nothing else during winter but make wooden tickets and stocks for the flowers.

A number of little Thuringian villages are almost upheld by the manufacture of flower pots for Erfurt alone. About 600,000 are planted yearly with about 3,600,000 stock-gilly-flowers. These placed in a single row would reach nearly fifty miles! In the year 1863, 150,000 pots were planted with 1,550,000 gillyflowers for seed, and these brought in an income of nearly fifty thousand thalers. The production of the gillyflower in sixteen varieties and over two hundred colors established the horticultural fame of Erfurt ever since 1810.

The cultivation of vegetables for the market is chiefly carried on in the so-called "Dreienbrunn," an area of nearly two hundred acres, which was formerly a great swamp, and used only for the production of watercress. In the fifteenth century the market gardens were all within the city walls; in the last century the watercourses in the "Dreienbrunn" were regulated, and the whole swamp changed into an immense vegetable garden. About twenty acres are still reserved for the production of cress. Before the era of railroads the Erfurt market was limited to the surrounding cities; but now the Thuringian Railroad takes the produce to Cassel, Leipsic, Halle, Nuremburg, Weimer, Gotha, and other places. Of the seeds, fifty-eight per cent is sent to Austria, twenty-four per cent to Germany, and eighteen per cent to other lands of Europe, to England and America. A large trade in dried flowers is also carried on. In some of the gardens it is very difficult to get even a single bouquet. Agriculture is also prosperous in and around Erfurt, the farmers also devoting their attention to the production of field vegetables.

THE FRICTION OF STEAM ENGINES.

[From The Engineer].

If we did not believe that it is easy to say something new on a subject which has been in a very peculiar sense worn threadbare by the inventors of cylinder lubricators and steam greasers this article would never have been written. So far as we are aware, all the information regarding the resistance of steam engines due to friction is to be found in the circulars of inventors, one or two papers read before engineering societies by the advocates of particular methods of lubricating engines, certain theoretical disquisitions contained in text-books of mechanical science, and perhaps a report or two in the *Journal of the Royal Agricultural Society*. It is almost needless to say that the subject is one of very considerable importance; but it may be worth while to bring this importance home in a tangible form to the employer of steam power. It may be stated, in pursuance of this object, that it by no means follows that an engine giving a very high indicated duty per pound of coal is really the most economical that a manufacturer can use, for the simple reason that the power required merely to drive the engine may be so great as to render the saving in fuel valueless. A case in point suggests itself. An experiment was made some time since with a compound engine, the general particulars of which are before us. This engine was of the annular type; the large cylinder about 35 inches diameter, the inner cylinder about 15 inches, the stroke of both pistons was the same, about 5 feet, the piston rods both laying hold of the same crosshead, which was connected with an overhead beam. The experiment consisted in shutting the steam off from the inner cylinder and driving with the outer annular piston alone. It was found that the engine, then indicating the same horse-power as before, failed to drive the machinery at the proper speed; and it was not till the indicated horse-power was augmented nearly 40 per cent that the engine would do the work. On permitting the steam to find its way to the inner cylinder as before, the indicated horse-power fell to the original point, the machinery being driven at the proper speed. We shall not pretend to explain why this was the case. It is indeed difficult to understand why the fact that the inner cylinder, though open to the atmosphere, took no steam, should so enormously reduce the effective power of the engine. The facts are as we have broadly stated them, and there is no reason to think they would now want explanation if engineers had in times past devoted a little attention to the study of the phenomena of friction in the steam engine. We have no doubt whatever that many so-called economical engines are doing very bad work indeed; nor that many so-called wasteful engines as far as coal is concerned, are giving out a far higher duty than is generally believed. The entire subject is wrapped up in mist—a mist which can only be dispelled by careful experiments, extending over long periods, and properly and fairly analyzed. That a few engineers have conducted experiments on the friction of steam engines and other machines is certain; but it remains to accumulate in a single volume the statistics which these gentlemen possess, and to put them into a form which may render them generally useful. In pursuance of this object we have for some time past been accumulating data, as yet infinitely far from being complete. But these data have, at all events, done this much—they have satisfied us that ordinary theories regarding friction in steam engines based on investigations concerning the coefficients of friction between lubricated surfaces, apply most irregularly and imperfectly. In other words, there is no theory at present in existence which will enable us even approximately to predicate with certainty what the loss of effect by friction in any given engine may be. In certain cases, calculations made with this object will correspond, with surprising exactitude, with the results obtained through the indicator and dynamometer. But the engineer, resting satisfied with such occasional coincidences, is mistaken in his views. In scores of other instances enormous discrepancies will be found to exist between theory and practice—the almost total absence of frictional resistance in some engines contrasting strangely with the expenditure of power absolutely wasted, in others. It is not the mere loss of fuel alone —although that is bad enough—that has to be considered in dealing with this subject. We find engines unable to do their work overloaded and worn out; boilers burned and overtaxed; grease and oil wasted; indeed, we go so far as to hold that every horsepower unnecessarily spent in overcoming the frictional resistance of a steam engine costs three times as much as if it were spent in doing useful work, and this without taking at all into account the fact that useful work returns money, while what we may term the internal work of the steam engine returns none.

