much more than covers the waste. Every now and then a little of the melted metal is taken out in a ladle, and plunged into cold water; the sample is then broken upon an anvil. Its fracture should be bright and crystalline, showing a very small proportion of carbon—not more than 0·1 per cent; it should also be tough and malleable. From 5 to 8 per cent of spiegeleisen, containing not less than 9 per cent of manganese, is thereupon charged through the side openings down upon the bank of the furnace, and allowed to melt down into the bath. The amount of carbon thus introduced determines the temper of the resulting steel. In the event of the sample containing too much carbon, as proved both by its appearance and by chemical analysis, the carbon is allowed to boil out if the furnace is too full, as the addition of more iron might cause accidents; but this boiling out takes time. The quickest way is to add more decarburized iron, if there is room for it in the furnace. In judging the amount of carbon present by the appearance of the sample, the rule is "the more silky the metal, the less carbon does it contain," and, when it is half way between the granular and silky states, then the bath is ready for the spiegeleisen.

The accompanying engravings show the form of the interior of the furnace. In charging it, it is first made quite hot, and then one tun of pig iron is charged in; this takes about an hour to melt, and then fills the bath to the proper level. After it is fairly melted, the men begin to charge the scrap on the bank, where it is allowed to get red hot before it is tumbled down upon the melted pig iron; it would chill the bath if it were added cold. The men keep on placing quantities of more or less carburised metal upon the bank, and tumbling it into the bath when hot, until the bath contains about four tuns, filling it to the proper level. The whole operation occupies seven or eight hours. The time varies a little; on a hot day the furnace will not work so well as on a cold one, because of the draught. After four tuns of iron have been melted, the men begin to take samples out, and then go on charging decarburised iron till the metal gets soft enough, at which point there ought to be about five tuns in the furnace. If it is too hard more shearings are added; if not hard enough a little pig iron is put in. Last of all the spiegeleisen is put in; it is placed on the top of the bank, and tumbled in directly it is warm enough. Then the furnace is quickly emptied, for the forgeability of the steel depends entirely upon getting the charge out directly after the spiegeleisen has been put in, or else the manganese would all be burnt out. The process of melting takes about ten hours from first to last. The furnaces work night and day; there are three men continually attending to each furnace, and they work twelve hours each. At present, however, the mill is working only one shift per day, which turns out 350 tuns of rails per week.

From experiments made in France by M. Sudre, at the expense of Napoleon III., it was found that it is just possible to raise the heat of an ordinary furnace, by means of a fan blast, sufficiently to effect the fusion of tool steel upon the open hearth, but that the cost of the fuel and the rapid destruction of the furnace are commercial obstacles to the use of the method.

In the Siemens steel furnace, the direction of the flame is from end to end, and the regenerators are placed transversely below the bed, which is supported on iron plates kept cool by a current of air; this cooling of the bed is very necessary to keep the slag or melted metal from finding its way through into the regenerator chambers. The bottom of the furnace is formed of siliceous sand. Instead of putting moist sand into the cold furnace, Mr. Siemens calcines the sand, and introduces it into the hot furnace in layers of about one inch in thickness. The heat of the furnace must be sufficient to fuse the surface of each layer; that is to say, it must much exceed a welding heat at the end of the operation, in order to impart additional solidity to the uppermost layers. Care must be taken that the surface of the bath assumes the form of a shallow basin, being deepest near the tap hole. Some white sand—such, for instance, as that from Gornal, near Birmingham—will set, under these circumstances, into a hard, impervious crust, capable of surviving from twenty to thirty charges of liquid steel, without requiring material repair. If no natural sand of proper quality is available, white sand, such as that of Fontainebleau, may be mixed intimately with about 25 per cent of common red sand, when the same result will be obtained. The actual requirement is sand containing about 96 per cent of silica and 4 per cent of alumina or magnesia.

After the steel is melted, it is tapped out of the furnace into a ladle, as in the Bessemer process, and is then run into ingots.

The rails for the Metropolitan Railway, made at the Landore Steel Works, have a flange of $6\frac{3}{8}$ inches across, which is a great width to "bring up" in steel, and can only be done with good metal; the steel, if of second rate quality, will crack along the edges of the flange.

We saw several testing machines in the works where inspectors employed by the different railway companies test the rails before accepting them of the makers. The test for the bridge rails used on the Great Western Railway is a weight of 21 cwt., allowed to fall from a height of 6 feet 4 inches upon the center of a piece of rail supported upon bearings 3 feet 6 inches apart. The blow is repeated three times upon the center of the same piece of rail; and if the center of the rail be then deflected about 7 inches, the steel is considered to be good. Sometimes the result is a deflection of not more than 5 or 6 inches, and sometimes the piece of rail breaks, but not often.

The total fall of the machine is 24 feet, upon an anvil block of solid iron weighing 15 tons. The rigidity of the anvil is an important point in testing steel rails or bars.

The test of the Bristol and Exeter Railway Company is a 10 feet fall of 2,240 lbs.; three blows; 5 feet bearings.

