

Whipsaw to up-and-down saw

For thousands of years members of the human family have lived in caves, tents of pressed wool or skins, or in homes of logs, or frame buildings of whipsawed lumber, or brick, adobe, and stone. For an equal length of time the only method of sawing lumber was with a whipsaw, one man holding the handle on a long saw blade above a log while it rested on a framework, and one man in a pit holding the lower end of the saw, the so-called "pit man."

This method, still being used in China and other parts of the world, is painfully slow. But in times past there was no need to hurry. Labor was cheap. Most people, up to the time of the Industrial Revolution, worked in a semi-slave economy, beholden to families who had acquired land-wealth either through conquest, marriage, inheritance or manipulation.

In the Thirteen Colonies of America, the pace of life was also slow, and for housing, people were using stone and brick, whipsawed lumber, or lumber sawed at a locally owned sawmill with reciprocating blade. Then, suddenly, the population of the several states began to expand, and when new waves of European immigrants increased this growth, a demand arose for more building materials than farmers could supply in their locally owned sawmills.

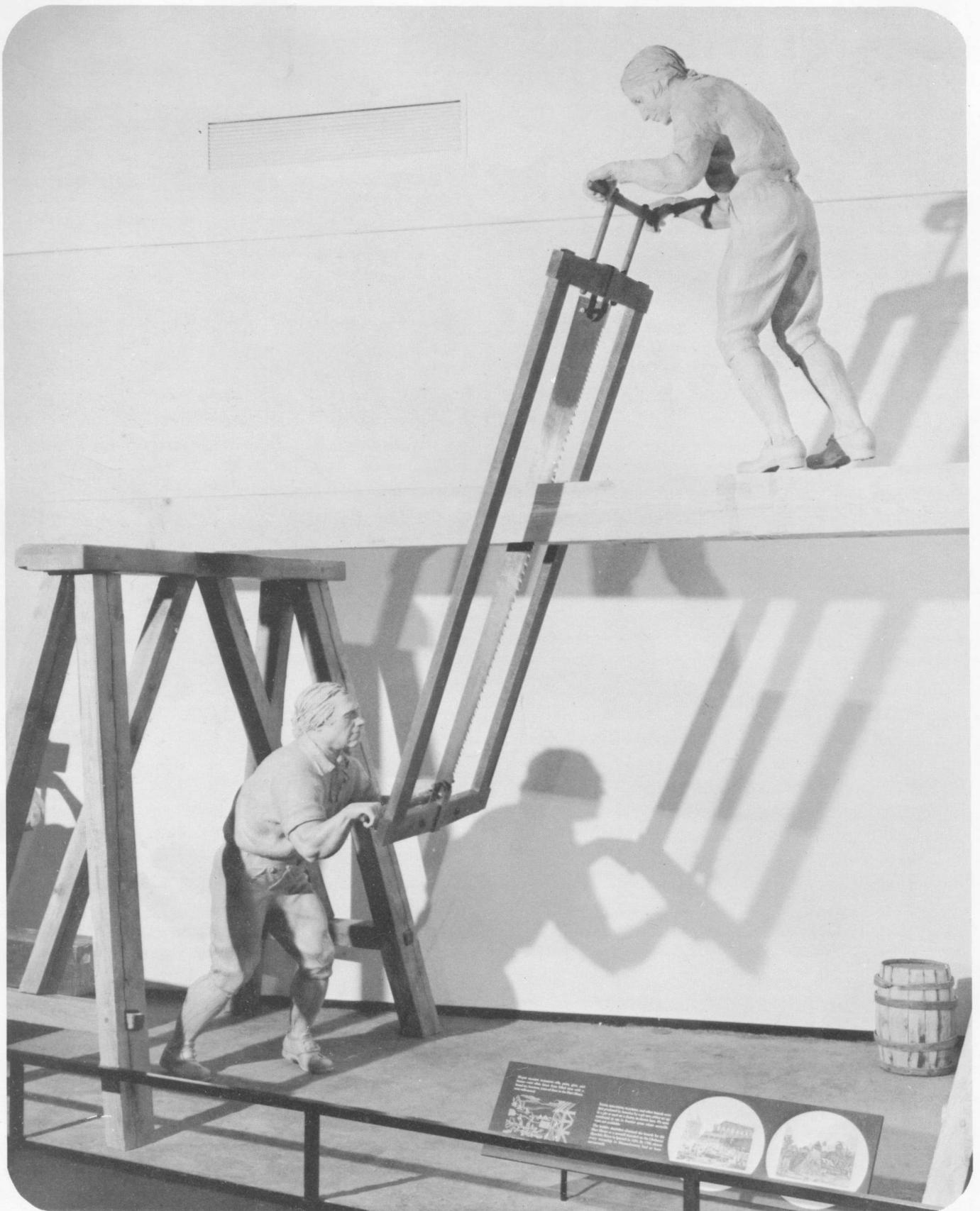
A need arose for a new industry devoted only to the manufacture of wood products. Not only was more lumber needed, but laths, shingles, pickets for fencing, wooden tools and implements, buckets, barrels, staves and, soon, railroad ties. These demands spurred the birth of forest industries. Sawmills were built on the rapids of the big rivers to take advantage of greater power facilities which could be developed by bigger overshot or undershot water wheels. So anxious were people in the Northeast to get on with the increased pace of lumbering that bees were organized to build dams, that is, people were willing to donate their own labor to the man who put up money for a dam, But, like most things, the owner did not come away scot free. The drinks were on the house, and one dam builder in Maine, in order to keep everyone happy while they struggled with the bulkheads, ordered the

following refreshments:

- one bottle of brandy
- one and half gallons of liquor
- one barrel of cider
- two bottles of liquor
- three gallons of rum

But no matter how many free dams were built, demand for lumber outgrew supply. At this point, big lumber companies, backed by investment capital from Boston and New York, were incorporated to buy timber lands and to harvest the timber. In the twenty-five years from 1825 to 1850 more was learned in Maine and New Brunswick about lumbering than had been known in the past thousand years. And in the twenty-five years that followed, when lumbering spread to the Lake States of Michigan, Wisconsin, and Minnesota, production doubled and tripled. From sawing three to four thousand feet of lumber in one day on the old up-and-down sawmills, the circular saw and muley gang saws, introduced in the 1850s, increased this figure to ten thousand feet per day. The climax came in the 1880s with the perfection of the band saw when some mills in Wisconsin, like the giants at Chippewa Falls and Menomonie, running day and night, were sawing a quarter of a million feet of lumber a day.

The history of sawmilling goes back to the third or fourth century A.D., when the Romans developed some kind of reciprocating saw. The use of the waterwheel, as a source of power, was probably known by the beginning of the Christian era, and from this someone eventually made a waterwheel with an axle on it to furnish power for an irrigation lift or other machine. Practically nothing is heard about the use of the reciprocating saw again until the end of the 13th century when a French architect, Villard de Honnecourt, circa 1270, developed a crude machine for sawing logs by water power. A sketch of this machine appears to be the earliest available in Europe, although it would be difficult to tell how well it worked. But the principle of the reciprocating saw, that is, a saw that moved up and down, was now firmly established. There were sawmills in the vicinity of Augsburg (Germany) in 1337 or earlier, and literary references have been found to a sawmill on



An exhibit in the Museum of History and Technology at the Smithsonian Institution reveals how whipsawing is done, one man above the timber and one below, pushing up and down on a saw that cut only on the downward stroke. Throughout the ages, this was the only way to saw lumber before the first up-and-down saws were developed for waterpower in Europe in the 13th and 14th centuries.

the island of Madeira after 1420, in the city of Breslau, Poland, about 1427, and to two mills in a forest owned by the city of Erfurt (Germany) in 1490.

In 1558 an Italian, Agostino Ramelli, published *Dell' Artificiose Machine*, and in it appears a woodcut showing a squared timber resting on a platform, or carriage which is being impelled into a rigid saw blade suspended from a headblock in a wooden frame. The frame moved up and down with the saw in it and was held in place by grooves or mortises inside two fender posts, something like a window that moves up and down inside a sash. It was for this reason that these early mills were often called "sash" mills and also "gate" mills because the saw works resembled a gate, but the most common designation was "up-and-down" mill.

The sketch by Ramelli also shows four square clamps on a squared timber. These clamps acted as a vise to hold the timber rigid. They were later discarded and metal pieces or "dogs" were used to hold the square timber down.

Despite this rather advanced technique, a Virginia pioneer, Edward Williams, apparently invented an "engine," as he calls it, for sawing lumber in a mill probably inferior to the Italian mill of an earlier date. Williams had a small book published in 1650, in London, called *Virginia's Discovery of Silke Worms . . . together with the Making of the Saw-Mill*. He explains how this Rube Goldberg device worked, and also says that "this engine is very common in Norway and the mountains of Sweden, wherewith they cut great quantities of deal-bords . . ."

It does not seem possible that any great quantity of deal-bords was ever cut with this "engine," but at least the Virginian had developed a slightly different principle for sawing logs, if not a very practical one.

The first sash, or gate, sawmills in America were built not long after the English colonists landed in Virginia. They needed lumber and planks faster than two men could whipsaw them. It is not possible, however, to determine with any degree of certainty, where the first mills were built, but tradition points to Virginia and to Newfoundland and to the years 1610 and 1620, although tradition

The two pictures at right and below were both taken in China in 1944. The men at the right are whipsawing in the traditional manner, up and down stroke, while the two in the lower picture are using the horizontal approach. The whipsaw is still being used in China and in parts of the world where, for local consumption, it does not always pay to install a mechanized sawmill.



fails to affirm which of these dates can be ascribed to which mill.

In Edward Knight's great work on the history of the machine, called the *American Mechanical Dictionary* (1876), a description appears of a mill built on the Danube River in 1575. In this mill multiple "up-and-down" saws were used, later known as "gang saws." These sawed several boards at once. Similar types of gang mills were built in Holland in the late 16th century and in England in the early 17th century, but all were abandoned. Apparently the chief reason these gang mills did not change sawmilling at the time was that workmen and trade guilds were opposed to them.

Here was a new device that could eliminate a work force which, since time immemorial, had been whipsawing lumber. In several instances sawmills, and even a windmill providing power for a mill, were destroyed by mob action. (When the first mechanical steam loaders, or “jammers,” were introduced in Michigan around the turn of the 20th century, they too were sabotaged by lumberjacks afraid of losing their jobs to a machine which could speed up the loading of logs.)