The difficulties which lie in the way of ascertaining by actual experiment what the frictional resistance of an engine is are very great, and to this cause no doubt is to be attributed the greater portion of the existing ignorance of the subject. The obstacles in the way are of two kinds. In the first place, it is very difficult to put a dynamometer or brake, on large engines, whereby to ascertain their duty; and, in the second place, the amount of friction varies not only in different engines, but in the same engines in a very extraordinary way. As regards the first difficulty, we can, in the case of pumping engines, ascertain precisely how many foot-pounds of work an engine actually gives out in the shape of useful effect, while the indicator shows the work done on the piston; but from these data it is impossible to calculate engine friction exactly, because our calculations are complicated by the greater or less efficiency of the pumps. It is possible that nothing can be more deceptive than the results obtained from pumping engines, and therefore we have no hesitation in rejecting their aid in dealing with questions of engine friction. Practically speaking, the only generally available test is the indicator, used with the engine light and the engine loaded; but diagrams taken thus do not account for the extra friction due to the performance of work, though useful to some extent in their way; but no investigation of the qualities of an engine can be regarded as complete unless the dynamometer is used as well as the indicator.

As regards the variation in the loss by friction in the steam engine, a very great deal might be said which we shall not attempt to say now. It may induce others to experiment for themselves, however, if we place a few facts curiously illustrative of the peculiar phenomena of engine friction before our readers. In one case we conducted the experiment personally; for the results of the other we are indebted to a gentleman who, in superintending the replacement of ordinary boilers by the now well-known Howard boiler, has occasion to indicate a very large number of engines and on whose accuracy we can rely with certainty. In the first experiment which we shall cite we found the full power exerted by a rolling mill engine in the north of England—where, it is unnecessary to specify—to be 291·5-horse. This included the resistance due to a fly weighing thirty tuns, a bar mill with two pairs of rolls working on heavy orders, and the requisite gearing. Engine and mill empty required, according to one set of diagrams, 74·8-horse power to run them at the working speed; but according to another set of diagrams, the frictional resistance of engine and mill is less than 35-horse power, and all the diagrams were taken within a few hours. We cite this case only to illustrate the difficulties engineers have to contend with in endeavoring to estimate the friction of engines under ordinary circumstances.

The other experiment is very interesting and curious as regards results. The engine was a double cylinder traction engine, built by Messrs. Howard, of Bedford. The cylinders are 8 inches diameter and 12½ inches stroke. The engine shaft can be disconnected from all the rest of the machinery, so that the whole work done by the steam consists in turning the crank shaft and overcoming the friction of the bearings, pistons, etc. With 60 lbs. of steam in the boiler, the engine, making 190 revolutions, indicated unloaded 2·64-horse power. The engine was then set to drive a brake loaded to 16-horse power, the link being put in full gear; under these conditions the engine indicated 22·55-horse power. The frictional resistance was therefore increased, by the fact that the engine was now doing work, to 6·55-horse power, or to nearly three times that of the unloaded engine. This is all plain sailing, but now comes a most remarkable fact. The throttle valve was thrown full open, or nearly so, and the engines linked up —that is, worked expansively at the same velocity, 190 revolutions per minute. The load on the brake, etc., remaining absolutely unaltered; any engineer would predict that, under these circumstances, the result would be the same; far from this being the case, however, it was now found that the effective work or duty of the engine being unaltered, the indicated power *was only 19·86-horse power*, so that the friction of the engine when linked up was only 3·86-horse power, or little more than one-half that of the engine working in full gear. Lest there should be any mistake about this, the brake was then loaded with 504 lbs. With the link in full gear the engine indicated 44·88-horse power; the link was then put in the first notch, and the throttle valve fully opened, everything else remaining unchanged, when the power fell to 40·92-horse, the frictional or internal resistance of the engine in the latter case thus being 3·86-horse power less than in the immediately preceding experiment. How are these facts to be accounted for? Is it that the varying strain on moving surfaces in contact, due to the action of expanding steam, is attended with less frictional resistance than is present when the metals are under the steadier strain of non-expanding steam? We shall not pretend to answer these questions. There are the facts for the consideration of those interested.

Is it too much to hope that engineers who have the opportunity, will take up this subject, and endeavor to throw light into what is at present a very dark and unexplored region of mechanical engineering? We are convinced that the results would, when time and perseverance had multiplied data, be found of very great value to those who desire to see the steam engine undergo the real improvement of which it is still capable. We venture to suggest that the general practice of indicating the engines tested by the Royal Agricultural Society while running against the brake, and the publication of those diagrams, would be productive of much good. Suppose the Society begin at Oxford?

A Curious Exhibition.

A singular idea is that of a public exhibition of fans; yet such an exhibition has been held at the South Kensington Museum in London. The object of the exhibition was to promote the employment of women in a branch of industry peculiarly adapted to them, though how such an exhibition could further this good object one fails at this distance to perceive clearly. Nevertheless the exhibition brought out some wonders of mechanism and art, according to the *Building News*, which gives a column and a half to its description.

