thinner blade ; *e.g.,* a 4-gauge saw is much thicker than an 8-gauge, &c. From the necessity for more rapid production grew the ‘ ‘ gang- saw," a modification of the gate, differing from it only in length and thickness (less than one-third the thickness of the ordinary gate-saw and but about two-thirds its length). A large number of these, varying from 2 to 40, are strained in a gate or frame, at such distances apart as the thickness of lumber demands, and the log is wholly made into boards in one operation, Of the recipro­cating class of saws is the “ cross-cut,” used for cutting across the grain of the timber or wood to be converted into shorter lengths. The length, breadth, “pitch,” and “set” of saws vary according to the use which is to be made of them and the kind of timber which is to be manipulated. In a cross-cut saw the cutting edge strikes the fibre at right angles to its length, and while its pitch is but slight (if any) it must sever from each side before dislodging the sawdust. “A slitting or ripping saw has the cutting edge about at a right angle to the fibre of the wood, severing it in one piece,—the throat of the tooth wedging out the piece.” In slitting saws the “rake” is all in front, in the cross-cut on the side.

The circular saw is of comparatively recent origin, its introduc­tion dating from 1790, when Brunel first announced the principle. At first only circular saws of small diameter were used ; but, from the small “buzz-saw” of the watchmaker and fine metal worker, or the ripping saw of the planing-mill or carpenter shop, where small diameters have to be divided, the circular saw has passed to the saw-mill, where, in diameters of from 12 to 30 inches, it is the heedful instrument for edging or ripping the lumber which drops from the log in an imperfect condition, requiring finer manipulation to prepare it for market; or in diameters of from 40 to 84 inches it may be found as the main saw of the mill for rending the logs as they come from the forest into shapes and sizes adapted for the various purposes of the builder. It is capable of dividing logs into boards one inch thick or upwards at as high a rate as 60,000 superficial feet in a day of twelve hours, while a straight (muley or gate) saw would give only 5000 to 8000 feet. In the chief lumber sections of the United States saws of 60 inches diameter are in most common use ; upon the Pacific coast saws of 8 feet diameter are not unknown. Attempts to work large circular saws in nests or gangs have not hitherto proved successful, but three, four, or five saws of 30 inches diameter hung on a single shaft or “arbor” may be used to trim and divide the boards or planks thrown off from a log.

Barrel saws, for the manufacture of staves for barrels, pails, or tubs, are in the form of a straight-sided barrel with both heads removed, and the stave ends of one head serrated.

For the manufacture of veneers, where valuable timber is to be economically manipulated, we have the segment-saw, constructed by bolting segments of saw-blades upon the outer rim of a cast- iron centre, forming a circular saw of the desired diameter, but with a cutting edge of so light a gauge as to waste but little of the valuable timber to bo sawed, the cast-iron centre insuring the requisite stiffness and strength. With these saws veneers scarcely thicker than a sheet of paper may be cut, the width being accord­ing to the size of the log ; such saws are often from 80 to 100 inches in diameter.

Circular saws of the larger size are often constructed with “inserted ” teeth. A disk of steel of suitable size, having slots cut in its periphery of the exact size and shape of the tooth which is to be inserted, may have these teeth removed as often as the wear upon them may require, without reducing the diameter of the plate. The teeth of lumber saws have to be sharpened with the file at least three or four times in twelve hours’ work, and a saw of five feet in diameter is rapidly reduced in size with a great loss of efficiency. In the insert tooth plate new teeth cost only about three cents (l1/2 d.) each, and the saw plate remains of its original diameter. Inserted teeth are of various forms and shapes, from that of the ordinary saw tooth, held in place by a rivet at the root of the tooth, to a “ chisel point ” held by an ingenious system of wedging.

Band-saws have for many years been used for continuous and rapid cutting in the planing mill or other wood-working establishment, where scrolls or fancy lines and curves were to be followed, requiring great flexibility of the saw-blade, of late, and notably within the past two years (1884-85), successful endeavours have been made to adapt them to lumber manufacture. The band-saw is a continuous blade or ribbon running over pulleys above and below, forming a “steel belt” whose serrated edge is always “ in the cut.” These saws are usually from a half inch in width (for shop work) to six and eight inches wide for the heavier work of the saw-mill, and in the latter have a cutting capacity of from 30,000 to 40,000 superficial feet in twelve hours. They are extremely thin (usually 16-gauge), and the kerf produced ‘is so much less than that of the upright or the circular that a saving of at least 20 per cent. of timber is claimed in their use.