The rails for the Metropolitan Company weigh 86 lbs. to the yard, and are tested, not by a falling weight, but by the dead weight produced by hydraulic pressure. A piece of the rail is placed upon 5 feet bearings, and a slightly curved iron surface $3\frac{3}{4}$ inches in width is made to press upon the center of the sample rail selected for testing. The test is that under these conditions a pressure of 40,000 lbs. shall not deflect the centre of the rail more than 1 inch; also that 60,000 lbs. shall deflect it 9 inches without breaking it.

A steel rail has fully six times the life of an iron rail, and the difference in price between them is about £5 per ton. Steel rails now cost £12 per ton.

There is a laboratory attached to the Landore Steel Works, under the direction of Mr. A. Wallis, where every sample of iron which enters the melting furnaces is first analysed to ascertain the proportion it contains of sulphur, phosphorus, and silicon. Every charge from the melting furnaces is tried also by the color test for carbon. If the proportion of carbon is found to be rather high, a rail is rolled and a piece of it cut off and tested before the remainder of the ingots are hammered. If it does not stand the test, the ingots are sent back to the furnaces.

DURABILITY OF TIMBER.

The following is an extract from the new edition of "Tredgold on Carpentry," edited by John Thomas Hurst, and noticed in another column:

Of the durability of timber in a wet state, the piles of the bridge, built by the Emperor Trajan across the Danube, are an example. One of these piles was taken up, and found to be petrified to the depth of three fourths of an inch; but the rest of the wood was little different from its ordinary state, though it had been driven more than sixteen centuries.

The piles under the piers of old London Bridge had been driven about 600 years, and, from Mr. Dance's observations in 1746, it did not appear that they were materially decayed; indeed they were found to the last to be sufficiently sound to support the massy superstructure. They were chiefly of elm.

We have also some remarkable instances of the durability of timber when buried in the ground. Several ancient canoes have been found, in cutting drains through the fens in Lincolnshire, which must have lain there for many ages. In the *Journal of Science*, etc., published at the Royal Institution, one of these canoes is described, which was found at the depth of eight feet below the surface of the ground. It was 30 feet and 8 inches long, and 3 feet wide in the widest part, and appears to have been hollowed out of an oak tree of remarkably fine free grained timber.

Also, in digging away the foundation of old Savoy Palace, London, which was built nearly 700 years ago, the whole of the piles, consisting of oak, elm, beech, and chestnut, were found in a state of perfect soundness; as also was the planking which covered the pile heads. Some of the beech, however, after being exposed to the air for a few weeks, though under cover, acquired a coating of fungus over its surface.

On opening one of the tombs at Thebes, M. Belzoni discovered two statues of wood, a little larger than life, and in good preservation; the only decayed parts being the sockets to receive the eyes. The wood of these statues is probably the oldest in existence that bears the traces of human labor.

A continued range or curb of timber was discovered in pulling down a part of the Keep of Tunbridge Castle, in Kent, which was built about 750 years ago. This curb had been built into the middle of the thickness of the wall, and was no doubt intended to prevent the settlements likely to happen in such heavy piles of building; and therefore is an interesting fact in the history of constructive architecture, as well as an instance of the durability of timber.

In digging for the foundations of the present house at Ditton Park, near Windsor, the timbers of a drawbridge were discovered about ten feet below the surface of the ground; these timbers were sound but had become black. Hakewell says that Sir John de Molines obtained liberty to fortify the Manor house of Ditton, in 1396; and it is most probable the drawbridge was erected soon after that time; and accordingly the timber had been there about 400 years.

The durability of the framed timbers of buildings is also very considerable. The trusses of the old part of the roof of the Basilica of St. Paul, at Rome, were framed in 816, and were sound and good in 1814, a space of nearly a thousand years. These trusses are of fir.

The timber work of the external domes of the Church of St. Mark, at Venice, is more than 840 years old, and is still in a good state. And Alberti observed the gates of cypress to the Church of St. Peter, at Rome, to be whole and sound after being up nearly 600 years.

The inner roof of the Chapel of St. Nicholas, King's Lynn, Norfolk, is of oak, and was constructed about 500 years ago.

Daviller states, as an instance of the durability of fir, that the large dormitory, of the Jacobins' Convent at Paris, had been executed in fir, and lasted 400 years.

The timber roof of Crosby Hall, in London, removed in 1869, was executed about 400 years ago; and the roof of Westminster Hall, which is of oak, is now above 340 years old.

The rich carvings in oak which ornamented the ceiling of the king's room in Stirling Castle, are many of them still in good preservation. It is nearly 360 years since they were executed, and they remained in their original situation till a part of the roof gave way, in 1777, when the whole was removed, and has since been dispersed among the collectors of curious relics of old times.

Moreton Hall, in Cheshire, where "the staircase winds round the trunk of an immense oak tree," and the building itself is chiefly constructed of wood, has now existed nearly 300 years.

And Mr. Britton describes an old house at Islington, constructed chiefly of wood, which he has ascertained to be about 240 years old.

Other notices of extraordinary durability will be found in the descriptions of the different kinds of wood. But enough already has been collected to show that timber is very durable where nothing more than ordinary means have been used to render it so; that is, nothing more than judicious selection and good seasoning.

Every permanent support should be formed of a good and sound piece of timber; inferior kinds should be used only for temporary purposes, or where no strain occurs, and where they can be easily renewed without injury to the strength of the building.