That journal says the present collection opens with a number of Chinese and Japanese fans, just brought over by one Mr. Mitford. They are, as a rule, very tasteful and curiously inexpensive. There are also some excellent specimens of Indian fans, lent by the Indian Museum, but the object of this exhibition is not so much to show us the different materials out of which a fan may be manufactured—such as carved in sandal wood, made from palm leaves, scented grasses, pheasants' feathers, or even beetlewings—as to set before us the fan as a work of art; and works of art most of the painted fans unquestionably are. Their subjects vary in an infinite number of ways. In this collection can be seen a geographical fan from Japan, with the route between Yeddo and Kiöto marked out upon it; a Spanish fan, containing an almanac and a globe; French fans, with revolutionary subjects; Italian fans, ornamented with paintings of Scriptural stories; and historical fans of all periods, from Rebekah and Eleazer down to the fan painted by Tjichy, a Hungarian artist, and presented to the Prince of Wales on the marriage of the Princess Dagmar with the heir of all the Russias. Here, too, are fans interesting to the public as relics—Nos. 262 and 272 were once used by the ill-fated Marie Antoinette; the Queen exhibits one which belonged to the Princess Charlotte; and a very curious fan, with imitation lace cut in paper and medallions in water color, was once possessed by Madame de Pompadour. It is not possible in this journal to devote much space to an object so apparently remote from its usual province as an exhibition of fans—nevertheless, there are points of common interest which claim our attention. Many of the French fans of the highest character, many Spanish fans, and some of the Italian ones, are of the class we will call pictorial. Thus the mounts of such fans are composed principally of pictures, no doubt designed to fill the peculiar space, but still pictures such as Gay describes as subjects for decoration:

> Paint Dido there, amidst her last distress,
> Pale cheeks and bloodshot eyes her grief express.

or—

> Here draw Œnone in the lonely grove,
> Where Paris first betrayed her into love.

Such fans have, at various times, been the work of the best artists of the day. Thus No. 224 is by Peter Oliver, the celebrated miniaturist of the time of Charles I. The subject of this fan, which has been painted out square and framed, is "The Triumph of Bacchus." Again, No. 348, a French fan, was painted about 1666, by Philippe de Champagne. It has a landscape on the reverse side, by PP. Valori. There are also one or two by Lancret, and No. 126 is a beautiful work by Boucher, while among those fans whose painters are unknown, we must call especial attention to "The Queen's Fan," No. 278, the subject of which is a highly-finished copy of Guido's Aurora. Some of the Italian fans of the pictorial class are enriched at the borders and near the sticks with delicate treatments of flowers and fruits so artfully arranged as to carry the color of the picture into the setting of the fan. No. 320 is a good specimen of such fans, while No. 82 is an excellent example of the same treatment of the mount, though the stick, which is of a subsequent date and quite plain, has been added to the fan without due regard to this artistic effect. Another class of fans may be described as a combination of ornament with pictures. A beautiful example of this is found in a modern fan belonging to the Empress of the French. In the center of the reverse side is a medallion, painted in grisaille by Moreau; while on each side some beautifully executed amorini, with arabesque ornaments, are supporting the imperial crown and her Majesty's initials. Of earlier examples Nos. 336 and 339, wherein vignettes are alternated with Pompeiian ornament, are very characteristic, and deserve study, because of the classic taste displayed in them. Many of the English fans of the last century belong to this class of treatment, sometimes consisting in vignettes and ornament, and sometimes in medallion portraits and ornaments. Of this character also is the fine French specimen by Boucher, to which we have already alluded. We cannot close without drawing attention to the fans decorated by Vernis Martin, that celebrated Frenchman, mentioned by Voltaire, who combined coach painting, when it still required the skill of an artist, with the decoration of furniture, snuff-boxes, and fans. He invented a varnish which has stuck to his name, and given character to the works of his hands. The labors of fan painting may be esteemed lightly by some, but we opine that when we find such French living artists as Eugene Lami, Moreau, and Hamon, not disdaining to devote their skill and time to such works, our countrywomen may well be proud to enter into the competition.

The first attempts to establish fire insurance were made during the reign of Charles II.

Jeddo.

Jeddo, the capital city of the Empire of Japan, is in the 36th degree of latitude, and is said to be one of the finest cities in the world. The streets are wide and clean, and the fine views of the Gulf of Jeddo, with the high hills beyond, and the picturesque gardens, trees, and temples nearer, make up many curious and beautiful views for a stranger to see.

The Emperor lives in the middle of the town, in the castle, surrounded with three walls or inclosures. The nobles and great people all have very fine houses, built principally of wood, carved, stuccoed, and ornamented. These houses are generally built in squares, the middle being the residence of the owner, the rest those of servants, dependents, etc. The gardens surrounding these places are laid out in good taste; every bit of ground taken advantage of, and mimic effects of scenery, such as tiny waterfalls, ponds, rock-work, etc., very well got up.

The Japanese bestow great care on the growth and culture of timber trees. The cedars grow to great hight; the oak tree, the mulberry tree—many towns live entirely upon the silk manufacture—then the urusi, or varnish tree, of which the people make the celebrated varnish known everywhere by the name of Japan; most of their furniture is coated with this, and all their plates, dishes and drinking vessels, as they do not appear to use glass or china ones; then the camphor tree, of which the puzzle boxes are made; the pepper tree, chestnut tree, walnut tree, and many others too numerous to mention.

They are the most curious people for dwarfing all manner of trees and plants. Growing things are twisted into all manner of shapes, and flowers and fruit of one sort growing on plants and trees of other sorts, outvying even Mother Nature herself. The love of flowers is strong among even the very poorest of the people, and few are without a pot or two, or some kind of tree or shrub grown against the back of the house, perhaps, reaching in through the windows, and loved and petted almost like children.

