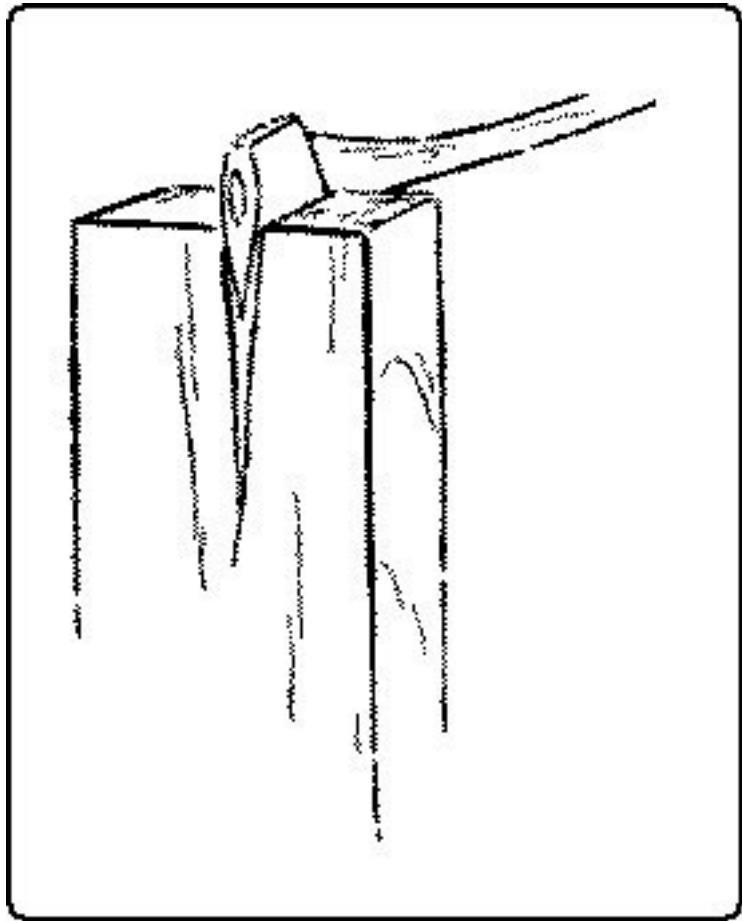


Fig. 59. Wedge Action.

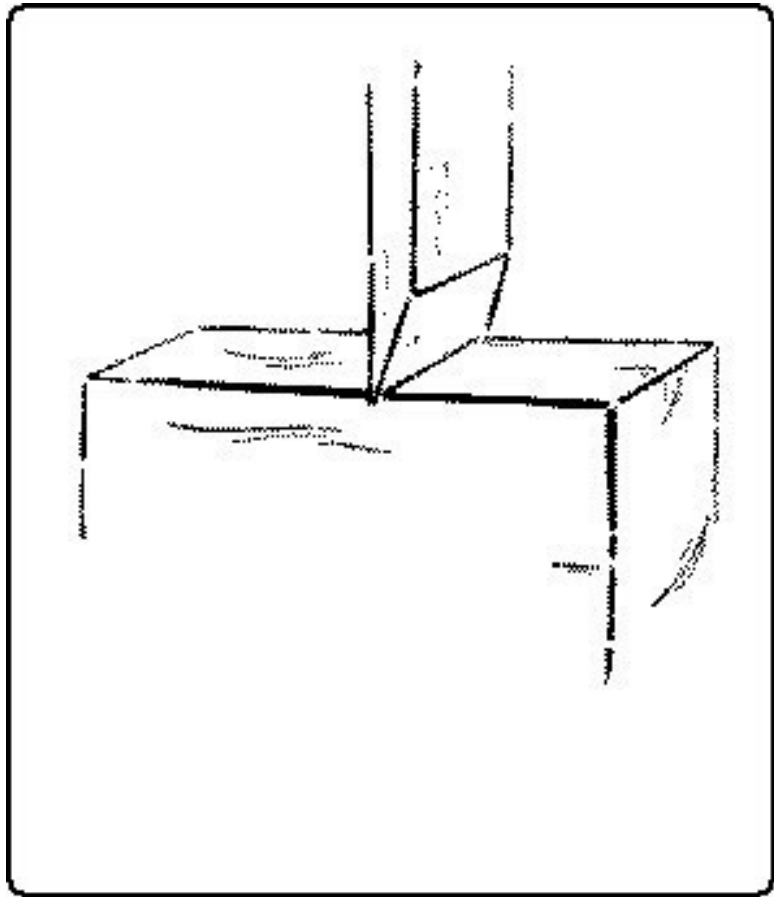


Fig. 60. Edge Action.

When a knife or chisel is pressed into a piece of wood at right angles to the grain, and at some distance from the end of the

wood, as in Fig. 60, a continuous cutting action is prevented, because soon the blade cannot force apart the sides of the cut made by the advancing edge, and the knife is brought to rest. In this case, it is practically only the first action which has taken place.

Both the actions, the cutting and the splitting, must take place together to produce a true continuous cut. The edge must always be in contact with the solid material, and the blade must always be pushing aside the portions which have been cut. This can happen only when the material on one side of the blade is thin enough and weak enough to be readily bent out of the way without opening a split in front of the cutting edge. This cutting action may take place either along the grain, Fig. 61, or across it, Fig. 62.

The bending aside of the shaving will require less force the smaller the taper of the wedge. On the other hand, the wedge must be strong enough to sustain the bending resistance and also to support the cutting edge. In other words, the more acute the cutting edge, the easier the work, and hence the wedge is made as thin as is consistent with strength. This varies all the way from hollow ground razors to cold-chisels. For soft wood, the cutting angle (or bevel, or bezel) of chisels, gouges and plane-irons, is small, even as low as  $20^{\circ}$ ; for hard wood, it must be greater. For metals, it varies from  $54^{\circ}$  for wrought iron to  $66^{\circ}$  for gun metal.