Saws used by surgeons, butchers, and in all branches of manu­facture are but modifications of one of the varieties above described, and do not demand more extended description.

*Saw-Mills* are factories for the conversion of forest trees into lumber and timber. The earliest form of saw-mill was unquestionably the saw-pit, still found in a modified form in shipbuilders’ yards, the log being raised on trestle horses instead of one of the sawyers being sunk in the pit. Saws were run by windmill-power as early as the 13th century; and the use of water-power soon followed. The primitive water saw-mill consisted of a wooden pitman attached to the shaft of the water-wheel, the log to be sawed being placed on rollers sustained by a framework over the wheel, and being fed forward on the rollers by means of levers worked by hand. Good authorities mention saw-mills running by water-power in Germany as early as 1322. In 1663 an attempt to establish a mill in England was abandoned owing to the opposition of the sawyers, and no further attempt was made till 1768, when a mill was erected at Limehouse, but was soon destroyed by a mob. North America, with its vast forests, may be aptly termed the home of saw-mills. As early as 1634 a saw-mill was erected at the falls of the Piscataqua, near the line divid­ing Maine from New Hampshire. This was no doubt the pioneer of the vast array of mills which subsequently made Maine famous as a lumber-producing State for many years. From about the same date several mills were erected along the Atlantic coast of America, a description of one being that of all. In these mills the saw was attached by a long pitman from the wheel shaft to a ponderous gate, running in wooden slides upon two heavy posts, crossed above by a beam connecting the two sides of the mill-frame. The mill-carriage on which the log lay was pushed towards the saw by a rack and pinion, &c., moved by a feed-wheel. The daily capacity of these mills was from 500 to 1500 superficial feet. The first great improvement upon this class of mills was in the introduc­tion of two or more saws to the gate, the general character of the methods remaining the same. With the demand for more rapid production came improvements in the “ gang ” feature, and the wonder of the age was the “ Yankee gang,” so arranged, by placing half the saws facing in one direction and the other half in the opposite, that two logs were worked up in one movement of the carriage, or, as in the “ slabbing ” gang, the outsides or slabs were cut from one log, which was then turned upon its flattened sides to the other set of saws which cut it into boards. The “stock” gang, “pony” gang, “slab­bing ” gang, and “ Yankee ” gang are favourites with saw-mill proprietors, because of the uniform character of the lumber produced, and the saving of timber realized from the use of saws of scarcely one-third the thickness of the gate, muley, or circular.

Gang-saws are seldom thicker than 14-gauge, and are success­fully worked at 18-gauge, making a saw-kerf or waste of but 1/8 inch, whereas the ordinary gate, muley, or circular takes 7/16 inch. The muley was introduced later than the gang, and was received with great favour, entering into more general use be­cause of its comparative cheapness and adaptability where the sawyer had not to deal with large quantities of lumber. The muley mill dispensed with the ponderous gate and heavy posts of the saw-frame. While the lower portion of the mill is arranged much as in the use of the gate-saw, with the addition of necessary slides, the upper end of the saw is guided in a strong iron frame pendent from the weigh-beam overhead. On each side of this frame are slides in which arc placed boxes, attached by a noddle pin and strap to the upper end of the saw, keeping the tool in line with the cut, and the cutting is accomplished wholly by the downward thrust, the motion of the crank beneath imparting a forward motion to the blade in its cutting functions and a retreating motion as it rises from the cut. By an ingenious arrangement of the slides an increased oscillation may be imparted, the object being to cause the saw- teeth to hug the timber closer on the downward or cutting thrust, and to recede and run clear of the timber on the upward motion, thus decreasing the friction. Muley-saws are usually run at a speed of 300 revolutions of the driving wheel per minute, and the daily capacity may be stated at about 5000 superficial feet.