On account of the populousness of this country, every inch of ground is improved to the best advantage, and not only the flats but the hills and mountains are cultivated, and made to produce such things as they can. The rice fields are a beautiful sight—so well kept and drained, and irrigated so carefully. They are not unhealthy as in other places. Common vegetables are also grown in abundance; indeed, the poorer classes live principally on fish and rice, varied by vegetables or wild plants. Tobacco is also grown in quantities—the Japanese being great smokers. Their pipe has a very small bowl, and hangs by a button from the girdle or belt—the people having no pockets. These buttons are often highly ornamented and expensive, and the pipes themselves works of art. The tobacco is cut in fine shreds, a bag full of which hangs with the pipe at the waist.

Nagasaki is the principal trading port with foreigners, having been the longest open to them. Decima, a small island close to this town, which is entered by a bridge, is the famous Dutch station, where for many years the Dutch people had a monopoly of trade with the Japanese—submitting to all sorts of indignities and close confinement for its sake; until within the past few years no foreign women were allowed in the place, and so the Dutch merchants had to bear this tedious exile from their families. Most of these indignities, however, were brought upon themselves, and richly deserved by their dishonest attempts to smuggle, and overreach an honest and trusting people. The Japanese are not naturally a suspicious people, and we must lay at the door of intercourse with civilized nations their being so now. They have had a hatred and contempt for foreigners which it will take years of intercourse with some of the better class of English and Americans to do away with.—*New Dominion Monthly for June.*

Twist Drills, and Recent Improvements in their Manufacture.

We condense from a paper recently read by Mr. G. Lauder, C.E., before the Liverpool Polytechnic Society, the following remarks upon twist drills:

The last half century has witnessed many important improvements in engineers' tools. Self-acting machines have been introduced and improved in numbers too great to mention in this paper.

The leading idea which seems to have controlled in all these improvements, is what has been designated the "guide principle;" as examples, we may cite the slide rest, the planing machine, etc., the objects to be attained being, first, greater accuracy in the work performed, and, second, greater speed in performing it.

After improved machines, which have enabled us to attain the first object, we have to look to the forms of the tools used in these machines, to enable us to attain the second object—speed.

Tools for cutting metals are divided into two classes, viz., paring tools and scraping tools—these being distinguished by the edge they present to the metal being cut.

The data on which our knowledge of paring tools is founded are altogether derived from practice in the workshop—workmen, themselves, he believed, having been, in a great many cases, the leaders in improvement. The best cutting angle has been found, for iron and steel, to be from 60° to 70°, and the angle of relief, 3°.

Drills have been the last tools in common use by working engineers to come under the whip of improvement, a large proportion of those now in use being of the worst conceivable form to effect the object they are designed for.

The speaker referred to the common form of drill, and at the same time, exhibited a sheet of drawings on which a number of different forms of drills were marked. Some of them depend for cutting action on—to use a homely phrase—"strength and stupidness," no attempt, whatever, being made to form a propper cutting angle. Others are more advanced in form, and have a proper cutting angle provided; sometimes a small portion of the bottom end, he said, is turned, and forms in this condition, a very excellent working tool indeed. A twist drill was next spoken of, which was the real object of bringing this paper under the notice of the society.

These drills have been known for a considerable length of time, but have not been much used in this country until recent years, Americans having been ahead in their use, and in manufacturing them as well. Strange as it may appear, it is still true, that all the drills of this class were, until within a recent period, imported from the United States.

Due consideration being given to the principles already explained, the advantages arising from the use of twist drills will be apparent at a glance:—first, they serve as a common drill, to bore a hole; second, they serve as a guide, while boring, to keep the hole true; and, third, they are so formed as to provide the proper cutting angle throughout their whole working length; fourth, they are tempered throughout their entire working length; fifth, they are ground up true to standard sizes, thus obviating any necessity for dressing. This last advantage will doubtless be highly appreciated by all who have had practical experience of the continual trouble and loss incidental to the wearing out of size of common drills.

The speaker then said, until the recent improvements which I am about to lay before you were perfected, twist drills were formed entirely by the clumsy method of cutting them out of a solid round bar, by means of milling tools, then turning, tempering, and straightening; it is but justice, however, to the parties who have been hitherto engaged in the manufacture, to say that their arrangements and machines for that purpose were admirable of their kind.

The method now pursued successfully in this country differs entirely from that just mentioned. First, the bar of steel which is destined to form the drill is rolled into a special shape, it is then cut into lengths and again rolled in cam rolls, which form a straight groove, after which the shank is formed by cresses. Next the blank, as it is now called, is passed to the twisting machine, which consists essentially of a hollow spindle having a perforated nut in the end to receive the blank. This spindle, when the machine is started, has a motion of rotation on its own axis, and, also, a motion of translation in the direction of its axis, being thus adapted to twist the blank, then held firmly at the outer end by vise clamps. Other clamps, worked by suitable gearing, close on the blank as the central spindles clear them: these serve to hold the twist given to the blank. After a blank is twisted, the clamps open, the blank is withdrawn, and the twisting spindle returns to its starting point.