In the early period of sawmilling, a log was usually hewed on one side before it was placed on the carriage. The illustration from Ramelli’s *Dell’ Artificiose Machine* shows that the timber being sawed is already squared. This followed the practice of squaring off a log, that is, hewing it square before it was turned over to the men who were doing the whipsawing. And this practice was carried over to the sawmills. Hewed in this manner, the piece was called a “balk.” In fact, there does not appear to be much difference between what Americans called a “square stick” (a squared timber) and a “balk.” However, as the technique of moving a carriage forward improved, the square stick was no longer necessary, but the log was still cross-cut square at the ends and hewed lengthwise on one side to give better bearing points on the carriage.

After the log had been rolled, laboriously, it may well be imagined onto a carriage, “dogs,” that is, short bars of curved iron with right angle spikes, were hammered into the log to hold it in place. By moving a lever which opened the watergates of the penstock, the head sawyer set the mill in motion.

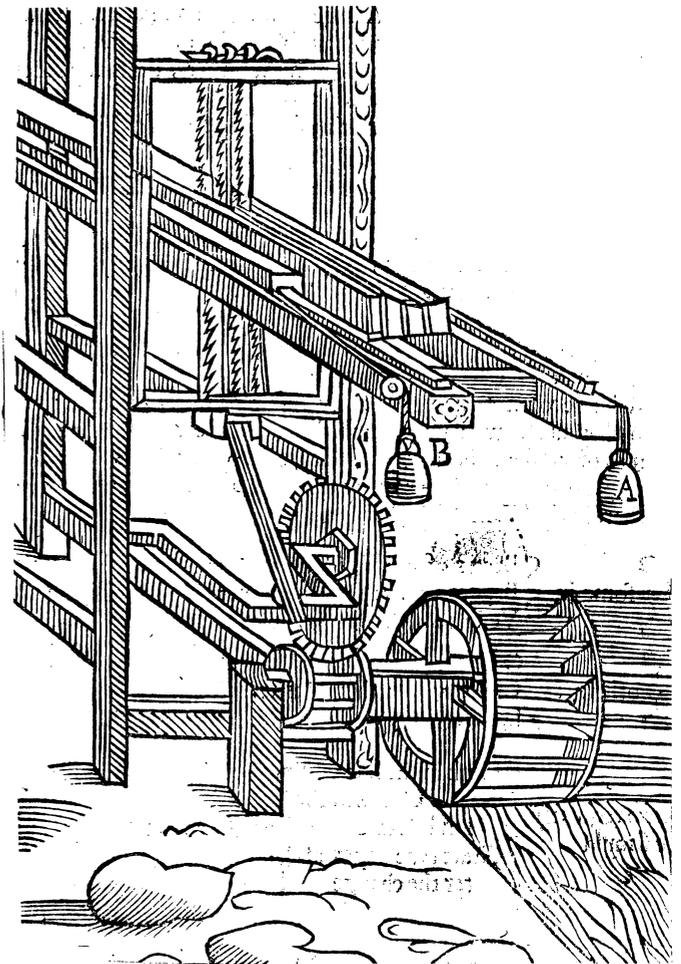
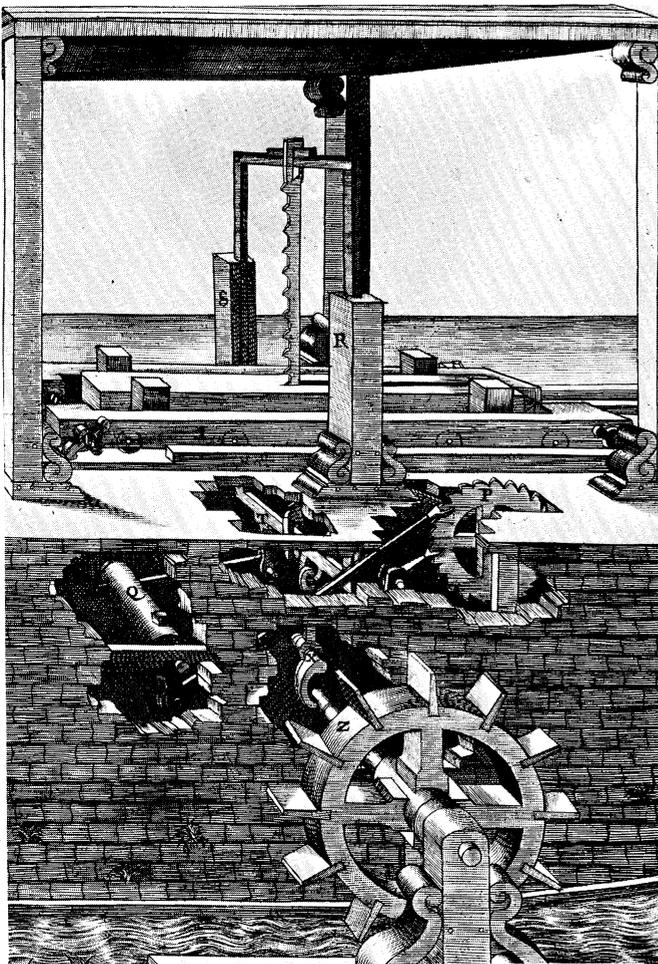
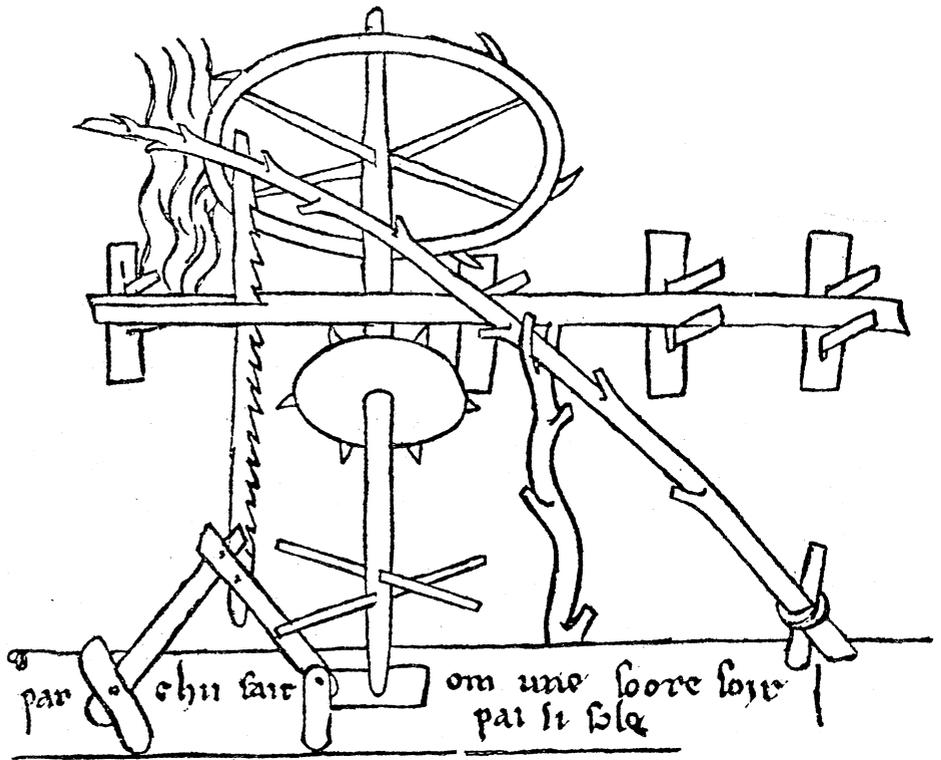
As the back end of the log neared the saw, the watergate was closed before the log reached the end to prevent the saw from buzzing the iron dogs. The carriage was then retracted to the starting position. After several boards were sawed, still clinging to the original log, or square stick, the ends were left unsawed. These unfinished ends, or “stump shots,” as they were called, were then split apart with an axe or frow. It left a rough surface, but then all the surfaces left by these early saws were rough. The teeth in the saw blade of the up-and-down saw pointed down, and since the saw cut only on the down stroke, the blade left its mark on each stroke. The stroke length varied but the average ran from eighteen to twenty-four inches. In short, any log larger than two feet on the stump had to be hewed with a broad axe before it could be sawed.