Mr. Barrow, in writing on this subject, very judiciously remarks, "that the felling of timber while young and full of vigor, making use of the sapwood, and applying it to ships and buildings in an unseasoned state, have no doubt contributed to make the disease of dry rot infinitely more frequent and extensive than it was in former times, when our ships were hearts of oak, and when, in our large mansions, the wind was suffered to blow freely through them, and a current of air to circulate through the wide space left between the paneled wainscot and the wall. In those old mansions, which yet remain, and in the ancient cathedrals and churches, we find nothing like dry rot, though perhaps

"perforated sore
And drilled in holes, the solid oak is found
By worms voracious eaten through and through."

In regard to the durability of different woods, the most odoriferous kinds are generally considered to be the most durable; also woods of a close and compact texture are generally more durable than those that are open and porous, but there are exceptions, as the wood of the evergreen oak is more compact than that of the common oak, but not nearly so durable.

Sir H. Davy has observed that, "in general, the quantity of charcoal afforded by woods offers a tolerably accurate indication of their durability; those most abundant in charcoal and earthy matter are most permanent; and those that contain the largest proportion of gaseous elements are the most destructible. "Amongst our own trees," he adds, "the chestnut and the oak are pre-eminent as to durability, and the chestnut affords rather more carbonaceous matter than the oak. But we know from experience, that red or yellow fir is as durable as oak in most situations, though it produces less charcoal by the ordinary process. The following table of the quantity of charcoal afforded by 100 parts of different woods is added, for the information of the reader:—

Kind of Wood.	Watson.	Mushet.	Proust	Rumford.
Oak, dry	22·92	22·6	19	43
Chestnut	....	23·2	..	....
Mahogany	20.82	25·4	..	....
Walnut	26·04	20·6	..	...
Elm	....	19·5	..	43·27
Beech	....	19·9	..	...
Fir	15·62	....	..	44·18
Norway Pine	....	19·2	..	....
Pine	....	....	20	....
Scotch Pine	....	16·4	..	....
Ash	17·71	17·9	17	....
Poplar	....	....	..	43·57
Lime	....	....	..	43 59
Birch	....	17·4	..	....
Sycamore	....	19·7	..	....
Sallow	....	18·4	..	....

In Count Rumford's experiments a longer period was allowed for the process; and, in consequence, his results represent more nearly the real quantities of carbon in each wood than the others. But even according to the common process, it does not appear that the proportion of charcoal is a satisfactory criterion of the durability.

An experiment to determine the comparative durability of different woods is related in Young's "Annals of Agriculture," which will be more satisfactory than any speculative opinion; and it is much to be regretted that such experiments have not been oftener made.

"Inch and half planks of trees from thirty to forty-five years' growth, after ten years' standing in the weather, were examined and found to be in the following state and condition:—

Cedar, perfectly sound; larch, the heart sound, but sap quite decayed; spruce fir, sound; silver fir, in decay; Scotch fir, much decayed; pinaster, quite rotten; chestnut, perfectly sound; abele, sound; beech, sound; walnut, in decay; sycamore, much decayed; birch, quite rotten.

This shows at once the kinds that are best adapted to resist the weather; but even in the same kind of wood there is much difference in the durability, and the observation is as old as Pliny, that "the timber of those trees which grow in moist and shady places is not so good as that which comes from a more exposed situation, nor is it so close, substantial, and durable;" and Vitruvius has made similar observations.

Also split timber is more durable than sawed timber, for the fissure in splitting follows the grain, and leaves it whole, whereas the saw divides the fibres, and moisture finds more ready access to the internal parts of the wood. Split timber is also stronger than sawed timber because the fibers, being continuous, resist by means of their longitudinal strength; but when divided by the saw, the resistance often depends upon the lateral cohesion of the fibers, which is in some woods only one twentieth of the direct cohesion of the same fibers. For the same reason whole trees are stronger than specimens, unless the specimens be selected of a straight grain, but the difference in large scantlings is so small as not to be deserving of notice in practice.

The Practical Philosophy of Gas Burning.

The secret of gas consumption is to secure good burners, to adapt them to the supply of gas, and to understand the simple principles by which the supply should be regulated. Probably nineteen twentieths of the gas burners now in use throughout the country are of irremediably bad construction, the most economical plan of dealing with which would be to throw them aside at once. A report to the London Board of Trade by the gas referees, containing "the result of their investigations of the principles which regulate the development of light from gas, and the application of those principles to the construction and use of burners in the manner most advantageous and economical to the public," forms the subject of an article in the *Spectator*. That journal says: "If any one is inclined to look contemptuously on so small a matter as the improvement of gas burners, a few of the facts stated in the report will, if he have any of the Englishman's regard for his pocket, very decidedly convert him to a sense of its importance. On an average, consumers of gas, by using well constructed and well adapted burners, instead of the usual clumsy, haphazard kind, may reduce their gas bills by one third or one half of the whole amount, while obtaining a stronger and more steady light than they obtained before. In a middle class household the gas bill is no inconsiderable item; and, even if the health of the family were not concerned, it would surely be desirable to control in some measure the unnecessary and expensive consumption. But we know the carelessness and contempt for thrift which prevails in these countries. It is more remarkable that in great business establishments, where the charges for gas must be of necessity enormous, some effort at improving the burners has not been made. The referees, having examined a quantity of burners supplied by the leading gas fitting firms, and having found the majority hopelessly defective, brought the matter to a practical test by visiting certain establishments, in the city, where night work prevails. As an instance of the waste in such places, we are informed that in the publishing offices of two great daily papers the burners chiefly in use gave out only one half the light that the gas supplied was capable of giving, while a large number furnished only one quarter of the true illuminating power. As compositors and other newspaper *employés* must have a strong light, it is clear that the place of this wasted power had to be supplied by additional burners. In private houses the loss is not so outrageous as this, but it is considerable almost everywhere, and the report affirms that, on a most moderate estimate, one fourth of the annual gas rental of London might be saved by the use of good burners. This rental is £2,000,000 a year, so that it is plain we are throwing away half a million per annum in mere heedless ignorance. Nor are we committing this waste with impunity. By the use of perfect burners we burn less gas to obtain the necessary quantity of light, and the less gas we burn the less do we pollute the air with the noxious products of combustion. The amount of these products, too, is diminished by the employment of burners which completely consume the gas supplied to them. It is obvious, therefore, that the use of ill contrived burners in large establishments, and the resulting waste described may be a prevalent cause of the ill health from which newspaper printers and other night workers suffer.