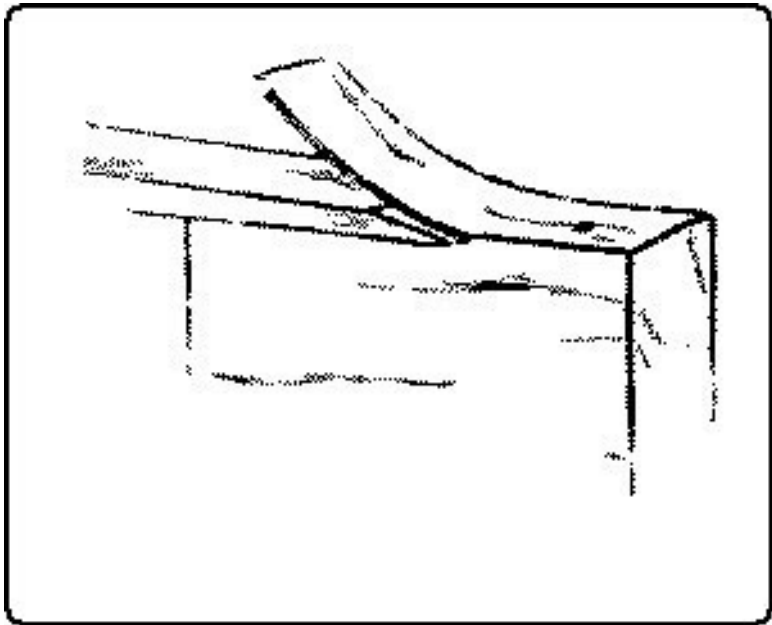


Fig. 61. Edge and Wedge Action With the Grain.

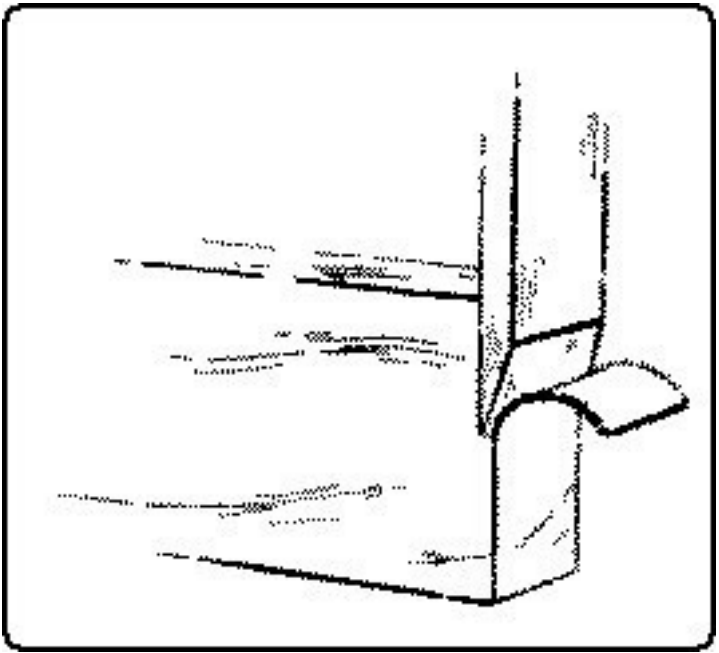


Fig. 62. Edge and Wedge Action Across the Grain.

Ordinarily a cutting tool should be so applied that the face nearest the material lies as nearly as possible in the direction of the cut desired, sufficient clearance being necessary to insure contact of the actual edge.

There are two methods of using edge tools: one, the chisel or straight cut, by direct pressure; the other, the knife or sliding cut.

The straight cut, Fig. 63, takes place when the tool is moved into the material at right angles to the cutting edge. Examples

are: the action of metalworking tools and planing machines, rip-sawing, turning, planing (when the plane is held parallel to the edge of the board being planed), and chiseling, when the chisel is pushed directly in line with its length.

The knife or sliding cut, Fig. 64, takes place when the tool is moved forward obliquely to its cutting edge, either along or across the grain. It is well illustrated in cutting soft materials, such as bread, meat, rubber, cork, etc. It is an advantage in delicate chiseling and gouging. That this sliding action is easier than the straight pressure can easily be proved with a penknife on thin wood, or by planing with the plane held at an angle to, rather than in line with, the direction of the planing motion. The edge of the cutter then slides into the material. The reason why the sliding cut is easier, is partly because the angle of the bevel with the wood is reduced by holding the tool obliquely, and partly because even the sharpest cutting edge is notched with very fine teeth all along its edge so that in the sliding cut it acts like a saw. In an auger-bit, both methods of cutting take place at once. The scoring nib cuts with a sliding cut, while the cutting lip is thrust directly into the wood.

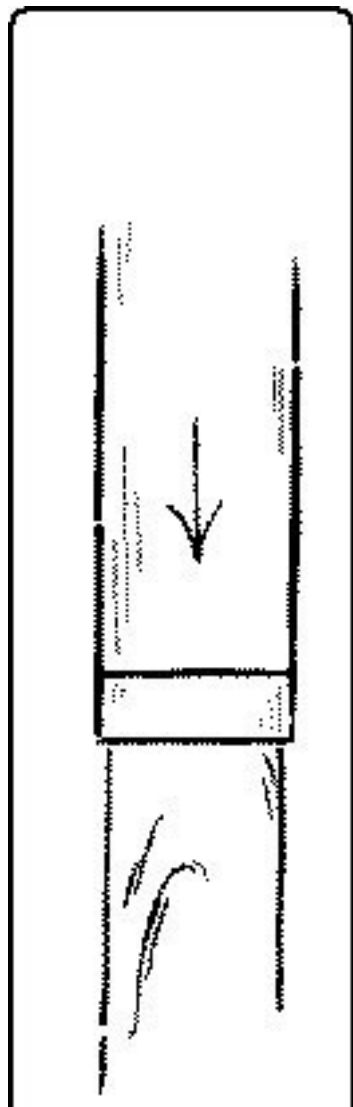
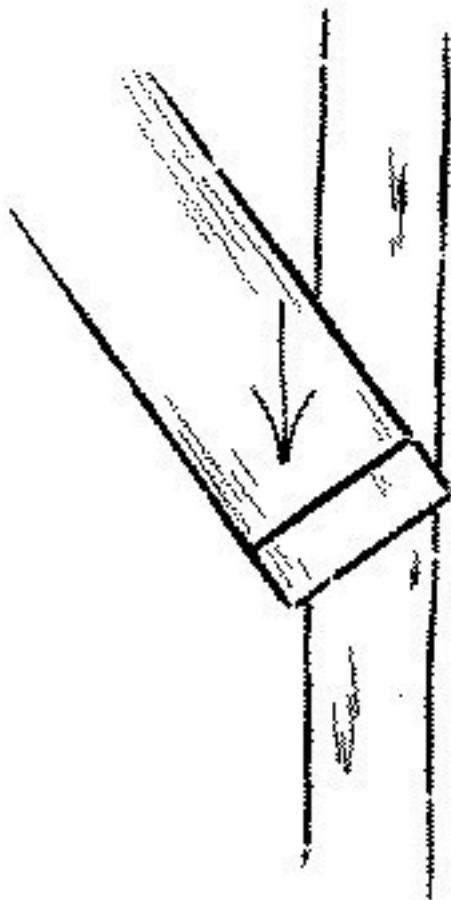