After twisting, the drills are centered and rough ground, then hardened by heating in a lead bath and cooling in cold water, next tempered in an oil bath, and finally finished by grinding to a standard gage.

The main features in this method, to which it was desired to direct attention, are the forging and twisting, in contrast to cutting from the solid bar. One of the principal difficulties in carrying out the new system, just described, was getting the blanks forged—accuracy being essential; this difficulty overcome, the benefits became manifest. Recent experiments have shown, that in shaping metals, nothing is of greater importance than attending to the "flow of the metal." Every particular shape into which a bar of iron or steel is forged, having an arrangement of the particles which compose it, peculiar to itself, any departure from this natural arrangement is prejudicial. By forging and twisting these drills, this law is paid the fullest attention to, each drill being finished, so far as shape goes, before a single particle of metal is cut from it.

By way of reward for attention to this natural law, the number of drills lost from water cracks, in hardening, is inappreciable as affecting the cost of production.

Dead Weight.

The first subject on the list for discussion at the coming Master Mechanics' Convention in September, is: Can the dead weight in rolling stock be materially reduced? An ordinary freight engine with tender containing fuel and water, weighs from 50 to 55 tuns, while the weight available for traction is about 20 tuns. In cars the proportion of dead weight to load carried, either freight or passengers, is very great.

Some idea can be formed of the extent of the evil by reckoning up the dead weight in an ordinary passenger train, which we give below:

	Pounds.
Weight of locomotive and tender	104,000
One baggage car	25,000
Three 56-seat passenger cars	84,000
One sleeping car	40,000
	253,000

These cars, if filled, will carry about 194 passengers, which will give 1,304 pounds of dead weight for each person carried. This estimate is a very moderate one, and we are satisfied that practically the dead weight per passenger will be nearer 1,500 pounds with a well filled train. It must be remembered, too, that trains are usually only about two thirds full, which of course would make the relative amount of dead weight per passenger considerably more.

If we deduct the weight of water and fuel, say 20,000 or 22,000 pounds, from the total weight of a locomotive and tender of the usual American plan, and of the size we have named—that is, weighing 104,000 pounds, we will have a permanent weight of 82,000 pounds left, of which only about 40,000, or less than half, is usually carried on the drivers and used for creating "adhesion." As practical experience has indicated that 10,000 pounds weight on each driving wheel is necessary for "adhesion" with a 30-tun locomotive, we must be careful not to lessen the weight on the drivers if we attempt to reduce the dead weight.

It would not, we think, be very difficult for an experienced and skillful engineer, in designing a locomotive, to reduce materially the weight of all the parts, without impairing their strength or efficiency, especially if steel was liberally used in the construction. If the dead weight should be thus reduced, some plan of locomotive must be adopted which will still leave 10,000 pounds weight on each driving wheel. The problem is to make all the parts of the locomotive lighter, and, at the same time, arrange their weight so that a larger proportion of it shall be on the drivers; that is, if the 82,000 pounds of permanent load should be reduced to, say 60,000, 40,000 of the 60,000 must still be retained on the driving wheels.

In the construction of cars, the paramount consideration should be safety to human life. Almost any amount of dead weight would be justified, if travel were made safer thereby, and the risk of injury to passengers lessened. The comfort of travelers is also a consideration which begins to influence the weight of cars.

Seats and frames are often made unnecessarily heavy, and the fittings and moldings, ornamentally, are frequently heavy enough to depress one's spirits. It is difficult to condense in any general statements the errors which are so very common, but it is evident that in very many cases reduction in weight was not a consideration which the car builder had in his mind at all. Elaborate carving in cars always seems out of place. The impossibility of keep it free from dust seems sufficient reason for discarding it.

The proper length of cars would be an interesting subject for discussion at the Master Car-builders' Convention, now in session. The weight of a bridge increases in a proportion approximating to the square of the span, and it seems reasonable to suppose that the strength of a car would be in a somewhat similar ratio. At any rate the most economical length for a passenger car seems as yet undetermined.

Of the weight of sleeping cars we have no accurate data to figure from. We have heard the most extravagant estimates of the weight of some of them, which, if true, would make it seem extremely probable that smaller cars, giving fully as much room and comfort to each passenger, would be more economical than many of the present "palace cars."

The evil of dead weight—as, alas! all evils do—multiplies itself. Often, too, the roots of it can be found in some other vicious practice. For example, a railroad company will insist on buying cheap axles; in due course of time several of them break on account of the poor material of which they are made; immediately some one jumps to the conclusion that they are too small; so a half inch is added to their diameter, and forms a perpetual incubus of dead weight which the railroad company literally must carry fourfold on each car they run. So with castings: some badly proportioned part breaks; the pattern maker at once adds 20 per cent to the weight, instead of exercising his brain in making the broken part in some better proportion. Heavier cars necessitate heavier engines, which implies greater wear of track and machinery and increased cost of transportation.

A great part of the cure of the evil, we are satisfied, must come from the use of a better quality and more skillful disposition of material. A young artist once inquired of Sir Joshua Reynolds how he mixed his colors; the reply was, "*With brains.*" So of railroad machinery, it must be built with more skill, and by the exercise of more thought, if dead weight is to be reduced.—*Railroad Gazette.*

The Volcano Fish.