A good gas burner is not an imaginary article, although a perfect burner has yet to be discovered. The referees in their recent inquiries and experiments have taken as a standard "Sugg's London Argand Burner No. 1," which is not the best invented by the maker, but seems at present the one most adapted for practical use. Comparing with this burner, when burning five feet of gas per hour, those in common use under the names "fish tail" and "bat wing" burners, we obtain some remarkable results. Taking the standard burner's illuminating power at 100, six fish tail burners gave these results:—73, 62, 52, 46, 36, and 19, the latter giving less than one fifth of the light supplied by the standard at the same consumption of gas. The bat wing burners show better results, being 86 and 82, as compared with the standard. It must be observed, however, that the standard is an Argand burner, in which the supply of air to the flame is regulated by a chimney. Comparing three other Argands with the standard, we find the illuminating power still far inferior, being no more than 78, 77, and 34 per cent respectively. These tests clearly prove the superiority, of Sugg's Argand No. 1, to any burner in common use. Of course it remains a question in particular instances whether the cost of supplying these burners would be too great to admit of their general adoption.

A burner is to gas and the development of light, as the report points out, what a boiler is to coal and the generation of steam. In the early days of the steam engine, before boilers were properly adapted to their work, there was an enormous waste of power, so that "one ton of coal in a locomotive of the present day generates as much force as six tons did forty years ago." But a well constructed boiler is fitted to do its work best when consuming a fixed quantity of fuel, and there is in, like manner, in the case of every gas burner, a certain rate of consumption at which the highest illuminating power in proportion to the supply is attained. Above or below this point there must be more or less waste, and there is as much above it as below it. This is a fact which deserves to be taken into account, for many consumers fancy that the more gas they turn on the better light they will get. It is now conclusively established that the quantity of gas does not influence the development of light, that the difference perceived, in the illuminating power afforded by the consumption of different quantities of the same gas, is due to the difference of the burners, each burner "doing justice" to the gas at a particular rate of consumption, and declining in illuminating power when the supply falls short of this rate or exceeds it. It has been proved also that the temperature at which the gas is supplied to the burner makes no practical difference to the light, that an over supply of air to the flame and an excess of pressure in the supply pipe are adverse to illuminating power. Gas, it appears, is in the fittest state to be burned, and to give out its maximum of light, when it streams through the burner under little or no pressure, flowing upwards like a natural flame. The practical suggestion deducible from these conclusions is, that the burners should be improved; and we have called attention to the best type yet brought into use."

The Metric System in the United States.

President Barnard, in his address before the University Convention of the State of New York, on the French metric system, said: "According to the best authorities I have been able to find, the total population of Europe approaches 260,000,000, of whom 135,000,000 have already accepted the metric system in all its details, or have given, to all the standard units of their own system, metric values. Add to these 25,000,000 more in Mexico and South America, and we have a total of 160,000,000 of civilized people in civilized lands who are irrevocably committed to the metric system, while a considerable proportion of the rest have made progress toward the system by adopting metric values in part, like Denmark, Austria and Turkey; or by adopting the decimal law of derivation without as yet the metric values, like Sweden; and 70,000,000 more, the people of the British Islands and of the United States, have made the denominations of the system lawful in all business transactions within their territory. All this has been accomplished by the pressure of public opinion; it has been distinctly a movement of the people and not of government: it is a social rather than a political phenomenon." In connection with the above, says the *Evening Post*, the following information, recently given by Mr. Hilgard, of the United States Coast Survey, to the *Journal of the Franklin Institute*, will be interesting: There are, in the custody of the Treasury Department, at the Office of Weights and Measures, the following authentic copies of the standard meter and kilogramme of France, viz.: Meter of platinum, compared and certified by Arago; meter of steel, compared and certified by Silbermann; kilogramme of platinum, compared and certified by Arago; kilogramme of brass (gilt), compared and certified by Silbermann. The length of the meter is 39·3685 inches of the United States standard scale, and the kilogramme is 15432·2 grains, or 2 lbs., 3 ozs., 119·7 grs. avoirdupois. There is also another meter, the property of the American Philosophical Society, which is one of the twelve original meters made by the French Government, and was brought to this country by Mr. Hassler, the originator of the United States Coast Survey. A comparison between this bar and the standard of France at the Conservatory of Arts and Trades was made by Dr. F. A. P. Barnard, with the result that, at the temperature of melting ice, there is no appreciable difference, by the most delicate means of comparison, between the platinum standard of the Conservatory and this iron meter. It is, therefore, possible for the Office of Weights and Measures to reproduce, for distribution to the different states, metric standards of great accuracy.