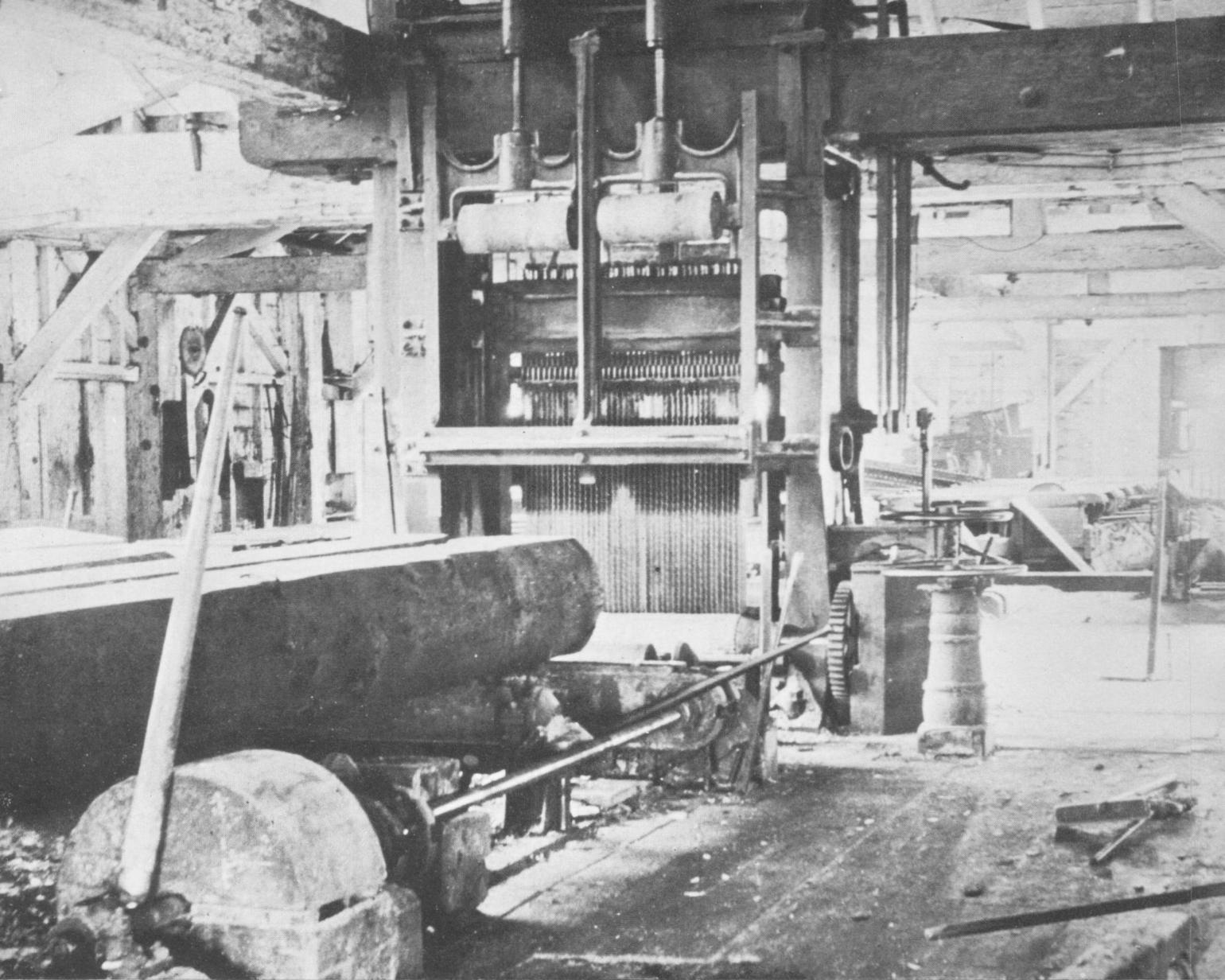
Oral tradition tells of a great white pine that stood on the farm of Per Dobbe (Portage County). Jim Bigler, who operated an up-and-down saw mill on Flume Creek, offered Dobbe a sack of flour for the tree. Dobbe agreed to the trade on condition that Bigler chop the tree down and remove it. The giant was felled. The first log to be loaded on the sleigh broke one of the beams. When this was repaired, the log was finally got to the mill. Here it was found that it would require so much work to hew it down to fit the carriage that Bigler abandoned it. The two big logs that remained on the Dobbe farm were never moved. The family bucked up one to make shake shingles, and there were enough shingles to roof all the buildings and more.