A paper having appeared some time since in a cotemporary, from the pen of the Rev. W. W. Spicer, in which the phenomenon of the expulsion of fish from volcanoes was spoken of as strange and astounding, and the idea being conveyed that the fish must have lived "in the line of fire" before being expelled. Mr. Scrope, F.R.S., writes to *Scientific Opinion*, February 23, as follows: This sensational version of a very simple fact is one only of several which, on the authority of "the great Prussian traveler," have been repeated by compilers of treatises on volcanic phenomena. The simple fact, I conceive, is that the fish in question lived in the open air in crater-lakes, such as are frequently found at the summit of trachytic volcanoes—for the reason that the fine ash, which is usually the last product of their eruptions, and therefore forms the lining of their craters, is very retentive of moisture, and consequently occasions the production of lakes at the bottoms of these hollows. Of course in these lakes the same kind of fish will probably be found as, by Mr. Spicer's own statement, are met with in other lakes at an almost equal elevation on the outer sides of these very volcanoes."

SOME time ago Piazzi Smyth went on a scientific expedition to Teneriffe, and on his return published a series of very interesting papers. In consequence of the favorable report made by him of the fitness of such high situations for astronomical and meteorological purposes, the Russian Government has resolved to establish an observatory on Mount Ararat.

IN some localities large quantities of beer yeast are run off into sewers and wasted. It contains from 7 to 11 per cent of nitrogen. M. Bernier mixes about 100 kilogrammes of the yeast with about 30 kilogrammes of quicklime and 10 of gypsum, and thus obtains a manure which may be used instead of guano.

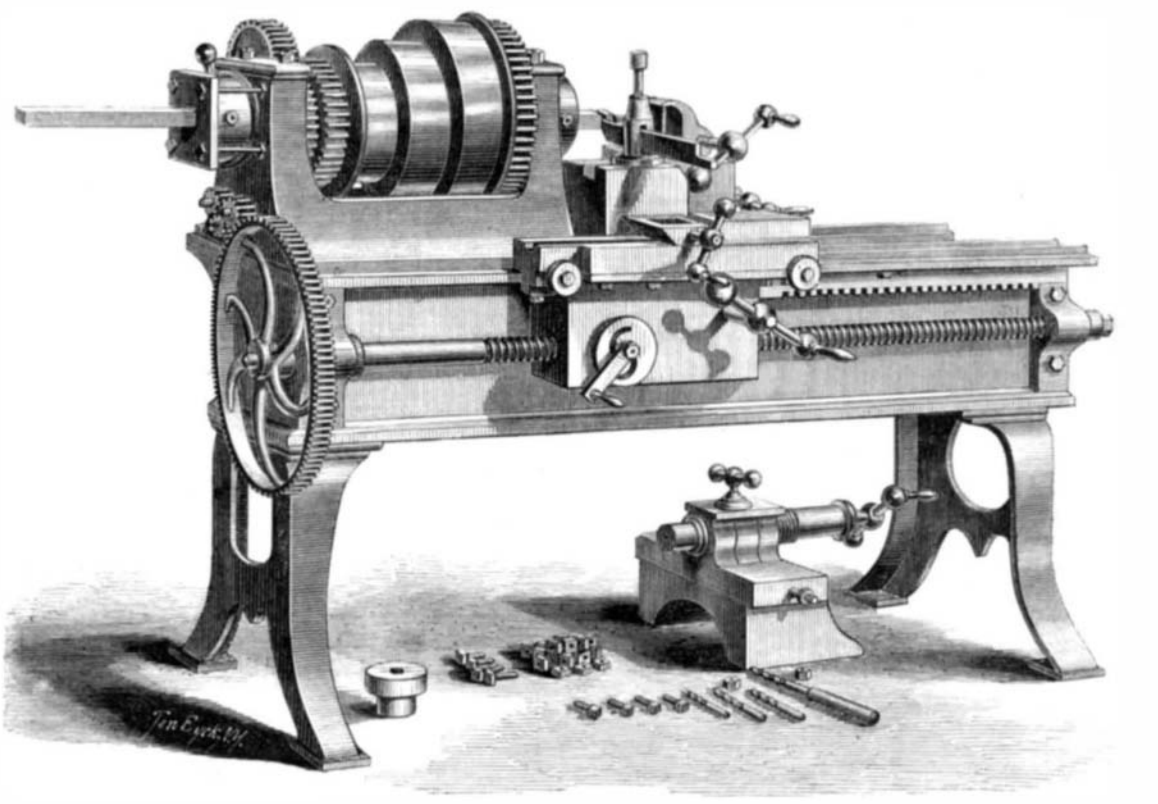
Machine for Manufacturing Finished Screw Bolts, Nuts, and Shafting.

So difficult is it to finish up a six-sided or an eight-sided nut, in a truly workmanlike manner that to do this has become a sort of test of skill with the file among mechanics. It is somewhat remarkable that the possibilities of doing this kind of work by simple machinery in a quicker and more accurate manner than can be done by manual labor did not earlier suggest themselves to mechanical minds. Certain it is, however, that such applications are of comparatively recent date, and that even at the present time there are many shops in which nuts and bolts are finished in the vise, by the use of the file.

The machine we herewith illustrate is capable of finishing all sorts of screw bolts and nuts of any usual or desired size, and also turns shafting of any length and of any diameter used for most ordinary purposes.