Manual Labor and Maximum Air Temperature.

There is some interesting information, on the maximum temperature of air which is compatible with the healthful exercise of human labor, in the report of the English commissioners appointed to inquire into the several matters relating to coal in the United Kingdom, just issued, the abstract of which we find in the *American Exchange and Review*. The committee, who undertook to determine the maximum depth to which it would be possible to work coal, found this question very difficult to decide. Evidence was given of extraordinary temperatures endured in the stock holes of steamers, and in places where glass blowers work. In some of these cases labor has been carried on, without serious detriment to health, where the thermometer has indicated 180° Fahr. In these instances, however, the thermometer was chiefly acted on by radiant heat, and therefore did not truly indicate the actual temperature of the air. In an experiment made under the direction of the committee, it was found that a thermometer, suspended in a stock hole and exposed to the radiation from the boilers, indicated a temperature of 105°; while another thermometer in the same position, but carefully screened from the radiant heat, stood at only 78°. It is important, also, to observe that the men who work in stock holes and glass houses have ready access to the external air, and avail themselves of numerous intervals in their labor to cool themselves. One of the medical witnesses, who had spent a great part of his life in tropical climates, states that he had experienced a temperature of 125° Fahr. in the shade, and that this great heat was rendered endurable by the dryness of the atmosphere; on the other hand, he had felt a damp atmosphere almost intolerable at the comparative low temperature of 86°.

The committee had information of mining work being executed in a Cornish mine, where the air was heated by a hot spring to a temperature alleged to amount to 117°, and was also by the same cause saturated with moisture. Dr. Sanderson was deputed to visit this mine and make an investigation. He found the highest temperature to exist at the extremity of an excavation forming a short *cul de sac*, where a stream of water entered at a temperature of 114½°. At a distance of a yard from the end of this *cul de sac* the thermometer indicated a temperature of 103°; but at a distance of only ten feet there was access to air, where the theremometer stood at 81°. According to other evidence, the temperature of the air occasionally reached 123°. The miners remained in their workings six hours out of the twenty-four. Four men were employed at a time, of whom two were always at rest in the cool air, and the other two were not always at work. The total duration of each man's work was less than three hours in the twenty-four. No miner remained more than fifteen minutes in the heat at one time. The condition of each miner on retreating into cool air is described as one of complete exhaustion; but by allowing cool water to pour over his body, the distress and exhaustion quickly passed off. Dr. Sanderson came to the conclusion that the occupation in question was not necessarily inconsistent with the enjoyment of vigorous health; but he found that there were many men who, after trying the work, were compelled to desist on account of the distress and exhaustion which were produced. It is Dr. Sanderson's opinion that labor is not practicable in moist air of a temperature equal to that of the blood, namely, 98°, excepting for very short intervals; and this conclusion is in harmony with the other medical evidence. The question of maximum temperature under which work could be carried on in a coal mine hinges, in a great measure, on the hygrometric condition of the air. The depth, at which the temperature of the air would, under present conditions, become equal to the heat of the blood, would be about 3,420 feet. Beyond this point the considerations affecting increase of depth and temperature become so speculative that the committee felt it necessary to leave the question in uncertainty; but looking to possible expedients which the future may elicit for reducing the temperature, they considered it might fairly be assumed that a depth of at least 4,000 feet might be reached.

Employments for Boys.

In a recent number, we published an article on the propriety of supplying boys with tools, that, in their leisure hours, they may be occupied with healthy and useful employment. In the last number of our most estimable exchange, the *Congregationalist*, of Boston, we find the same subject discussed:

In every family where there are boys, from six to twelve years of age, it is much of the time a pressing question what to do with them: how to employ their thoughts and their hands out of school time. This question is all the more important in view of the extreme desirability of keeping them, at their age, off the streets and away from unhealthful associations, and it is all the more pressing now that the winter, with its out door cold and long evenings, is at hand. Making due allowance for skating, sledding, and kindred sports, the boys are to be shut up in the house more or less of the time for six months to come, and something else must be found to occupy them than books and study. What now shall it be?

One unfailing resource for boys of certain taste—and a large class they are—is an assortment of carpenter's tools, with a suitable place in which to work. Put a boy of a mechanical turn of mind in possession of a little room which he may call his shop, give him a bench, a set of planes, a couple of saws, a few chisels and gouges, several pounds of nails of different sizes, and a variety of good clear "stuff," and you have provided him with the materials for unfailing recreation. He will, doubtless, make a noise, and perhaps cut his fingers; but worse things than either of these may happen. He will waste his nails and his boards, and, and at first, may spoil his tools; but no matter. The money spent for them will be money well spent, and the return for it, in the providing of a healthful, harmless, attractive occupation, will be prompt and large. We speak that we do know, and testify that we have seen.