Fig. 63. Straight Cut.



## Fig. 64. Sliding Cut.

The chisel and the knife, one with the edge on the end, and the other with the edge on the side, are the original forms of all modern cutting tools.

The *chisel* was at first only a chipped stone, then it came to be a ground stone, later it was made of bronze, and still later of iron, and now it is made of steel. In its early form it is known by paleontologists as a celt, and at first had no handle, but later developed into the ax and adze for chopping and hewing, and the chisel for cuts made by driving and paring. It is quite likely that the celt itself was simply a development of the wedge.

In the modern chisel, all the grinding is done on one side. This constitutes the essential feature of the chisel, namely, that the back of the blade is kept perfectly flat and the face is ground to a bevel. Blades vary in width from  $\frac{1}{16}$  inch to 2 inches. Next to the blade on the end of which is the cutting edge, is the shank, Fig. 65. Next, as in socketed chisels, there is the socket to receive the handle, or, in tanged chisels, a shoulder and four-sided tang which is driven into the handle, which is bound at its lower end by a ferrule. The handle is usually made of apple wood.

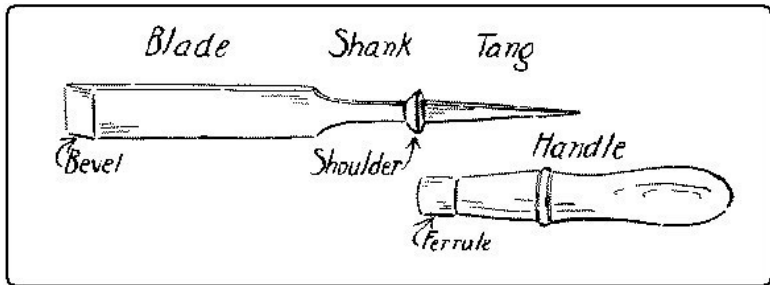


Fig. 65. Firmer-Chisel.

The most familiar form is the *firmer-chisel*, Fig. 65, which is said to get its name from the fact that it is firmer or stiffer than the paring-chisel. (See below.) The firmer-chisel is a general utility tool, being suited for hand pressure or mallet pounding, for paring or for light mortising.

Different varieties of chisels are named; (1) according to their uses; as paring-chisels, framing-chisels, mortise-chisels, carving-chisels, turning-chisels, etc.

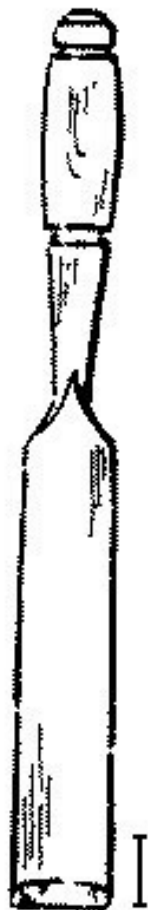


Fig. 66. Paring-Chisel. Fig. 67. Framing-Chisel. Fig. 68. Mortise-Chisel.

The *paring-chisel*, Fig. 66, has a handle specially shaped to give control over its movements, and a long thin blade, which in the best form is beveled on the two edges to facilitate grooving. It is intended only for steady pressure with the hand and not for use with a mallet.

The *framing-chisel*, Fig. 67, is thick and heavy and was formerly much used in house framing. It is usually made with the handle fitting into a socket on the shank, in order to withstand the shock of heavy blows from the mallet.

The *mortise-chisel*, Fig. 68, is made abnormally thick to give the stiffness necessary for levering the waste out of mortises.

(2) Chisels are also named according to their shapes: as, skew-chisels, corner-chisels, round-nosed chisels, etc.

The angle of the bevel of a chisel is determined by the kind of wood for which it is most used, hard wood requiring a wider angle than soft wood, in. For order to support the edge ordinary work, the bevel is correctly ground to an angle of about 20°. The chisel is a necessary tool in making almost every kind of joint. It may almost be said that one mark of a good workman is his preference for the chisel. Indeed an excellent motto for the woodworker is: "When in doubt, use a chisel".

In general, there are two uses for the chisel (1), when it is driven by a push with the hand, as in paring, and (2), when it is

driven by blows of a mallet, as in digging mortises.

In relation to the grain of the wood, it is used in three directions: (1) longitudinally, that is with the grain, called paring; (2) laterally, across the surface, called cutting sidewise; (3) transversely, that is across the end, called cutting end-wood.