The earliest visual evidence of an up-and-down sawmill in America may be this sketch reproduced life size from the *Pictorial History of the United States* published in Connecticut, 1847. Two mills may be seen at left and center, but there is no clue to the source of power that keeps these mills going this close to the sea. A ship’s hull is under construction at the far right. The leisured life of a sawmill operator is reflected in the man atop the log who, knowing he has time to chat, will jump off the log before the saw gets too close to him. A chain is attached to a log below the mill to lift log into the mill, but the windlass is obscured or overlooked by the engraver. The saw machinery also seems incomplete.

Evidence of an up-and-down sawmill (right) appears in French texts about the year 1270 A.D., a saw developed by Villard de Honnecourt, an architect. It had no sash, or gate to hold the sawblade. But the blade seems to have been held by a long spring pole at the top. The long board or plank being sawed has two guide posts to hold the board in place, and some sort of a dog holding the opposite end, (left). This saw was crude but it revived the principle of the reciprocating or up-and-down saw. The illustration appears in Agostino Ramelli's *Dell' Artificiose Machine*, printed in 1588. The French text reads in translation: "With this you can make a saw cut through a beam lengthwise." The illustration below (left) appears in the same book by Ramelli, with detail of an Italian up-and-down mill of the 16th century. Below, right, an engraving of a mill developed by Edward Williams, a Virginian, in the mid-17th century.





A gang mill at one of Knapp, Stout & Company's mills in Menomonie, about 1885. The logs have been squared, probably by a circular saw, and then sent to the gang saw where multiple boards will be made in one pass through the saws. Only the largest mills in Wisconsin resorted to the gang saw and most of them were discarded in favor of the band saw in the 1890s.

This, incidentally, also reflects the waste that characterized much of the logging era. It seems incredible that Bigler did not realize the limit of his own saw rig before he bartered the sack of flour, but, then, stranger things have happened. One early expedition to the South Pole forgot to bring shovels.

Another story about the Bigler mill tells of a crew that rolled a log onto the carriage, set the water wheel in motion, and then went to breakfast. By the time breakfast was finished, one board had been sawed. This is a story exaggerated for the benefit of a later generation. But the crew at a mill farther down the same stream, according to hearsay evidence, played cards while waiting for

