Saw Manufacture at Sheffield.

First, the saw is cut out of the sheet. If a heavy or large saw, it is never toothed while soft. The third stage is that of hardening. Placed in a structure like a baker's oven, and floored like a baker's oven with brick, the saws are left there to harden, and when they come out they are, when cool, brittle as glass. To abate this brittleness, they are put into a composition, where they lie, for a time, in a sort of oily bath. This makes the fourth stage. After this they are tempered over a coke fire, watched by men who, guided by their experience of color, take them out when they have acquired the tint which will leave them with a blueish hue, that indicates, to the practised eye, the amount of elasticity in them. At this point you may bend them like whalebone from heel to point, so elastic have they become. This makes the fifth stage. The tempering warps them, and they now require to be flattened. The flattening is the work of the "smithers," who hammer and beat them into an attitude of precision. This makes the sixth stage. Now the blades have to be ground and glazed. This makes the seventh stage. The saws, being now flat and bright, have their teeth "set," by the laying over the edge alternately, and with the setting the sharpening is associated. This makes the eighth stage. At this point it is necessary to restore to the saw blade the measure of elasticity which has been taken from it by the processes of rubbing and glazing, so it is put into the oven; for the mere rubbing or glazing of the saws does, somehow or other, extract from them a large amount of the elasticity imparted to them by the tempering process, and for this reason they are heated to restore to them their lost suppleness. This makes the ninth stage. When they come out of the oven, they have on them a sort of straw tinted bronzing, which has to be removed. To remove it, they are placed in a bath, which immediately takes it off. This makes the tenth stage The saw has now to be etched. This is the eleventh process. If a hand saw, it needs the hold for the hand or handle to be put on, and this is done with remarkable dexter ity and when done the twelfth stage is completed. Nothing remains now but to have the saws examined. Messrs. Spears and Jackson, of Sheffield, make circular saws of from one inch to ten inches in diameter. These miniature circulars are exquisite specimens of the sawmaker's art, are chiefly destined for Paris, there to be employed by silversmiths and others in the production of those beautiful and ornamental articles for which Paris stands unrivalled. They also make saws on models which it is proved are from two to three thousand years old. These are for the Hindoos, and have the teeth set towards the handle, so as to cut by the up stroke instead of the down. Saws are of an almost infinite variety—some narrow as lengths of steel tape, some round and broad as a cart wheel or the top of a large loo table. Some have beautifully small teeth, others have teeth larger than a horse's. Some are destined for the most delicate operations of fancy cabinet work, and some are to be employed in sawing Bessemer steel rails by steam, at the rate of 800 revolutions per minute, while others are framed to spin along with a rasping sound all day long, cutting their way through the largest logs of timber in the naval dockyards.

The saw trade is a very ancient one, for the saw itself is figured on the ancient monuments of Egypt and Babylon. The cutting out of the edge in the form of teeth is done by machines, and where the teeth are small it is done at the rate of 400 per minute. The usual way to set the teeth is alternately to the right and to the left before completing the saw; but in the East, where ancient usages are preserved, the teeth of the large saws are bent aside in groups of perhaps a dozen each. The sharpening and setting of a saw requires considerable skill of hand and accuracy of eye; for if any one of the teeth projects either edgewise or sidewise beyond the true line, it renders the sawing harsh and difficult. When the teeth of a hand saw become blunted by use, they are sharpened again by means of a three-square file; but previously to this, comes a necessity for turning the saw to the fire where it is heated.—*Ironmonger.*

Metropolitan Railway of Paris.

We translate the following from *Le Moniteur des Intérêts Matériels:*

An important project was submitted to the Municipal Council in Paris during its last session. Its object was an underground railway to be completed by private enterprise, without subsidy, either from the State or the city. The scheme is not a new one, complete plans and designs of such a system having been presented to the Government in 1864, by M. Mouton. It is this project which has recently been again put into shape.

According to these plans, the railway will commence at Longchamps, will follow the course of the Avenue de la Grande Armée and the Champs Elysées as far as the Place de la Concorde, and, going along the Rue de Rivoli (the railway being the axis of the section of the main subways), will reach the chief market (Halles Centrales), and subsequently the depots of the railways of Vincennes and Lyons, and that of Orleans by passing over the Seine on a viaduct.

A branch will leave the main line at the Halles Centrales, going towards the depots of the Northern and the Eastern Railways, and rejoining the Belt Railway (Chemin de Fer de Ceinture).

Two other branches, leaving the Palais Royal station, will extend, one towards the depot at Saint Lazare (west, right bank of the Seine) and the other towards the depots at Mont Parnasse (west, left bank) and d'Orsay, by crossing the Seine in a tunnel and following the line of the Rue de Rennes.