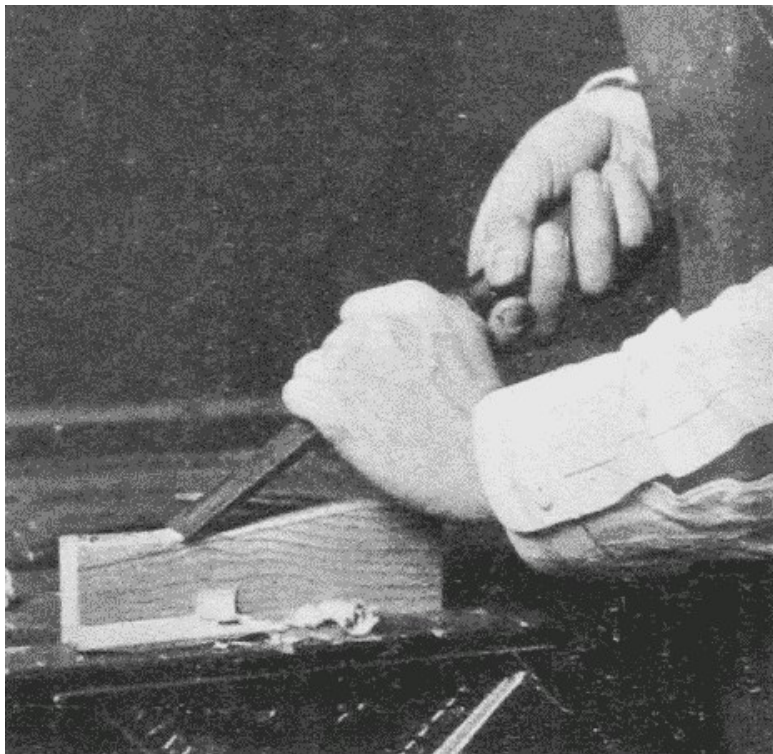


Fig. 69. Paring with a Chisel.

1. *Paring*. To remove shavings rapidly, the chisel is held flat side up, the handle grasped by the right hand, with the thumb pointing toward the shank, and the blade held in the left hand, as in Fig. 69. Held in this way great control can be exerted and much force applied. For paring the surface as flat and smooth as possible, the chisel should be reversed, that is, held so that the flat side will act as a guide. Held in this way the chisel has no equal for paring except the plane. Paring with the chisel is the method used in cutting stop chamfers. (See [p. 185](#), Chapter VIII.) By holding the cutting edge obliquely to the direction of the grain and of the cut, the effective "sliding cut" is obtained, Fig. 64.

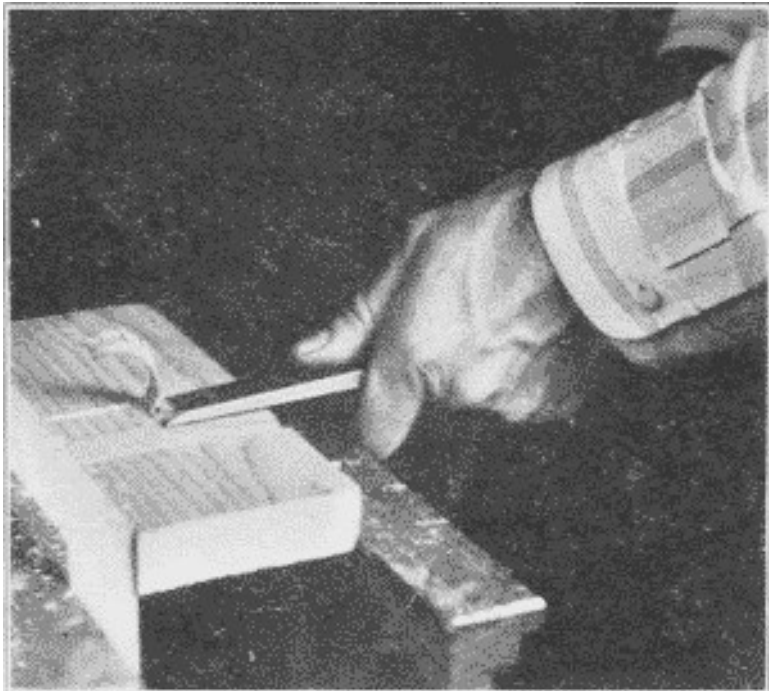


Fig. 70. Chiseling Out a Dado. (First Step).

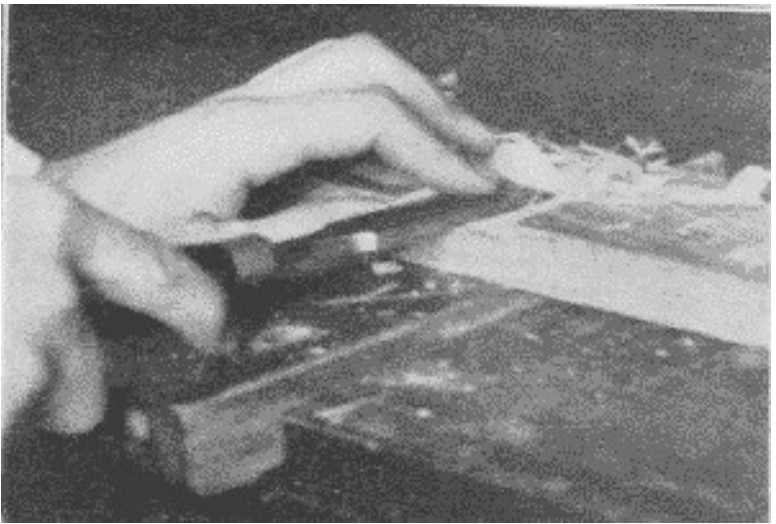


Fig. 71. Chiseling Out a Dado. (Second Step).

2. In *sidewise chiseling* the chisel is held in the same manner as in paring. A typical form of sidewise chiseling is the cutting out of a dado, Fig. 70. The work may be placed on the benchhook or held in the vise with the side up from which the groove is to be cut. The chisel is pushed directly across the grain, the blade being somewhat inclined to the upper surface so as to cut off a corner next the saw kerf. After a few cuts thus made with the chisel inclined alternately both ways, the ridge thus formed is taken off, Fig. 71. In this way the surface is lowered to the required depth. If more force be required, the palm of the hand may be used as a mallet.