It will be seen also, when we come to describe the principle of the machine, that a very great degree of exactness and uniformity is attainable, which specially adapts the machine for the use of locomotive works, as the extra bolt can be relied upon as being of uniform size, and therefore certain to fit.

It is also claimed by the inventor that a stronger head and thread are obtained in making the bolts in the manner he employs, and that a finished bolt can be produced by this machine cheaper than those made by forging and subsequent finishing in lathe and vise.



RHEYDT'S MACHINE FOR MANUFACTURING SCREW BOLTS, NUTS, AND SHAFTING.

Fig. 1 is a perspective view of the machine, and Fig. 2 shows the form of the annular rose-cutters employed, and also a sectional view of them, showing them applied to the shaft of a bolt, as hereinafter to be described.

The general construction is that of an ordinary engine lathe. The spindle which carries the cone pulley is hollow, and through it the bar, from which the nuts or bolts are intended to be formed, or the shaft to be finished is passed. These bars, when nuts or bolts are to be made, are prismatic, having a cross section like that of the head of the bolt or the nut to be made. The cone pulleys are loose on the spindle, and by a system of gearing impart motion to the spindle itself. The bar, Fig. 1, being chucked properly to the center turns with the spindle.

If nuts are to be formed the bar is drilled lengthwise, and a cutting tool cuts off the nut of the proper thickness. Both the drill and the tool which cuts off the nut may act simultaneously, so that the work proceeds rapidly; the cutting tool finishing one side of each of two consecutive nuts at a single cutting. In this way very accurate nut blanks may be produced with great facility.

When bolts are to be made, two sizes of rose-cutters, A and B, Fig. 2, are used. The drill is removed, and these cutters are chucked and firmly held by suitable jaws at a proper distance from each other, as shown on the shaft, C, of the bolt, Fig. 2. The bar revolving enters these cutters, as shown in the section, Fig. 2, and cuts the shafts in the form shown, leaving the shafts of the blank above the thread, and the part upon which the thread is to be subsequently cut, of proper length and size. A cutting tool, similar to that used for separating the nut blanks from the bar, serves to give the finished form to the top of the head of the bolt, shown at D, Fig. 2.

The rose cutters are also employed for finishing shafting, which can thus be turned to uniform size without employing calipers. These cutters are formed with a depression at E into which a corresponding projection upon the jaw fits, or they may be held in any other efficient manner deemed most convenient. The machine may be used as a common lathe by the use of suitable appliances which accompany it.

This machine was patented, December 29, 1868, through the Scientific American Patent Agency, by Ferdinand Rheydt, and an application for a patent or further improvements is now pending. Address at No. 224 North Franklin street, Chicago, Ill., for further information.

How to Prepare Mortar.

Though many of the accidents which are constantly taking place from the weakness in construction of our buildings, are rightly attributed to faults in the original plan, and the incompetency of the architect, it not unfrequently happens that a large portion of the blame should be placed upon the builder having the immediate charge of the work, and under whose supervision are conducted those minor details in construction upon which depend to so great an extent the stability of the whole. Walls may be made of insufficient thickness and yet stand for a long time if the masonry be good; and, again, they may be heavy enough in the plan and fall when built, if the mason does not thoroughly understand his business. In such a case, blame is often attached to the architect when an accident occurs, which should in reality hang upon the skirts of the builder. Upon the quality of the mortar used in construction depends, in no slight degree, the strength of the walls; and regarding the best method of mixing mortar, it is proposed in this article to offer a few suggestions

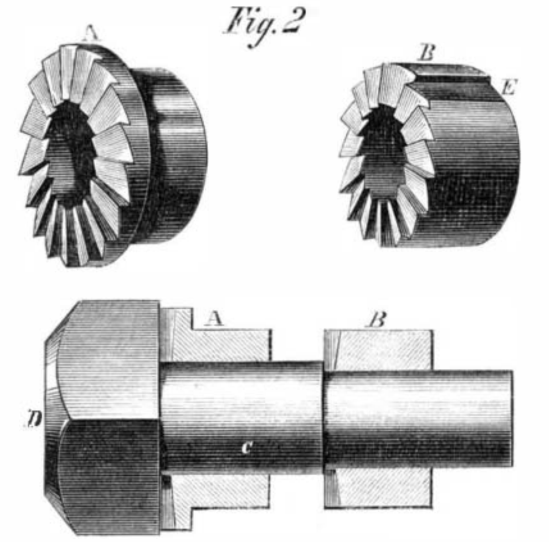
The common mode of making mortar is to first put the lime to slack in a box prepared for the purpose, and, after the slacking has continued for a time, to mix with it, in the same box, sand which has been previously screened. The mixture thus compounded is afterwards shoveled out of the box into a heap; and as mortar is required for use, a portion of this heap is drawn out and tempered to the proper consistency. In mortar prepared in this manner the mass is rarely homogeneous, lumps of unslacked lime and portions of gravel occurring promiscuously throughout the whole.

The proposed improvement in mortar-making provides an entirely different mode of operations, and, it is believed, obviates all the evils attending the present system.