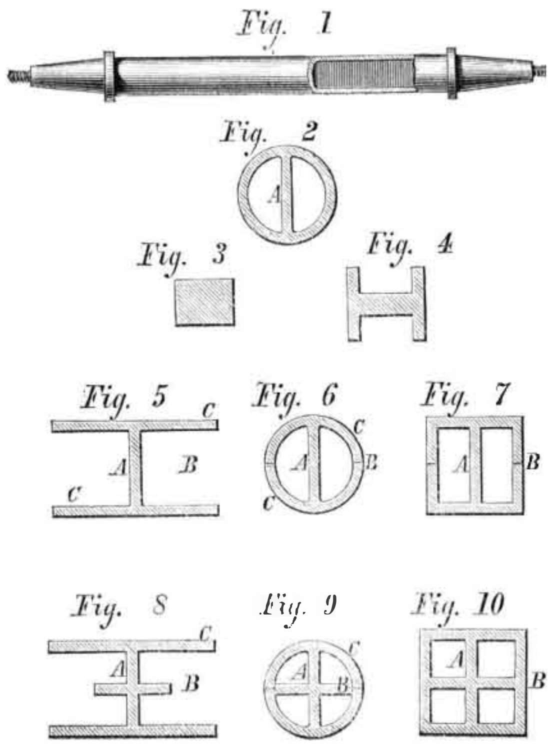
All the depots will thus be united to the Halles Centrales. The greatest depth under ground in this railway will be 13·5 meters, while the Metropolitan Railway of London in many places descends to a depth of 17 meters.

The tunnel will have a width of section of 60 meters; the surveys will be made similarly to those for the underground railways of London, which have been operated for many years past with complete success. When, seven years ago, this project was submitted for the first time to the Prefect of the Seine, it was returned for examination by the two engineers-in-chief of the city. M. Belgrand reported that the scheme gave every satisfaction to the needs of his important branch of the service, that of the subways. M. Alphand made the same declaration, subject to his examination of the design for the station to be established at Longchamps.

This great work deserves the attention of the Municipal Council. There are no technical difficulties to hinder the construction of a network of subterraneous ways in Paris; and we believe that statistics of the probable traffic will convince the public that the capital employed will obtain a large profit.

IMPROVED AXLE FOR RAILWAY CARS AND LOCOMOTIVES.

What proportion of all the destructive accidents on railways originate in the breaking of axles, we have not statistics at hand to determine. It is certain, however, that much destruction of life and property has arisen from this cause. On the 6th of February, of the present year, the public was horrified by the account of such an accident, at New Hamburgh on the Hudson River Railway, the terrible details of which are still fresh in the minds of all our readers.



This instance alone, of the many similar ones that might be recorded, is enough to illustrate the importance of any invention giving greater strength and security to axles. Such an invention will be appreciated, not only by those who incur the personal risks of railway travel, but especially by railway companies, whose interest it is to avoid all such disasters and the pecuniary loss and reputation for insecurity resulting therefrom.

Such an invention we herewith present to our readers. It furnishes, without doubt, a much stronger axle in proportion to its weight than are the axles at present in use; and experts who have examined it assert that it can be made as cheap, or nearly so, as the ones now employed.

The strength of a given weight of metal, when formed into a hollow cylinder, has long been known to be much greater than when wrought into a solid cylinder. Galileo was the first to demonstrate mathematically the proportionate strength of hollow and solid cylinders. He showed that the resistance of a hollow cylinder is to that of a solid one, of the same length and weight, as the radius of the hollow cylinder is to that of the solid one. According to this formula, the strength of a hollow cylinder, the metal of which would make a solid one of the same length and one twentieth the diameter, would be 4·47 times stronger than it would be were it wrought solid. The theories of Galileo relative to the strength of materials were based upon the assumption that the fibers of beams are neither elongated or compressed by the strains to which they are subjected, each acting with equal energy throughout their cross sections. Robert Hooke, in 1678, announced the fact that fibers are compressed on the lower side and extended on the upper side of beams subjected to downward transverse strains. Mariotte, in 1680, investigated the position of the neutral axis, or the points in the sections of beams, subjected to neither extension nor compression; and the results of his researches were confirmed by Leibnitz in 1684. Parent, in 1713, published the following principle, namely, that "the total resistance of the compressed fibers equals the total resistance of the extended fibers." Coulomb, in 1773, generalized this principle to make it applicable to beams upon which forces are applied in an oblique direction. In 1807, Young investigated the *modulus* of elasticity. Other investigators followed these researches, adopting some false principles, but all struggling to arrive at truth on a difficult subject, some points in which are still matters of debate. The reader will find much interesting historical matter in connection with the subject, in Wood's "Treatise on the Resistance of Materials," published during the present year by John Wiley & Son, New York, and from which the above synopsis is compiled.