## Fig. 72. Perpendicular Chiseling.

3. In *chiseling end-wood*, it is well, if possible, to rest the piece to be trimmed flat on the cutting board or on a piece of waste wood. Work done in this way is often called perpendicular chiseling, Fig. 72. The handle is grasped in the right hand, thumb up, while the blade of the chisel passes between the thumb and first finger of the left hand, the back of which rests on the work and holds it in place. As the right hand pushes the chisel downwards the thumb and first finger of the left hand control its motion. When chiseling it is well to stand so as to look along the line being cut. Incline the chisel toward you, and use the near part of the cutting edge for a guide and the farther corner for cutting, pushing the handle both down and forward at the same time, Fig. 73. Or, by pushing the chisel sidewise with the thumb of the left hand at the same time that the right hand pushes it downward, the effective sliding cut is obtained.

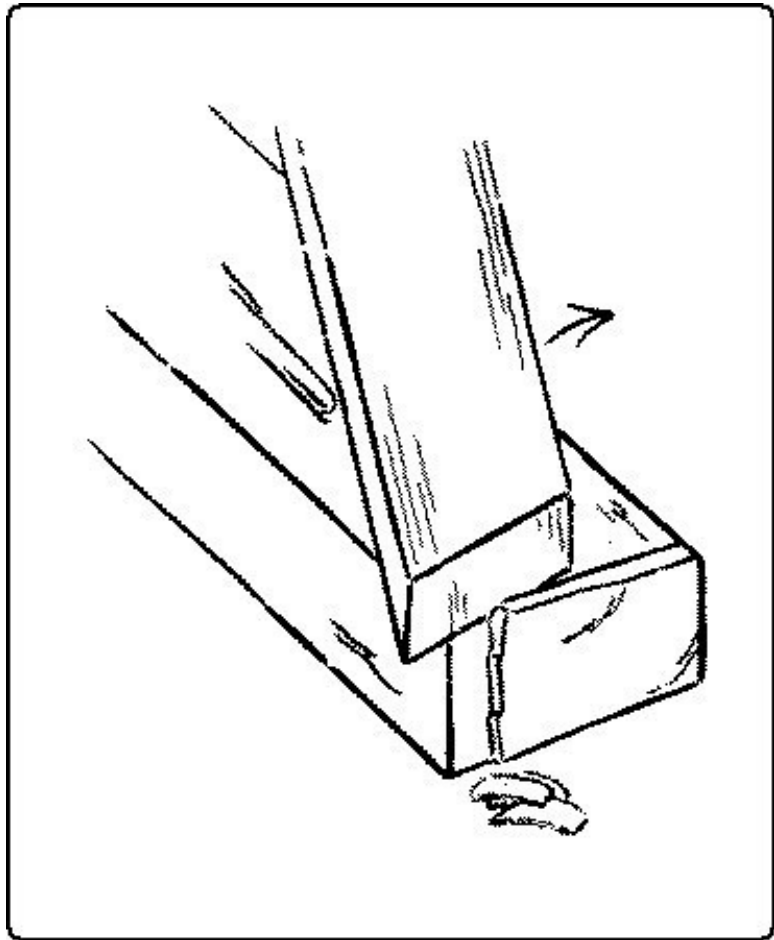


Fig. 73. Chiseling End Wood.

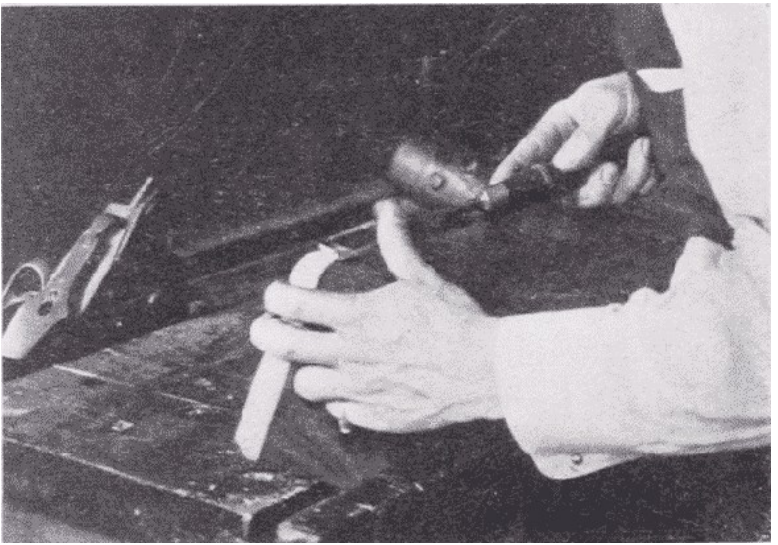


Fig. 74. Paring a Corner Round.

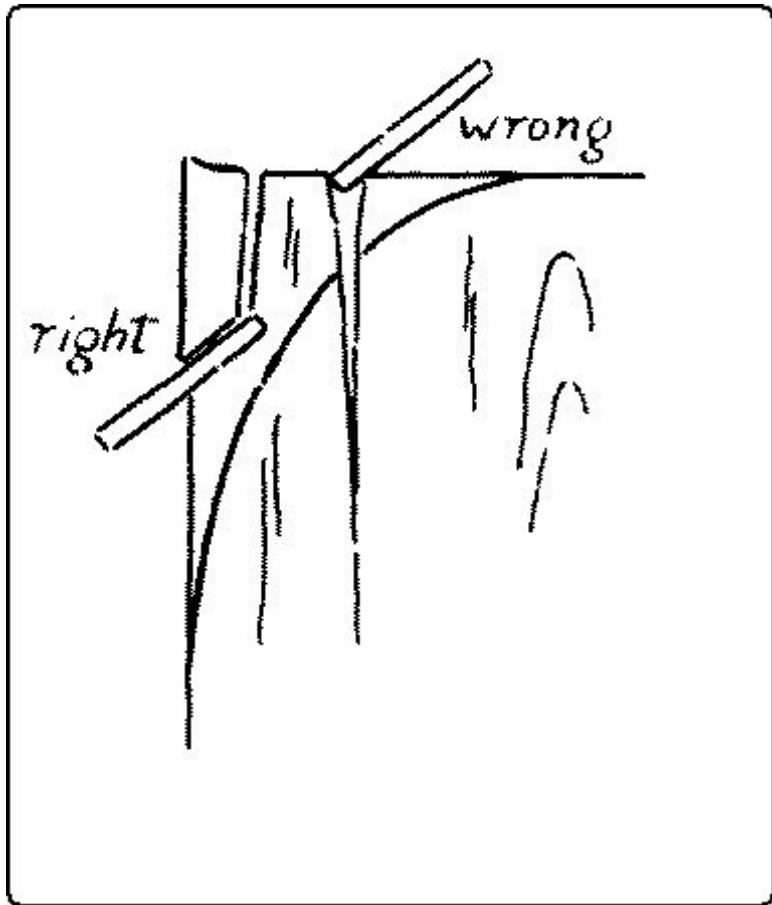


Fig. 75. Right and Wrong Ways of Perpendicular Chiseling.