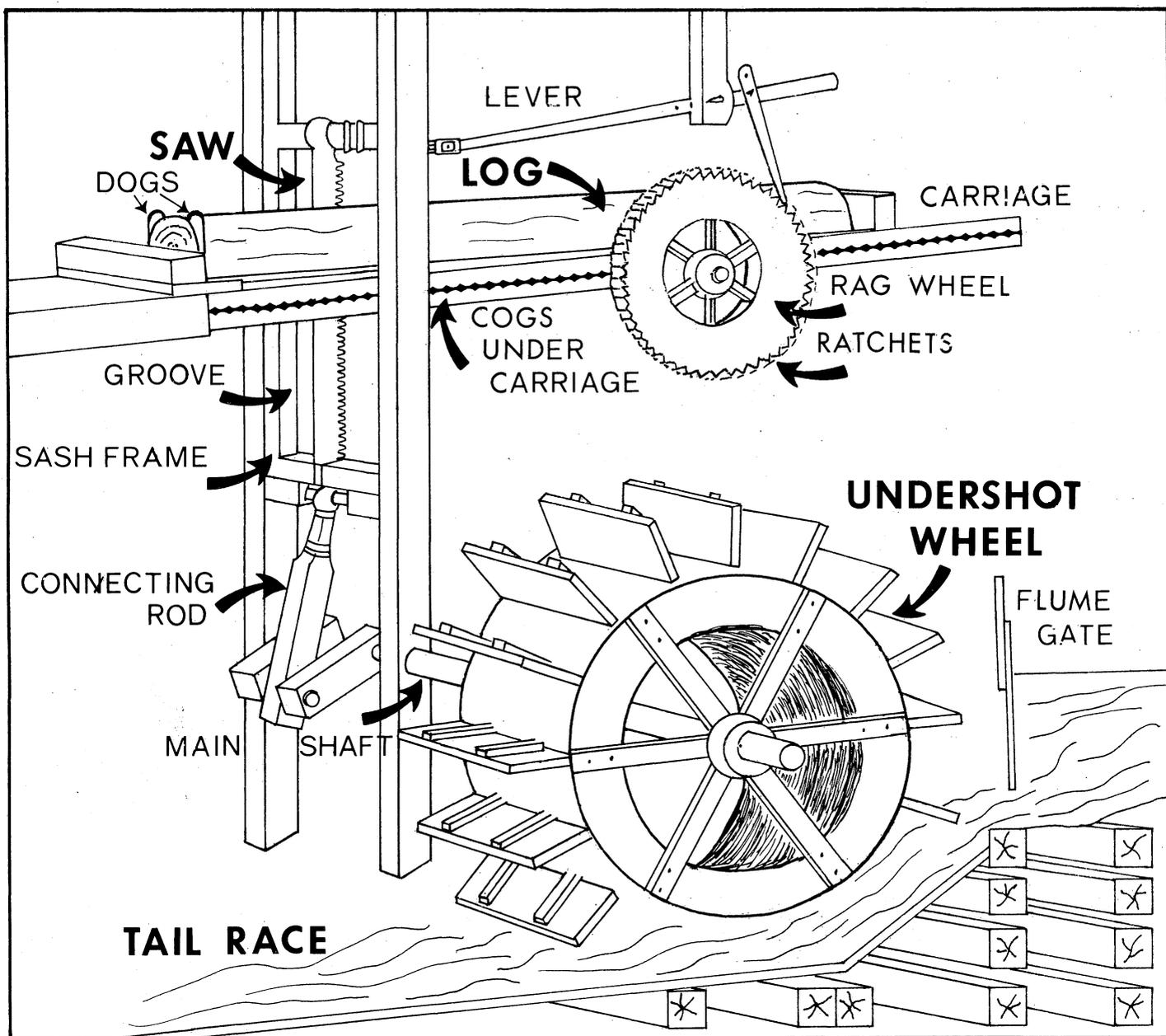
the saw to finish a board. This seems possible because a hand of cards can be laid down at any time. Both stories, true or half true, point up the unhurried, almost leisurely method of sawing logs in the small mills of Wisconsin up to 1870.

The Museum of History and Technology in Washington D.C. has on exhibit a partially restored up-and-down mill that was found in 1961 at Chester Springs, Pennsylvania. According to the descriptive plaque at the base of the exhibit, the saws of the 18th and 19th centuries in Pennsylvania made one hundred to one hundred and thirty strokes per minute. The log moved forward on the carriage at the rate of one quarter inch or more per stroke, or two feet or more per minute.

The mill at the Smithsonian Institution, described above, is probably the type that George Stevens of Almond, New York, brought with him when he came to build a mill on the Wisconsin River at "Big Bull Falls" (Wausau) in 1839. Nelson Week, who, as a boy, watched his father's mill in operation on the Big Eau Pleine River in the early

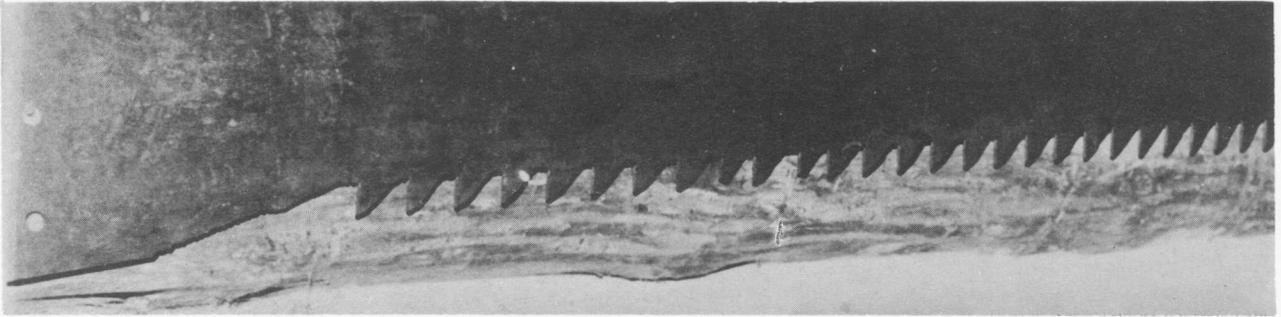
1850s, recalled that the mill sawed up to five thousand feet of lumber a day, but he failed to explain the length of the day. Many of these early up-and-down mills ran a day shift and night shift, and it is quite probable that the Week mill did the same.