The result of all these labors has led to the construction of formulæ different from that of Galileo, based upon the results of extended experiments with various kinds of materials. The relative strength of solid, as compared with hollow, beams, has not received the share of attention that, in our opinion, its importance demands. And although it has been shown that a tube of rectangular section, whose hight is considerably greater than its thickness, will sustain a greater amount of lateral pressure than a hollow cylinder of the same thickness, it is obvious that this can only be the case when the strain is applied in one direction.

The results of actual experiments are better guides for the estimate of relative strength of hollow and solid cylinders than any formulæ that can be adduced.

A round tube, whose external diameter is to its internal diameter as 10 is to 7, has, according to Tredgold, twice the strength of a solid cylinder of the same length, material, and weight.

Experiments conducted in England, in 1842, an account of which is given in the *Mechanics' Magazine* (Vol. XXXVIII., page 254), gave the following results: "A weight of six hundred pounds was allowed to fall from a hight of nine feet upon solid railway axles, and with that force they were frequently broken at the second blow, and sometimes at the first; while, by letting ten hundred pounds fall on hollow axles from a hight of fifteen feet, not one of them was broken."

The invention under consideration consists in the construction of tubular axles, round, oval, or square, with one or more interior longitudinal strengthening webs or supports. The object of the invention is to manufacture all sorts of axles, which will be much stronger, lighter, cheaper, and better lubricated than any axles now in use.

Fig. 1 is partly a side view and partly a longitudinal section of a cylindrical axle so constructed. Fig. 2 is a transverse section of the same. Fig. 3 is an end section of a bar of which the axle is made. Fig. 4 is an end section of the same, after once passing through the rolls, and indicates the manner in which the completed blanks, Figs. 5 and 8, are produced. Figs. 6 and 7 are forms produced from the form shown in Fig. 5, and Figs. 9 and 10 are made from the form shown in Fig. 8, by uniting the edges of the parts, C, at B, and properly welding them there. Fig. 6 is an end section of a vehicle axle, with one internal longitudinal web, to strengthen it and prevent it from collapsing. Fig. 9 is an end section of a railroad axle, with a perpendicular web, crossing a horizontal one at right angles.

The hollow chambers in the axle have been found to afford great facilities for lubricating, and it is quite evident that the addition of the web to the hollow cylinder forms the lightest and strongest axle that can be made on any principle yet discovered; and, from the amount of metal saved, we should judge that it is also the cheapest. Such axles may be rolled or cast, and, by recesses of suitable shape in the rolls or molds, they can be made square for about ten inches inside the collar washer, to receive the clips which hold vehicle axles from rotating.

The internal webs prevent the buckling of the external tube without great increase of weight, and the strength thus gained is self evident. We see no practical reason why such axles as these should not be generally adopted, and if this be the case, the invention will give rise to an extensive and important branch of industry.

It was patented, Oct. 31, 1871, through the Scientific American Patent Agency, by Joseph W. Cremin, 213 East Fifty-first street, New York, who may be addressed for further information.

Leland's Galvanic Battery.

This invention has for its object to produce an electric battery which will operate continuously without requiring attention, as long as it remains provided with the requisite exciting substances. The invention consists in placing within the porous cup, containing the platinum element, sulphate of mercury alone or mixed with black oxide of manganese, and in surrounding the cup with water, which is in contact with the zinc. This combination, it is claimed, produces reliable action, and is very economical, as the spent sulphate of mercury falls to the bottom of the cup in a shape to be readily reconverted.

The inventor states that, by connecting the poles of the platinum and zinc plates, a steady action is maintained until the sulphate of mercury is entirely decomposed and falls to the bottom of the cup as metallic mercury, ready to be reconverted into sulphate of mercury. This insures great economy.

This battery will, it is claimed, work weeks or months without attention, except perhaps the filling up of evaporated water, and the supply of sulphate of mercury. No acid being required, offensive fumes are avoided, and much steadier action is insured.

The improvement is the invention of Mr. Edwin J. Leland, of Worcester, Mass.

AN English author, Miss Meteyard, remarks in her life of Wedgewood, that the earliest mention of the photographic art is a discovery by Thomas Wedgewood in 1791. She gives a *fac simile* of the earliest sun picture on record, and states that she has traced the connection between the Wedgewood family and the Frenchman Dominique Daguerre. This version of the origin of the universal and beautiful art of photography shows it to be much older than people generally suppose, and adds an additional lustre to the name of Wedgewood.