End chiseling requires considerable force and therefore only

thin shavings should be cut off at a time. Or the mallet may be used with caution. In order to leave a smooth surface the chisel must be very sharp. Even then the lower arris (corner) is likely to be splintered off. This can be prevented by clamping the work down tight with a handscrew to a perfectly smooth cutting board. It is often advisable however, to set the piece upright in the vise and pare off thin shavings horizontally, Fig. 74. In rounding a corner, both this and perpendicular chiseling are common methods. In both cases care should be taken to cut from the side toward the end and not into the grain, lest the piece split, Fig. 75. In horizontal end paring, Fig. 74, in order to prevent splintering, it is well to trim down the arrises diagonally to the line and then to reduce the rest of the end surface.

In all hand chiseling, it is a wise precaution not to try to cut out much material at each stroke but to work back gradually to the line.



## Fig. 76. Mallet Chiseling.

The Piece is Clamped Down on the Bench With the Bench Hook.

A typical form of mallet chiseling is the digging of a mortise, Fig. 76. (See also [p. 56](#).) The chisel is held perpendicular in the left hand, while the right hand drives blows with the mallet. The hammer should never be used. (See mallet, [p. 96](#).) By rocking the chisel and at the same time giving it a twisting motion while the edge is kept on the wood, the edge can be stepped to the exact place desired. Care should be taken to work back to the lines gradually, to cut only part way thru from each side (in the case of a thru mortise-and-tenon), and to keep the cut faces perpendicular to the surfaces.

In sharpening a chisel it is of first importance that the back be kept perfectly flat. The bevel is first ground on the grindstone to an angle of about  $20^{\circ}$  and great care should be taken to keep the edge straight and at right angles to the sides of the blade.

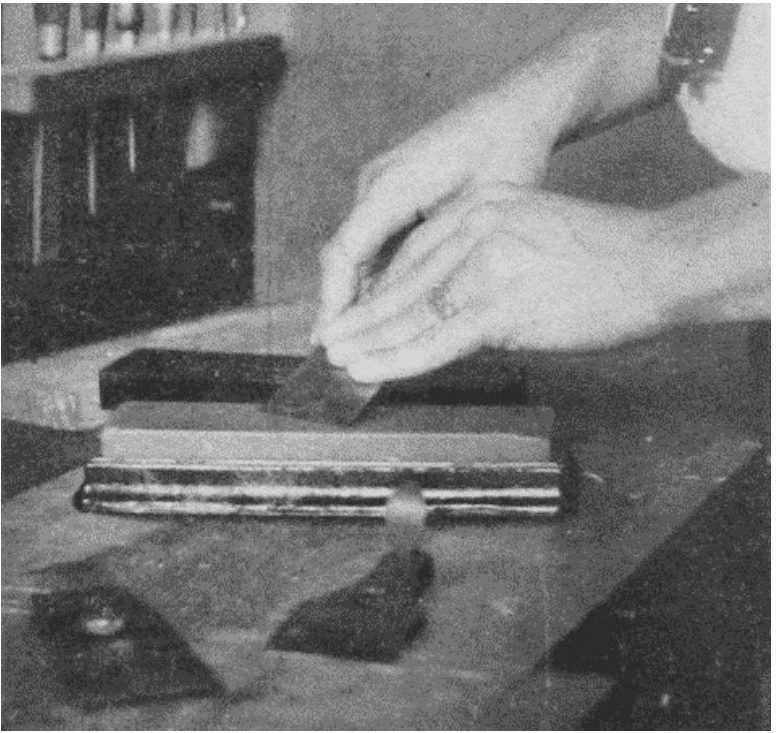


Fig. 77 Whetting a Plane-Bit.

After grinding it is necessary to whet the chisel and other edged tools. (See also under oilstones, [p. 121](#).) First see that there is plenty of oil on the stone. If an iron box be used, Fig. 77, the oil is obtained simply by turning the stone over, for it rests on a pad of felt which is kept wet with kerosene.

Place the beveled edge flat on the stone, feeling to see if it does

lie flat, then tip up the chisel and rub it at an angle slightly more obtuse than that which it was ground, Fig. 78. The more nearly the chisel can be whetted at the angle at which it was ground the better. In rubbing, use as much of the stone as possible, so as to wear it down evenly. The motion may be back and forth or spiral, but in either case it should be steady and not rocking. This whetting turns a light wire edge over on the flat side. In order to remove this wire edge, the back of the chisel, that is, the straight, unbeveled side, is held perfectly flat on the whetstone and rubbed, then it is turned over and the bevel rubbed again on the stone. It is necessary to reverse the chisel in this way a number of times, in order to remove the wire edge, but the chisel should never be tipped so as to put any bevel at all on its flat side. Finally, the edge is touched up (stropped) by being drawn over a piece of leather a few times, first on one side, then on the other, still continuing to hold the chisel so as to keep the bevel perfect.

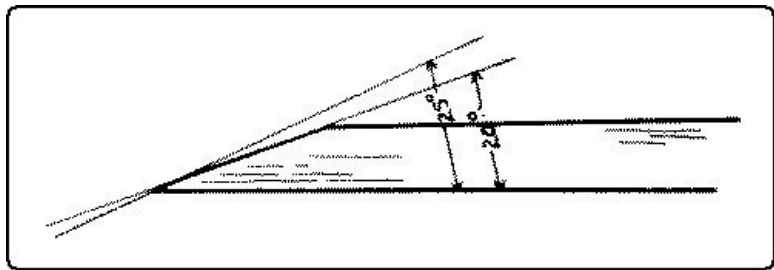


Fig. 78. Grinding Angle,  $20^\circ$ . Whetting Angle,  $25^\circ$ .