Another excellent thing to put into a boy's hands is a small printing press with its accompanying outfit, by no means an extensive or cumbersome or complicated affair, but one which is altogether suited to the capacities of any intelligent lad of ten or a dozen years. We have particularly in mind a small sized Novelty Press, so called, which is simple, compact, and easily worked. Having a small font of type, ink, paper, a press, and his wits at work, who shall say what typographical triumphs our boy may not produce? He may blacken his hands; but there are far deeper stains than those of printer's ink. The printing establishment will quicken the boy's mind as well as exercise his fingers—for he must be his own editor; composer as well as compositor; proof reader as well as pressman.

When this article was projected—composed, in fact—we had not a thought of the arrangements just announced whereby we are able to offer tool chests and Novelty printing presses as premiums for new subscribers to the *Congregationalist*. But we are now pleased to think that the paper may serve as a means of placing these really valuable articles in many families where we are sure they will render a most useful ministry in the manner indicated.

There is this additional reflection. The boy who half plays, half works in a miniature shop, or with a miniature printing office, is certain to familiarize himself with the rudiments of a trade, of which he *may* find it very convenient to know something in after days.

WE have, says *Nature*, on various occasions, alluded to the large amount of encouragement to the pursuit of science afforded by the governing powers of the United States, both by the Central Federal Government at Washington, and by those of the individual states. The sums of money voted for such purposes by our American relations would make the hair of our economical Government officials in this country stand on end, and would be certain to provoke angry comment in our House of Commons; while the number of scientific men, paid for carrying out the investigations and preparing reports on various subjects of great practical value for the welfare of the country, would almost bear comparison with the number we pay for doing nothing or for obstructing all rational improvements.

Life in Japan.

The following are extracts from a volume of "Travels in Japan," from the pen of Bayard Taylor, Esq., just published by Scribner & Co., 654 Broadway, N. Y.

RICE PLANTING IN JAPAN.

"As we advanced through the country, both men and women were busily employed in planting out their rice. This was the first time I had seen any but isolated cases of women being engaged in field labor in Japan; for the Japanese appear to me to be honorably distinguished among nations of a higher civilization, in that they leave their women to the lighter work of the house, and perform themselves the harder out door labor. Indeed, I was at first in some doubt here, for it was by no means easy to distinguish the women from the men at a little distance. To guard the legs, probably from leeches, as they paddled in the mud, they all wore gaiters up to the knees and short cotton trowsers. When the neck was covered, there was no very distinguishing difference between the sexes, as the men never have any hair about the face. The wheat in Japan never appears to be sown broadcast. All that I have seen has been drilled and planted in rows, much as the rice is, a few stalks together. Labor is cheap, and it is to be presumed they find this the more profitable way."

JAPANESE JUGGLERS.

"The jugglers and mountebanks are also distinguished by the variety and originality of their feats. For instance, they perform a series of tricks by means of an enormously long false nose. One will lie down on his back, with a boy balanced on the end of the nose, the boy supporting an open umbrella on the end of his own nose. Another will hold up his foot, upon the sole of which a boy plants his nose, and balances himself in the air. Some of these feats seem impossible, without the aid of some concealed machinery.

"I was witness to some astonishing specimens of illusion. After a variety of tricks with tops, cups of water, and paper butterflies, the juggler exhibited to the spectator a large open fan which he held in his right hand, then threw into air, caught by the handle in his left hand, squatted down, fanned himself, and then turning his head in profile, gave a long sigh, during which the image of a galloping horse issued from his mouth. Still fanning himself, he shook from his right sleeve an army of little men, who presently, bowing and dancing, vanished from sight. Then he bowed, closed the fan, and held it in his two hands, during which time his own head disappeared, then became visible, but of colossal size, and finally reappeared in its natural dimensions, but multiplied four or five times. They set a jar before him, and in a short time he issued from the neck, rose slowly into the air, and vanished in clouds along the ceiling.

"At the fair of Asaksa, in addition to the performances of jugglers of all kinds, there are collections of animals which have been taught to perform tricks—bears of Yeso, spaniels which are valuable in proportion to their ugliness, educated monkeys and goats. Birds and fish are also displayed in great quantities. But the most astonishing patience is manifested by an old Corean boatman, who has trained a dozen tortoises, large and small, employing no other means to direct them than his songs and a small metal drum. They march in line, execute various evolutions, and conclude by climbing upon a low table, the larger ones forming, of their own accord, a bridge for the smaller, to whom the feat would otherwise be impossible. When they have all mounted, they dispose themselves in three or four piles like so many plates.

JAPANESE GYMNASTS.

M. Humbert gives the following description of the performances of this class, both in the streets and booths. "In the public squares, the shouts and the sound of tambourines of two troops of gymnastic mountebanks, installed at opposite corners, are heard above the voices, songs, and clatter of implements of labor in the surrounding workshops. One of these troops performs in the open air, its heroes being the swallower of swords, and the prodigious jumper. The latter leaps with impunity through two hoops crossed at right angles, fixed on the top of a pole, which also supports a jar carefully balanced on the intersecting hoops. But his most remarkable feat consists in leaping, or rather flying, from end to end through a cylinder of bamboo lattice work six feet long and placed on trestles. When he wishes to excite the amazement of the spectators to the highest pitch, the performer lights candles and places them in a line, at regular intervals, in the interior, of the cylinder; after which he passes through like a flash without extinguishing or deranging them.