The last advance in the up-and-down technique



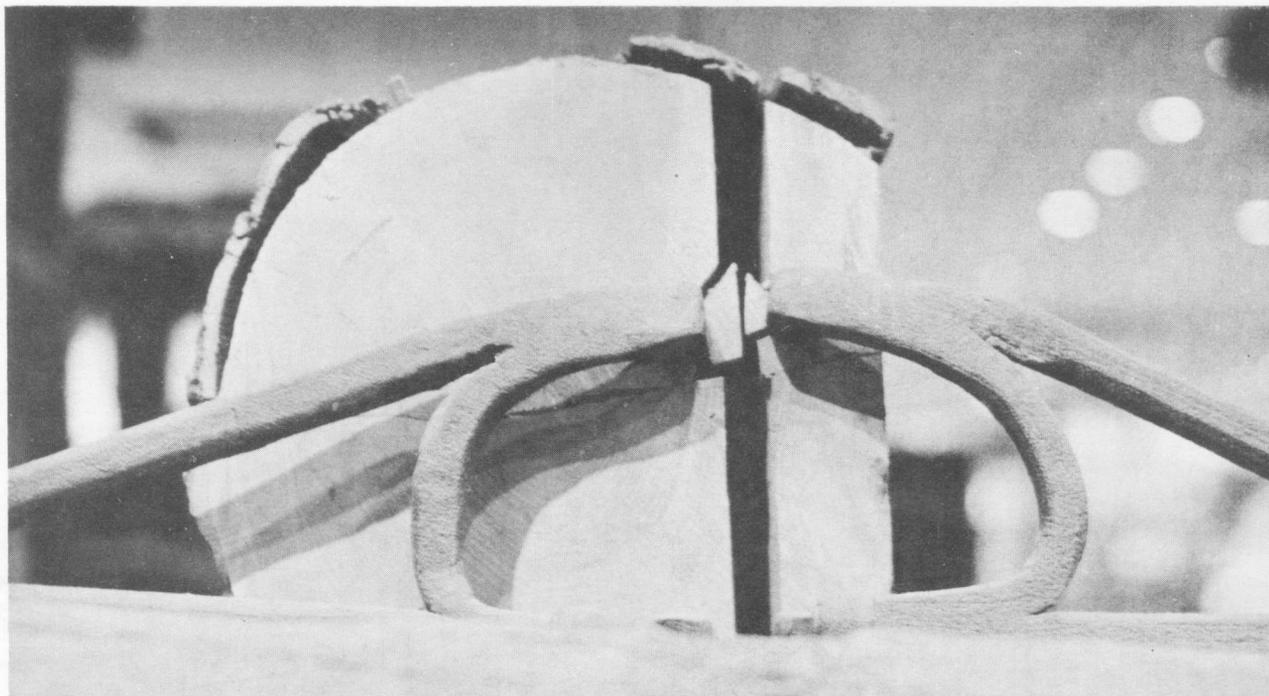
A mechanical drawing by Randall Rohe of an up-and-down sawmill powered by a waterwheel.

One of the few relics left from the days of the up-and-down saw in Wisconsin is this blade which is on exhibit at the Rhinelander Logging Museum, but the origin is uncertain. Both a saw and sash are preserved at the Dunn County Historical Society Museum at Downsville.