To test the sharpness of a whetted edge, draw the tip of the finger or thumb lightly along it, Fig. 79. If the edge be dull, it will feel smooth: if it be sharp, and if care be taken, it will score the skin a little, not enough to cut thru, but just enough to be felt.



Fig. 79. Testing the Sharpness of a Chisel.

The *gouge* is a form of chisel, the blade of which is concave, and hence the edge curved. When the bevel is on the outside, the common form, it is called an outside bevel gouge or simply a "gouge," Fig. 80; if the bevel is on the inside, it is called an inside bevel, or inside ground, or scribing-gouge, or paring-gouge, Fig. 81.<sup>6</sup>

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<sup>6</sup> Another confusing nomenclature (Goss) gives the name "inside gouges" to those with the cutting edge on the inside, and "outside gouges" to those with the cutting edge on the outside.



Fig. 80. Firmer-Gouge Outside Bevel.	Fig. 81. Inside bevel Gouge.
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Carving tools are, properly speaking, all chisels, and are of different shapes for facility in carving.

For ordinary gouging, Fig. 82, the blade is gripped firmly by the left hand with the knuckles up, so that a strong control can be exerted over it. The gouge is manipulated in much the same way as the chisel, and like the chisel it is used longitudinally, laterally, and transversely.

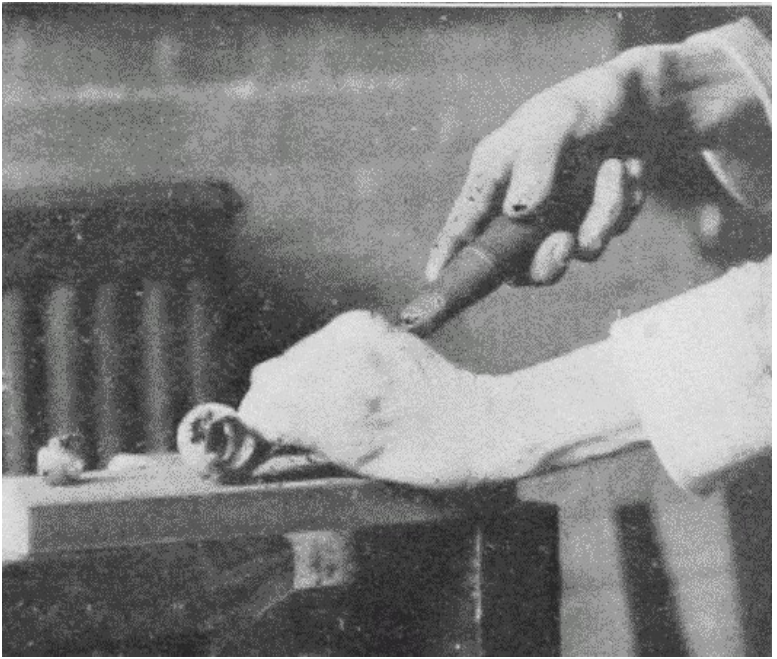


Fig. 82. Gouging.

In working with the grain, by twisting the blade on its axis as it moves forward, delicate paring cuts may be made. This is particularly necessary in working cross-grained wood, and is a good illustration of the advantage of the sliding cut.

In gouging out broad surfaces like trays or saddle seats it will be found of great advantage to work laterally, that is across the surface, especially in even grained woods as sweet gum. The tool

is not so likely to slip off and run in as when working with the grain.

The gouge that is commonly used for cutting concave outlines on end grain, is the inside bevel gouge. Like the chisel in cutting convex outlines, it is pushed or driven perpendicularly thru the wood laid flat on a cutting board on the bench, as in perpendicular chiseling, Fig. 72. [p. 56](#).

In sharpening an outside bevel gouge, the main bevel is obtained on the grindstone, care being taken to keep the gouge rocking on its axis, so as to get an even curve. It is then whetted on the flat side of a slipstone, Fig. 83, the bevel already obtained on the grindstone being made slightly more obtuse at the edge. A good method is to rock the gouge on its axis with the left hand, while the slipstone held in the right hand is rubbed back and forth on the edge. Then the concave side is rubbed on the round edge of the slipstone, care being taken to avoid putting a bevel on it. Inside bevel gouges need to be ground on a carborundum or other revolving stone having a round edge. The outfit of the agacite grinder, (Fig. 224, [p. 120](#)), contains one of these stones. The whetting, of course, is the reverse of that on the outside bevel gouge.



Fig. 83. Whetting a Gouge.

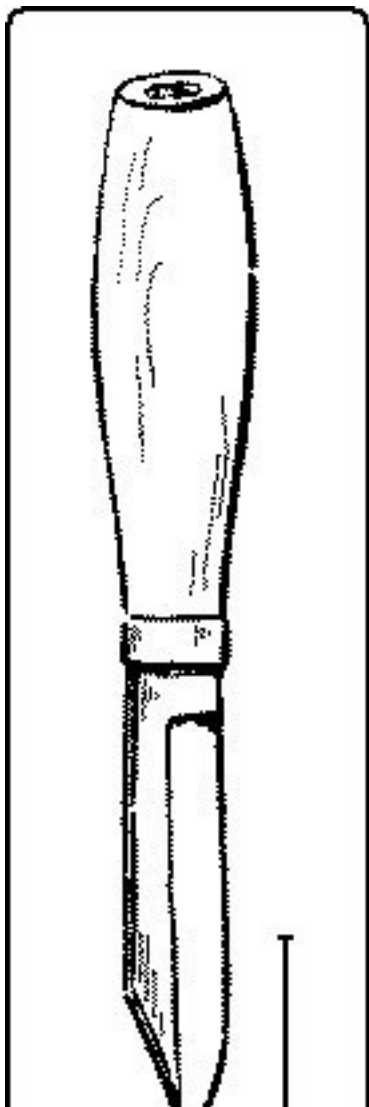


Fig. 84. Sloyd Knife.