"His gentle spouse, seated on a box beside the cylinder, accompanies the different stages of the performance with airs on her guitar. To the shrill sounds of the instrument she adds, from time to time, the tones of a voice which is either hoarse and hollow, or piercingly elevated, according as she judges it better to encourage sternly or to celebrate triumphantly the prowess of the astonishing man whose fortunes she is permitted to share."

Electromagnetic Burglar Proof Curtain.

This invention consists in the arrangement of a burglar proof curtain to be suspended in front of safes, vaults, behind windows, or in other suitable places, and connected with an electric alarm apparatus in such a manner that it will, when moved or pierced, cause the alarm to be sounded.

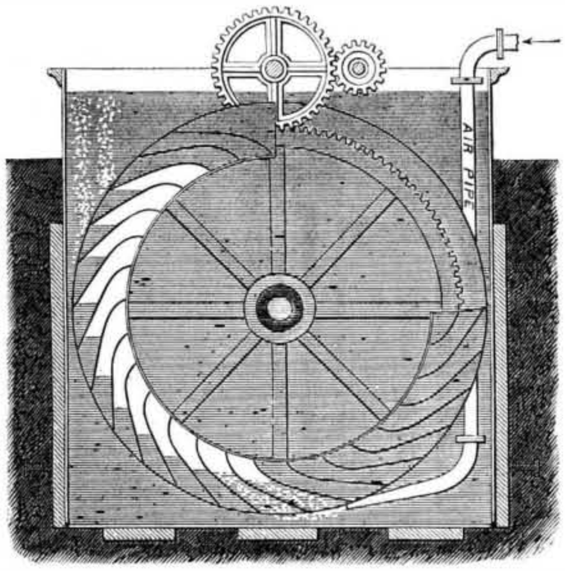
By the use of such curtain a very cheap and, it is claimed, most effective guard is obtained, which can, over night, be suspended in front of the things or openings to be protected, while during day time it can be rolled up out of the way or otherwise do the service of ordinary curtains.

Any attempt to enter by cutting through the curtain will cause an alarm to be sounded by the establishment of a complete circuit, while, on the other hand, any attempt to roll up the curtain or lift the roller from the brackets will, by entirely breaking the circuit, also cause an alarm to be sounded.

Messrs. Edwin Holmes, of Brooklyn, N. Y., and H. C. Roome, of Jersey City, N. J., are the inventors.

CALLES' HYDRO-AERO-DYNAMIC WHEEL.

A mode of transmitting power to great distances, proposed by an exhibitor at the Paris Exposition, from Belgium, Mr. A. Calles, makes use of air under a certain degree of compression as the vehicle of the force to be transmitted, not by accumulating the air thus employed in reservoirs, but by driving it, by the operation of the original motor, directly into a tube extending to the point of final application, where it is to be discharged beneath a wheel submerged in water, which it is to turn by its ascensional force. The mode of application is illustrated in the accompanying engraving, and is described as follows in Dr. A. P. Barnard's report on machinery and processes:



The idea of employing compressed air as a means of transmitting power is not new; but the mode here suggested of using the power so transmitted is sufficiently original. The exhibitor claims originality in another point of view. His application of the power is not only original in form but in principle also. At Mont Cenis, where air is employed as a vehicle of force, it is the elasticity of the compressed air which furnishes the motive power. Consequently, it is there important that the compression should be carried very far. It is carried, in fact, up to six atmospheres. The present apparatus proposes to derive its mechanical advantage not from elasticity, but from volume. It is, therefore, here equally important that there should be as little compression as is compatible with the attainment of the object.

The air being employed to turn a submerged wheel, it will be easily understood that the wheel must have the form of an ordinary overshot water wheel reversed. In the overshot wheel, it is the weight of water, which is in the buckets of the descending side while those of the ascending side are empty, which causes the wheel to turn. The motive power is the difference between the counteracting weights of the two sides. In the submerged wheel driven by air, on the contrary, it is the weight of water which is displaced from the buckets of the ascending side, while those of the descending side are full, which is the measure of the driving power. In the present case, as in the former, this driving power is the difference between the weights of the two sides.

It is assumed by the inventor that air immerged in water ascends to the surface with a velocity of one meter per second. In point of fact, the rapidity of ascent of air in water will depend very much upon the volume ascending, and will be, on an average, materially greater than is here stated. But assuming the statement to be correct, it would furnish a limit to the velocity which can be given to the circumference of the wheel; and a given wheel will perform its maximum of work when the supply of air is sufficient to keep its ascending buckets full at half this velocity. Considering, however, that the motive power in the case is gravity, the most advantageous velocity must be necessarily not greatly different from that which experience has shown to be best with the ordinary overshot wheel working in the air—that is to say, must not exceed one meter per second at the circumference.

The compression of the air must evidently be sufficient to overcome the pressure of the water at the point of efflux beneath the wheel. This point may be taken at three or four meters of depth, and the corresponding pressure will amount to three or four tenths of an atmosphere. As the air ascends, it resumes by degrees the bulk which belonged to it before compression. In order to take advantage of this circumstance, the velocity of discharge must be so adjusted to that of the wheel that the buckets may not be entirely filled at the bottom. Otherwise there will be an overflow from the rising buckets, and to that extent a loss of motive power.