The plan to be adopted which, in the estimation of the writer, is at once the most thorough and the most economical, is as follows:

Three boxes are first constructed, the first box being higher than the second, and the second box higher than the third. These boxes are connected by passages, at which are placed screens, such as are ordinarily used in mortar-making. Into the first box is put lime for slacking, and there mixed with water and manipulated until it is about the consistency of cream; after which it is allowed to run through the screen

Fig. 2



into the second box. It should be premised that, while the process is conducting, boards are placed over the screens and removed only when it is desired to unite the contents of different boxes. After the lime has been admitted to the second box, unscreened sand is thrown into the box in quantity deemed sufficient to make the mortar. The sand and lime, thus mixed, are then run through the screen into the third box or mortar bed, and there allowed to stand for twenty-four hours, when the mortar becomes fit for use, and requires no further tempering or mixing before its application.

The advantages of the above method are very apparent. In the first place, about one-fourth less lime is required than in mortar made in the usual way, and the mortar is more thoroughly mixed—and, therefore, much better—than that dealt with by the common process. Again, since the different boxes are separated by screens, the preliminary labor of screening is entirely avoided, all the lumps of unslacked lime being retained in the first box, and all gravel and foreign matter in the sand are retained, in a similar manner, in the second box. After the mixture is finally run into the mortar bed, all the refuse matter remaining in the first and second box can be shoveled out, and the boxes made ready for a repetition of the process. While the mortar is running into the third box, lime can again be slacking in the first box, without loss of time until the mortar-bed is filled. The bed can be made of any dimensions to hold the mortar required in the construction of a large building. In regard to the quality of the mortar made by the above process there can exist little doubt. It is more easily applied, more durable, and better adapted for all kinds of work than that made in the usual way. The writer has followed the system for many years, and has continually greater reason to be satisfied with its decided superiority.—*Condensed from the American Builder.*

Fog Signals.

In some places there is a curious natural provision for fog-warning, in the fact that the spots in question, generally islands, are the habitation of large numbers of sea-birds, which make a noise that can be heard far away. The South Stack, near Holyhead, is a well-known example; and in these places the birds are generally preserved and fostered as benefactors to mankind. But such cases are rare, and artificial expedients have to be resorted to. Bells have been tried—we all know the story of the Inchcape Bell, and have heard of the Bell Rock on the Scotch coast; and every yachtsman has passed the Bell Buoy at the entrance of Southampton Water—but the sound of both bells and gongs has been found to be so damped by fog as to be heard only a short distance away. Guns are troublesome, and not always suitable; and there has been, until lately, much difficulty in finding anything that would do. A short time ago, however, an invention by an American, Mr. Daboll, was brought to the notice of the Trinity House authorities; and, as it appeared promising, it was tried with so good a result that it may probably come more extensively into use as a fog-signal. We have been allowed, by the courtesy of the authorities, an inspection of the apparatus, and will endeavor to explain its construction and action to our readers. It is a very powerful horn or trumpet, blown by highly-compressed air, the sound being produced, however, not on the principle of either of these instruments, as ordinarily used in military bands, but on that of the clarionet or the brilliant trumpet-pipes of an organ. The sound of a clarionet is due to the vibration of what is called a *reed*—*i. e.*, a thin tongue of elastic material, which is placed so as to cover a long opening or slit leading into the pipe of the instrument. The reed is fixed at one end, the part over the opening being left free to vibrate. When the player covers the reed with his mouth and attempts to blow into the tube, the reed, by its flexibility and elasticity, alternately closes the opening and leaves it again, allowing a jet of air to enter the tube every time the opening is free. By this action the reed is set into quick vibration; and the puffs of entering air, following each other in regular succession and with great rapidity, give rise, on well-known acoustical principles, to a musical tone. This tone is further modified in quality by reverberation in the tube of the instrument, and is greatly strengthened by the bell-shape given to its extremity. The pipes of what are called the *reed-stops* of an organ are on the same principle as the clarionet; but the vibrating reed is in this case a thin plate of brass, varying in size according to the pitch of the note; but, for the middle tones, an inch or two long, a quarter to half an inch wide, and the substance of a thin card. The mouth of the player is represented by a box, inclosing the whole of the reed apparatus, and the pipe is generally of metal, conical in shape, or with a bell-mouth some inches in diameter. The fog-horn is essentially of the same construction as the reed-pipe of an organ, but with all its parts magnified to colossal dimensions. The reed, instead of being a thin leaf of brass, is a thick plate of hard steel, five inches long, two inches wide, and a quarter of an inch thick at the root, tapering down to an eighth of an inch at the loose end. The tube is of brass, eight or ten feet long, gradually expanding in diameter till it finishes in a bell-mouth two feet across. The pipe is placed vertically, its upper part projecting through the roof of the building, and being bent into an elbow, so as to make the bell part horizontal, delivering its sound straight out to sea. The compressed air for sounding the horn is supplied from a reservoir, into which it is forced by pumps worked with mechanical power. In the experimental apparatus a hot-air engine, of American contrivance, is used for the purpose; but a small steam-engine would probably be a more simple and trustworthy machine. A duplicate engine is required in case of any part getting out of order. The pressure of air required to sound the pipe is on the same magnified scale as the pipe itself; in an organ it amounts only to an ounce or two on every square inch; for a fog-horn it is from five to ten pounds, and the quantity of air required at this pressure is very large, but the volume of sound is immense.—*Cornhill Magazine.*