The *knife* differs from the chisel in two respects, (1) the edge is along the side instead of the end, and (2) it has a two-beveled edge. Knives are sometimes made with one side flat for certain kinds of paring work, but these are uncommon. The two-beveled edge is an advantage to the worker in enabling him to cut into the wood at any angle, but it is a disadvantage in that it is incapable of making flat surfaces. The knife is particularly valuable in woodwork for scoring and for certain emergencies. The sloyd knife, Fig. 84, is a tool likely to be misused in the hands of small children, but when sharp and in strong hands, has many valuable uses. A convenient size has a  $2\frac{1}{2}$  inch blade. When grinding and whetting a knife, the fact that both sides are beveled alike should be kept in mind.

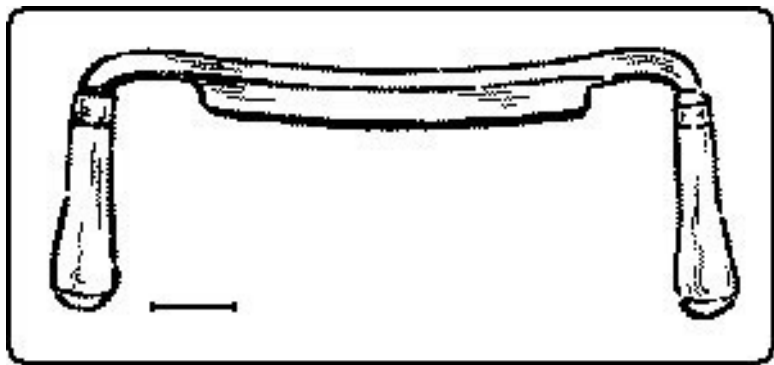


Fig. 85. Draw-Knife.

The *draw-knife*, Fig. 85, is ground like a chisel, with the bevel only on one side, but the edge is along the side like a knife. Instead of being pushed into the wood, like a chisel, it is drawn into it by the handles which project in advance of the cutting edge. The handles are sometimes made to fold over the edge, and thus protect it when not in use. The size is indicated by the length of the cutting edge. It is particularly useful in reducing narrow surfaces and in slicing off large pieces, but it is liable to split rather than cut the wood.

## SAWS

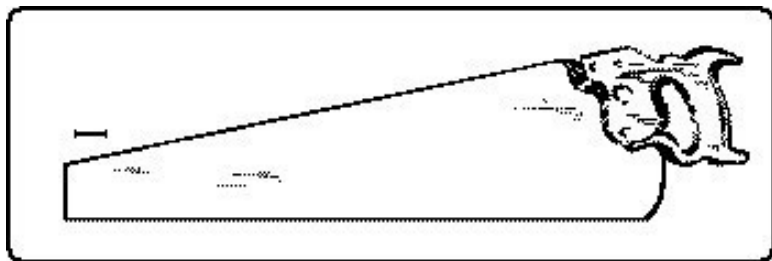


Fig. 86. Hand Saw.

The object of the saw is to cut thru a piece of material along a determined line. Its efficiency depends upon (1) the narrowness of the saw cut or "kerf," and (2) upon the force required to drive it thru the material. The thinner the blade, the less material

will be cut out and wasted, and the less force will have to be applied. In order to have the saw as thin as possible, almost all the people of the world, except the Anglo Saxons, have saws that cut when they are pulled toward the worker. The blade is in tension while cutting and in compression only when being returned for a new cut. German carpenters use a saw like our turning-saw. English and Americans have developed the saw on the opposite principle, namely, that it should cut on the pushing stroke. As a matter of fact, the crosscut-saw cuts somewhat on the back stroke. The pushing stroke necessitates a thickening of the blade sufficient to prevent buckling,—a not uncommon occurrence in the hands of a novice, in spite of this thickening. But tho this requires more force, and involves more waste, there are the compensations that the arm can exert more pressure in pushing than in pulling, especially when the worker stands upright or stoops over his work, and the stiffer wide blade acts as a guide to the sawyer. Each method has its advantages. Whatever may be true of hand-saws, in machine-saws the tension method, as illustrated by the gang-saw and the band-saw, is steadily displacing the compression method utilized in the circular-saw. Many kinds of work, however, can be done only on the circular-saw.

In order to diminish the disadvantages of the thrusting stroke, the modern hand-saw, Fig. 86, has been gradually improved as the result of much experience and thought. The outline of the blade is tapered in width from handle to point; it is thicker also

at the heel (the handle end) than at the point; its thickness also tapers from the teeth to the back. All these tapers gives stiffness where it is most needed. It is made wide for the sake of giving steadiness in sawing. The fact that it is thinner at the back than along the teeth gives it clearance in passing back and forth in the kerf, but the friction is still great, especially in sawing soft or damp wood. To avoid this binding still further, the teeth are "set" alternately one to one side and the next to the other, and so on.

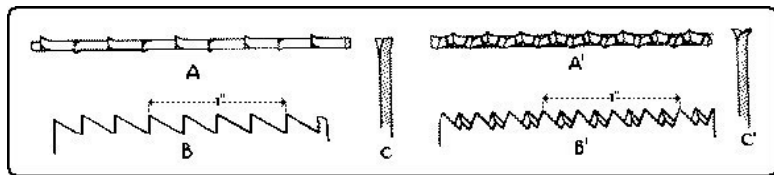


Fig. 87. Rip Saw Teeth: A-edge view, B-side view, C cross-section.

Crosscut-Saw Teeth: A'-edge view, B'-side view, C'-cross-section.

The size of saws is indicated by the length of the blade in inches. The coarseness of the tooth is indicated by the number of "points" to the inch. "Points" should not be confused with teeth as there is always one more point per inch than there are teeth. For example, a five point rip-saw has five points to the inch but only four full teeth, Fig. 87. Rip-saws run from 4 to 7 points per inch; crosscut-saws from 6 to 12 points per inch.

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