The inventor takes no account of the resistance of tubes to the flow of air through them. He supposes that at low pressures and low velocities this resistance will be insensible, so that the power received from the source may be almost wholly re-established by the wheel. He has erected a wheel in the park of the Exposition, which is designed to demonstrate the truth of this proposition, and to illustrate his system generally. It is driven by air compressed by an engine in the palace, and transmitted through a tube nine and a half centimeters ($3\frac{3}{4}$ inches) in diameter, and one hundred and fifty-seven meters (more than 500 feet) in length. This tube makes in its course fourteen right angles in order to avoid the constructions which it encounters on its way. It is computed that a force of nine and a half horse power is expended in compressing the air, and that the velocity of efflux is thirty-two meters (more than 100 feet) per second. On the other hand, the power of the wheel turned by the escaping air is stated at nine horse power. From these figures it would result that the loss in the present instance is but about five per cent. That there is a fallacy in the calculation is evident from the consideration that the loss of a submerged wheel, driven in this way by air, cannot be less than that of an ordinary overshot water wheel of the same dimensions; and that this loss is at least one fifth, and is often more than one third. And it results from the experiments of the Italian engineers at Coscia, on the resistance of tubes to columns of air driven through them, that to maintain such a velocity as is stated to be given to the air in this experiment, and to the distance named of one hundred and fifty-seven meters, there would be required an expenditure of force without return, sufficient to produce a compression of nearly an atmosphere and a half.

Locomotive and Traction Engines.

Thomas Aveling, of Rochester, England, well known in connection with the celebrated Aveling & Porter's steam road rollers and traction engines, has just patented, through the Scientific American Patent Agency, an improvement the object of which is to construct agricultural, road, traction, and portable steam engines, and tramway locomotives, in a simpler and more economical manner than heretofore, and at the same time to render them stronger and more durable.

At each side of the fire box end of the boiler is fixed a strong wrought iron horn plate. These horn plates are riveted to the boiler and firebox. They project beyond the end of the fire box, and above the top of the boiler. The projecting portions of the horn plates are connected to the crown of the boiler by curved or bent plates, between which and the horn plates are secured the bearings for the crank-shaft. The axle of the traveling wheels works in bushes secured in screw bolts to the rear ends of the horn plates. Above this axle is a shaft, also working in bushes and carried by the horn plates. To this shaft is keyed the gearing for transmitting the rotary motion of the crank shaft to the axle of the traveling wheels. The crank shaft receives rotary motion in the usual manner from the cross head and connecting rod of the engine, and is fitted at one end with a spur pinion which drives intermediate gearing; and, through the spur wheel, gives rotary motion to the axle of the traveling wheels. A fly wheel, on the opposite end of the shaft, is employed to carry the crank shaft over its dead points. The engine is fitted, as usual, with a tank, and it is provided with any approved steering apparatus for guiding the front wheels.

From the above description, it will be understood that as the wrought iron horn plates will take all the thrust from the piston acting on the crank shaft the boiler and fire box will not be so liable as heretofore to be damaged or strained by the working of the machinery.

Resistance of Nickel to the Action of Water.

A small square bar of steel coated with nickel has been repeatedly immersed in water for hours together without showing any signs of rusting, and Mr. John Spiller states, in the *Photographic News*, that he finds it possible to bury it in flowers of sulphur for several days without tarnishing the lustre of the nickel surface. Neither has this latter severe test any effect upon the copper and brass bars upon which the nickel coating has been applied, and these metals may even be immersed in aqueous solution of nitrate of silver without effecting the reduction of that metal. In one of the angles only, where the coating seemed to be imperfect, was there any indication of silver reduction in the case of the brass tube, the steel bar being perfectly protected over the whole surface against the action of silver and copper solutions.

Here, then, is a most valuable property in electro-deposited nickel. A metal of the zinc and iron group is proof against the action of nitrate of silver; the experiment proves it to be so, and we must regard pure nickel as belonging (from this point of view) to the class of noble metals, resisting, like gold and platinum, the attacks of sulphur and of highly corrosive metallic solutions. The nickel facing, when burnished, has a whiter color than polished steel, although not equal to silver itself, its aspect being rather that of rolled platinum. It withstands the action of heat also remarkably well, for the fusion point is very high, and oxidation occurs only at elevated temperatures. For fine balance beams and weights, lens mountings, reflectors, laboratory microscopes, Sykes' hydrometers, still worms, egg beaters, camera fittings, and a variety of apparatus used by the chemist and photographer, the nickel coating will, probably, find extensive application.

THE steamer *New London*, recently burnt in Long Island Sound, is reported to have been scandalously ill furnished with appliances for subduing fire and for saving life. "The life preservers and the boats were inaccessible, and the people on board the steamer had to make their escape as best they could, throwing planks and state room doors into the water, and then leaping after them in hopes of reaching shore by their friendly aid. The fire extinguishing apparatus, too, could not be promptly and effectually used." The *Commercial Advertiser* thus accounts for a calamity in which at least twenty persons lost ther lives.