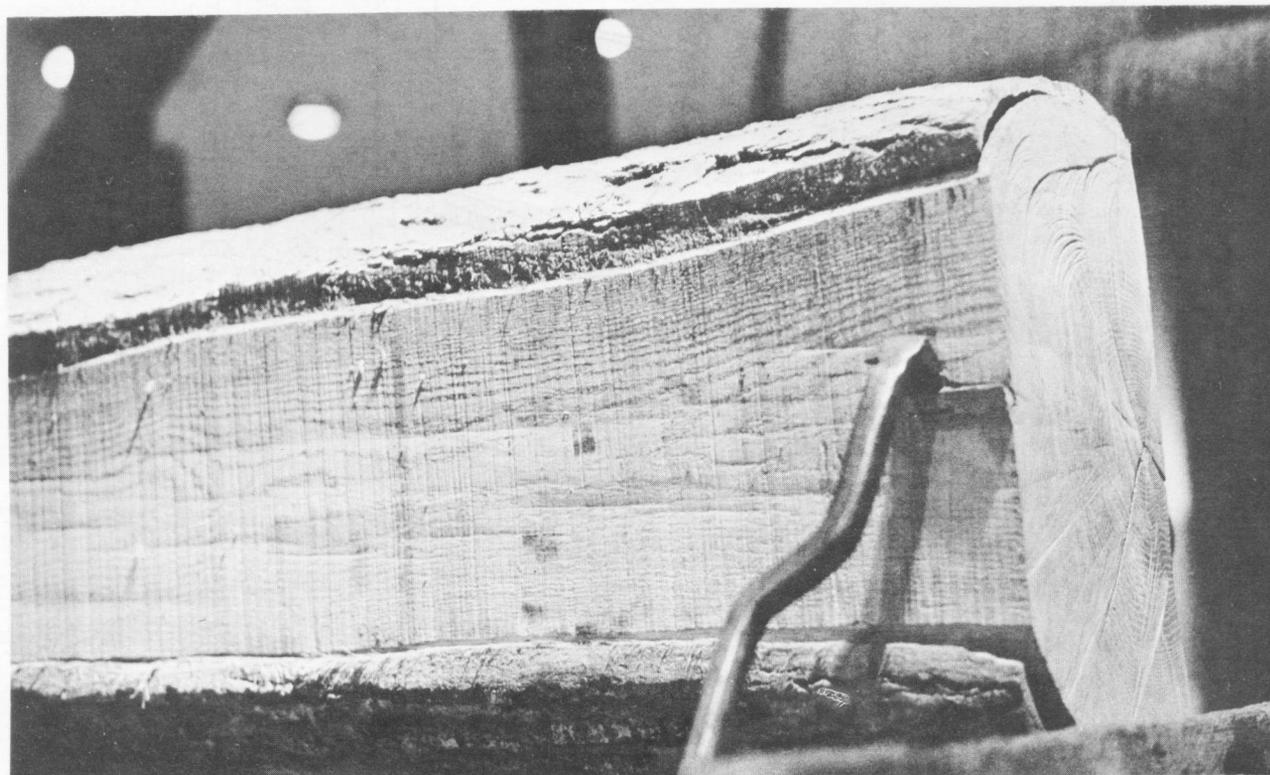


This photograph, taken at Chester Springs, Pennsylvania, before the up-and-down sawmill seen here was moved to the Museum of History and Technology in Washington D.C., in 1961, gives a fair idea of the headblock that held the suspended saw blade in place. The headblock is attached to two fender posts with grooves inside, and the whole headblock and saw moved up and down along these grooves like a window in a sash, hence the alternate name, "sash" saw, or "gate" saw.





Early types of dogs used to hold a log in place on the platform or carriage for sawing. The two photographs by the author were taken of the restored model of an up-and-down saw at the Museum of History and Technology in Washington. The position and design of the dogs explains why the up-and-down saw never sawed the entire length of the log. A life-size log has been used in this restoration, but most of these early mills sawed only logs hewed on four sides, or logs hewed on one side to enable the dogs to provide a better grip.

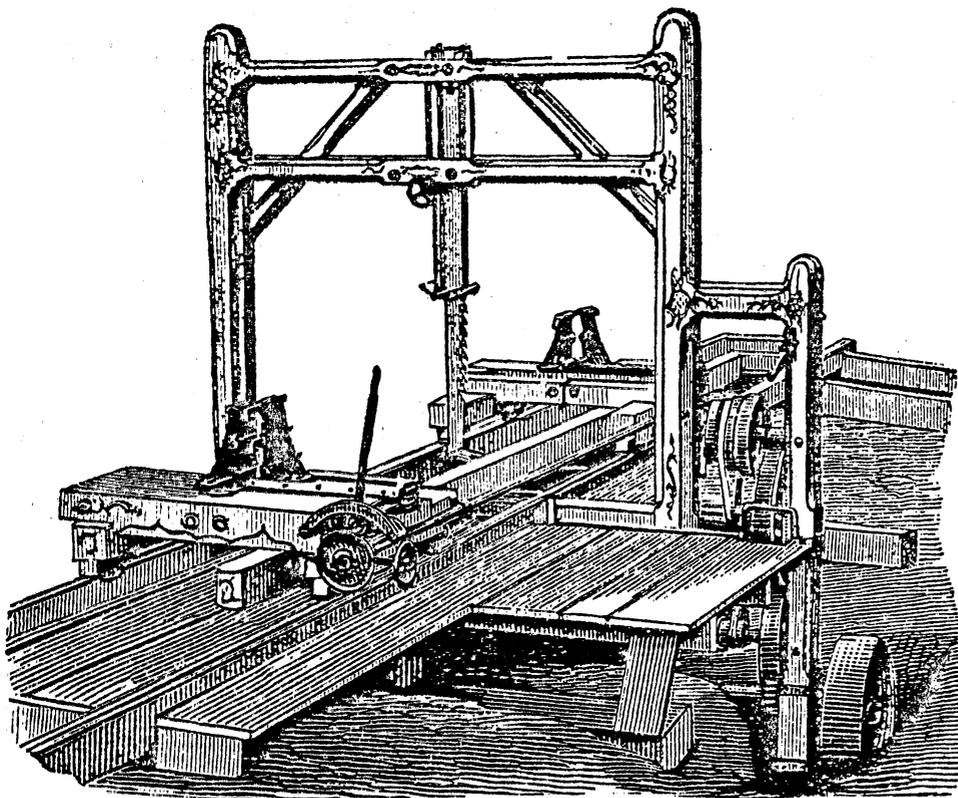


of sawing lumber was made with the introduction of the muley (or as mulay) saw. It was probably first used in the Thirteen Colonies in the 1780s, and by 1825, according to Barbara Benson, in a doctoral thesis on the lumber industry, the muley had come to Michigan. It was a slight improvement over the up-and-down saw because the saw blade moved up and down, not the whole frame, or sash, that held it. Although the muley, too, cut only on the down stroke, the saw was more efficient and increased production to more than six thousand feet per day in two shifts. The drawback was that it still cut a kerf nearly half an inch wide—an incredible waste—and perhaps for this reason the single muley saw was never popular with lumbermen in Wisconsin.

Meanwhile, the gang saw had come to America, and it probably was used in Michigan by the mid-1830s. Thus, when the circular saw came into general use in the late 1850s, it did not displace the sash saw mainly because of the much improved gang saws that were on the market. The main drawback to the gang saw in this period was that it could not saw a raw log. The log had to be squared off or hewed before it could be sent through the gang.

By 1874, one of Knapp, Stout & Company's sawmills at Menomonie was operating six big rotary saws and seven gang saws, and manufacturing nearly a quarter of a million feet of lumber in twenty-four hours.

The muley (or as mulay) saw that followed the up-and-down saw was not an invention of principle, nor did it replace the up-and-down saw entirely, but it speeded up production somewhat because it was more efficient in its mechanism. The saw moved up and down within its own casing; the headblock and frame remained stationary. But the muley saw did nothing to change the width of the kerf over the up-and-down saw, and it was therefore just as wasteful of good lumber as the former. This engraving appears in the *Fourteenth Annual Report of the Indiana State Board of Agriculture, 1872*.



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